Measuring and monitoring the information and knowledge societies: a statistical challenge

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UNESCO Publications for the World Summit on the Information Society

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PREFACE

UNESCO has fully supported the World Summit on the Information Society (WSIS) preparatory process from its beginning, and has succeeded in defining and promoting its positions while setting the ground for its contribution to the Declaration of Principles and the Plan of Action that the Summit is expected to adopt. UNESCO's proposed elements for inclusion in the Declaration of Principles and the Plan of Action are based on its mandate, which leads it to promote the concept of *knowledge societies*, rather than that of global *information society* since enhancing information flows alone is not sufficient to grasp the opportunities for development that is offered by knowledge. Therefore, a more complex, holistic and comprehensive vision and a clearly developmental perspective are needed.

The proposals are responses to the main challenges posed by the construction of knowledge societies: first, to narrow the digital divide that accentuates disparities in development, excluding entire groups and countries from the benefits of information and knowledge; second to guarantee the free flow of, and equitable access to, data, information, best practices and knowledge in the information society; and third to build international consensus on newly required norms and principles.

Knowledge societies should be firmly based on a commitment to human rights and fundamental freedoms, including freedom of expression. They should also ensure the full realization of the right to education and of all cultural rights. In knowledge societies, access to the public domain of information and knowledge for educational and cultural purposes should be as broad as possible providing high quality, diversified and reliable information. Particular emphasis should be given to diversity of cultures and languages.

In knowledge societies, the production and dissemination of educational, scientific and cultural materials, the preservation of the digital heritage, the quality of teaching and learning should be regarded as crucial elements. Networks of specialists and of virtual interest groups should be developed, as they are key to efficient and effective exchanges and cooperation in knowledge societies. ICT should be seen both as educational discipline and as pedagogical tools in developing effective educational services.

Lastly, these technologies are not merely tools, they inform and shape our modes of communication, and also the processes of our thinking and our creativity. How should we act so that this revolution of minds and instruments is not merely the privilege of a small number of economically highly developed countries? How can we ensure access for all can to these information and intellectual resources, and overcome the social, cultural and linguistic obstacles? How should we promote the publication on line of increasingly more diversified contents, potentially a source of enrichment for the whole of humanity? What teaching opportunities are offered by these new means of communication?

These are crucial questions to which answers must be found if knowledge societies are to become a reality, and offer a world-wide space for interaction and exchange. They are also questions which the actors of the development of these technologies – States, private enterprise and civil society – must answer together.

On the occasion of the World Summit on the Information Society, UNESCO intends to make available to all participants a series of documents summarizing some of the most worrying questions which have just been mentioned. These will help participants to take the measure of the upheavals brought about by the emergence of the new information and communication technologies (NICT), and will deal with the potential for development, the difficulties encountered, possible solutions, and the various projects implemented by UNESCO and its many partners.

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for Communication and Information

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Acknowledgements

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Introduction

"All men by nature desire knowledge" Aristotle

A fundamental transformation of human society, perhaps comparable only to those engendered by the invention of the alphabet and the printing press, is the emergence of the information society. In this dynamic environment, a new culture is emerging with prospects of having an impact on all aspects of human life. Information and knowledge hold the promise of alleviating many of the problems confronting human society if only they could be equitably shared. The power of this transformation can be discerned in terms of its impact on knowledge sharing, dissemination, socio-economic behaviour, business and political practices, political engagement, media habits, education and health related behaviour, leisure and entertainment. This emerging culture is based on new symbols, codes, practices, models, programmes, formal languages, algorithms, virtual representations and mental landscapes, all of which imply the need for a new "information literacy". The hallmark of this new environment is the speed at which information is gathered and transmitted. All this has been made possible by the advent of the Information and Communication Technologies (ICT), particularly the Internet and wireless technologies, together with an increased use of ICT in traditional media such as print, radio and television.

Information Society has been defined as "a society that makes extensive use of information networks and information technology, produces large quantities of information and communication goods and services, and has diversified content industry" (Jeskanen-Sundström, 2001). Often the debate surrounding the notion of an Information Society focuses on a rather restrictive economic or infrastructure agenda, with little attention given to social and human aspects. Yet these aspects are important, for not only are there disparities in the access and usage of ICT between developed and developing countries, but also between the richer and poorer populations

within the same country and between different regions of the same country. In particular, these disparities are most evident for women, minority groups, and other socially and economically disadvantaged and marginalized groups. Neglected groups must be brought squarely into the international forum of discussion and addressed through the definitional framework.

It is widely recognized that the mere creation of an Information Society as defined above is not sufficient to address human development issues on a global scale. Acquiring and dissemination of knowledge is a fundamental requisite for human progress and is essential to empower the underprivileged sections of our society. The transmission of knowledge and information (which traditionally has been passed on through interpersonal contacts) has undergone dramatic change with the advent of ICT. Today, information is shared and disseminated at a much faster rate than ever before. ICT have made it possible for information and knowledge to permeate all layers of our society. By harnessing the potential of information and communication technologies in all areas of human life, improved responses to vital and longstanding issues are possible. ICT can be used to effect poverty reduction, the creation of health and wealth, to impact on whole societies and to support social justice and equity. The notion of a Knowledge Society goes beyond that of an Information Society by ensuring that all persons, without distinction, are empowered to create, receive, share and utilize information and knowledge for their economic, social, cultural and political development. Finally, it is critical that ICT should be regarded as tools to progress, and not as ends in themselves.

The emergence of global Information and Knowledge Societies can be viewed as both an opportunity and a challenge. It is an opportunity for societies which can quickly employ ICT effectively and a challenge to those that cannot do so. Unfortunately, the pattern of this transformation to date has been marked by extreme disparities with regards to access to this new culture, between the developed and the developing countries, as well as between the privileged and underprivileged sections within societies themselves. The provision of mere infrastructure is a necessary but not sufficient condition in addressing this inequity. Local customs, traditions, and perceptions often serve a role in either enhancing or hindering such issues of access. These need to be understood in order to be taken into consideration when national policies are formulated. Only then can the

world move towards a place where "Information for All" can become a reality. Key players and the stakeholders in the world forum must work together to achieve this end. Therein lies one of the challenges of 21st century "society".

The current discourses on ICT generally center around the more recent technologies of Internet and telephony. However, many countries, particularly in the developing world, still use the older technologies of broadcast such as radio and television as a means to development within the context of the Information and Knowledge Societies. Thus, although this report will focus primarily on the newer technologies, it will examine the relevant and important older technologies as well.

There are three aspects to the rationale underpinning this report by the UNESCO Institute for Statistics (UIS):

i) There is a need to take stock of the current global data with regard to ICT, and to identify any gaps that might exist, in order to help decision-makers within countries draft informed national policies vis-à-vis the Information/Knowledge Society. "Gaps" refer to current data systems that are weak, incomplete or limited in their ability to inform policy-makers, as well as data that is currently not being collected at all but might be valuable. There is a need to consider ICT data as part of national official statistical systems so that current gaps can be identified and closed.

ii) At the World Summit on the Information Society (WSIS) in Geneva, the world will debate, formulate and adopt a Declaration of Principles and an Action Plan to address a wide range of issues. This debate will be continued at the second phase of the World Summit which will take place in Tunis in 2005 where the key focus will be to assess the progress that has been made since 2003. But how can the world understand its progress without concrete measurements of where we stand currently and without commitment to continue to measure progress? Thus there is an immediate need to put in place reliable data systems and well-defined series of both baseline and repeated data sets and indicators that are capable of giving a quantitative picture of change.

iii) A particular need exists for more data on social aspects and impacts of ICT and the Information/Knowledge Society. To this end the UIS is undergoing a fundamental review of its own statistical programme of work in the area of communication. This report is a first step towards determining the UIS programme of work vis-à-vis data collection and indicator development in the upcoming years.

In summary, the focus of this report will be data systems and measurement issues with regard to ICT, including aspects of data availability, international comparability and quality, as well as their content. The overall aim is to support the development of national, regional and international data systems and indicators that are comprehensive, policy relevant and reliable for the proper understanding, monitoring and development of a sustainable and equitable Information/Knowledge Society. The first part of this report will include a stocktaking of selected global ICT data from a variety of sources. This will be followed by a discussion on the limitations of the existing data as well as barriers and problems that might be encountered in collecting of such data. The final section of the report will discuss what data might be of value to collect in the future. The report will conclude with a series of recommendations.

I. A Review of a Selection of Existing ICT Data for Cross-National Comparisons

Monitoring of progress towards the achievement of an equitable Information/Knowledge Society depends upon the availability of reliable data on key indicators. There is a need for data and indicators for monitoring all aspects of the Information/Knowledge Society, including infrastructure as well as issues relating to access, usage and impact. However, access, usage and impact are more difficult to measure due to their inherent socio-cultural complexity and a general inadequacy of proper measurement tools to generate comparable cross-cultural data. In fact, most of the existing data and indicators on access and usage are in their infancy and exist mainly in developed countries that have the resources to gather them.

Measurement systems typically encompass both raw data and the quantitative indicators that are built from them. Indicators quantitatively express concepts deemed important for measurement and define the data

required for the indicator calculation. It is essential to ensure that the development of indicators is based upon proper and objective needs assessment with consideration given to resources required for data collection. In the context of monitoring progress towards international declarations and goals, statistical reporting systems need to result in indicators that reflect the needs of those who are likely to be excluded from the mainstream of such progress. To this end it is important to ensure that the development of indicators for measuring progress towards the declarations and goals takes into account all the stakeholders, particularly the poorer and the marginalized groups of our society.

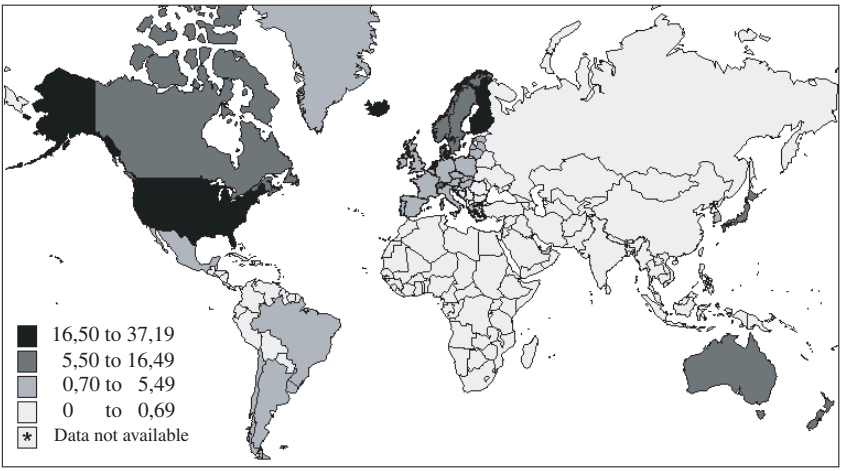
This section will provide an overview of selected quantitative data and indicators in the key areas of basic ICT infrastructure, as well as access and use of ICT, focusing on applications in Education, Culture (and Communication), and Science and Technology, which are UNESCO's domains of competence. The emphasis will be on data that can be used for cross-national comparisons to support the main analytical endeavours of member countries to benchmark their progress relative to themselves over time, as well as to other countries having similar social and economic structures. Such comparisons will also facilitate UNESCO Institute for Statistics and other international organizations in helping countries to collect data to analyse issues in areas in which these organizations have expertise.

1. Basic Infrastructure Data

Currently, data relating to ICT are being collected and disseminated by a number of institutions, both national and international. The International Telecommunication Union (ITU) in Geneva is the lead UN agency for telecommunications and it monitors some key indicators relating to ICT, mainly on infrastructure and access, as part of the global statistical system of the UN. It collects data from about 200 countries, by means of an annual questionnaire through which information is provided by government ministries, government regulators and telecom operators. ITU then provides statistics and information tables disaggregated by operator/company, by country and by region. Some telecommunication areas of focus for ITU include Internet hosts, main telephone lines, and cellular mobile telephone subscribers.

As an example, the Map 1 shows the data collected by ITU, which has been summarized by the indicator "Internet Hosts per 100 inhabitants". It is interesting to note that five countries are home to between 16.5 and 37 hosts per 100 inhabitants, and that these five countries all lie in the developed world. Furthermore, the significant gap between countries in the developing world compared to those in the developed world can be clearly seen.

Map 1: Internet Hosts per 100 Inhabitants, 2001

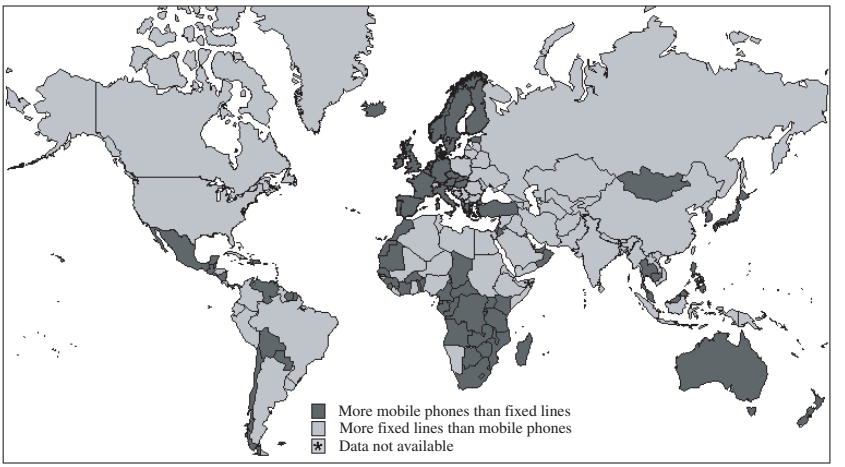


Sources: ITU World Telecommunication Indicators Database (2003); UNPD World Population Prospects: The 2000 Revision (2001).

Map 2 indicates countries of the world where the presence of mobile phones exceeds the number of fixed phones. This may be due in part to the so-called "leapfrogging effect", a phenomenon whereby a country is able to bypass the wide adoption of an earlier and less advanced technology by using a more recent one. In the case of telephone versus mobile phones, this adoption can be explained by the fact that mobile phones do not need the infrastructure at a household level required by fixed phone lines, an important issue in most developing countries where even basic infrastructure such as electricity is in short supply. Note that while Map 2 indicates that several countries in the developing world (particularly parts of Africa) show the presence of mobile phones exceeding that of fixed phone lines, this

alone does not necessarily indicate enormous advances in development. It is possible that even in the cases where mobile phones well exceed fixed phone lines, the percentage of the population having access to either technology is minimal. Therefore, a more complete picture needs to include additional information on penetration rates as well, to be able to make a more realistic assessment of the situation. As a related remark, even in the case where penetration rates are high, there is a danger in confusing the wide adoption of such newer technologies with the notion of development whereas the adoption should only be viewed as means towards development, not development itself.

Map 2: Number of Fixed Telephone Lines versus Cellular Mobile Telephone Subscribers, 2001



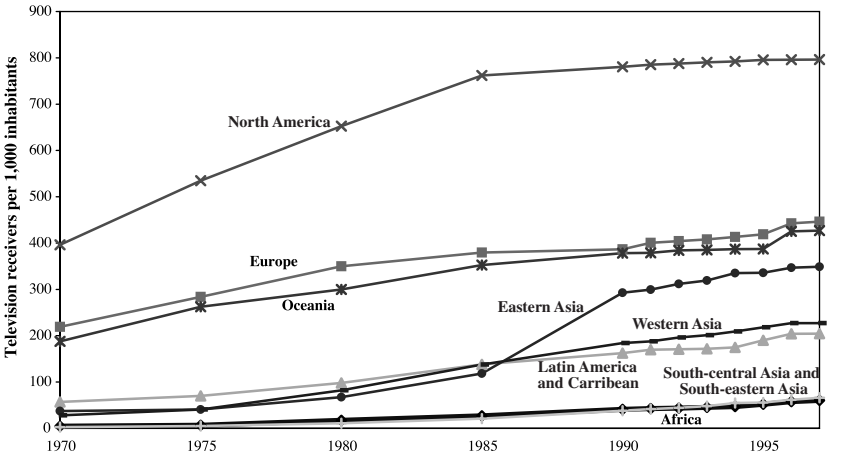
Source: ITU World Telecommunication Indicators Database (2003).

In addition to its basic data sets and indicator tables, ITU has also produced various country-specific case studies for selected African and South East Asian countries. These cases cover such topics as: regulation and policy-making, tariffs, networks, international traffic, mass media, Internet market structure, international connectivity and peering (between Internet Service Providers (ISPs)), licensing, content, domains, as well as some general information on the demography of the country, its economy, human

development, government, education, health and e-commerce. These case studies could serve as valuable models for other similar country assessments.

UNESCO is the lead UN agency for culture and communication (as well as for education, social and human sciences, and natural sciences). In this capacity, the precursor to the UIS, the former Division of Statistics of UNESCO, gathered data on radio and television via an annual survey sent to Member States. A variety of information was collected pertaining to: institutions, personnel, programmes, coverage and potential audience, as well as estimated number of receivers. Regional trends of the above data for the time span from 1970-1997 may be seen in Graph 1, represented by the indicator "Television Receivers Per 1000 Inhabitants". Note that much of the growth for this technology occurred before 1985; after that, the trend line flattened for most regions of the world.

Graph 1: Regional[1] Trends of Television Receivers per 1,000 Inhabitants, 1970-1997



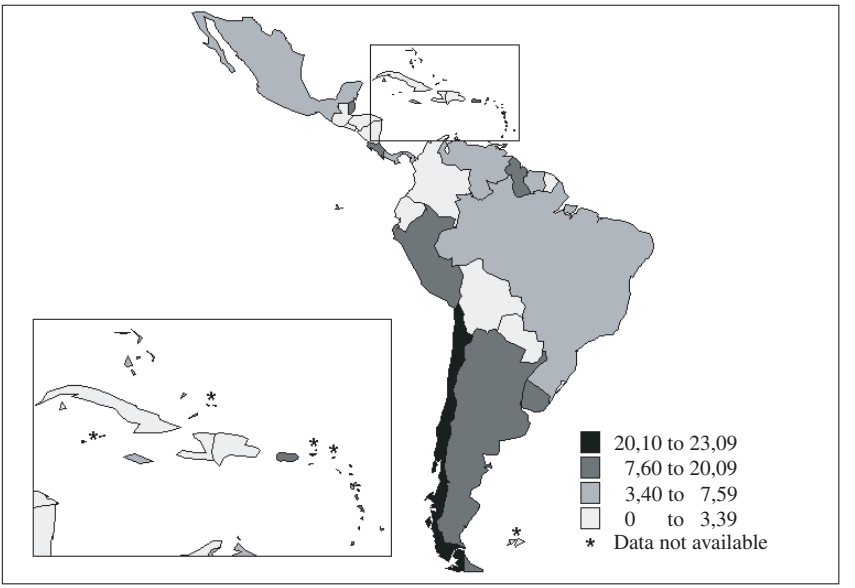
Source: UNESCO Institute for Statistics (2003).

1. Prior to 1990 figures for independent states from the former U.S.S.R. have been included with those of Europe. In addition, all the country groupings in this report refer to the United Nations groupings classification.

2. Basic Data on Access and Use

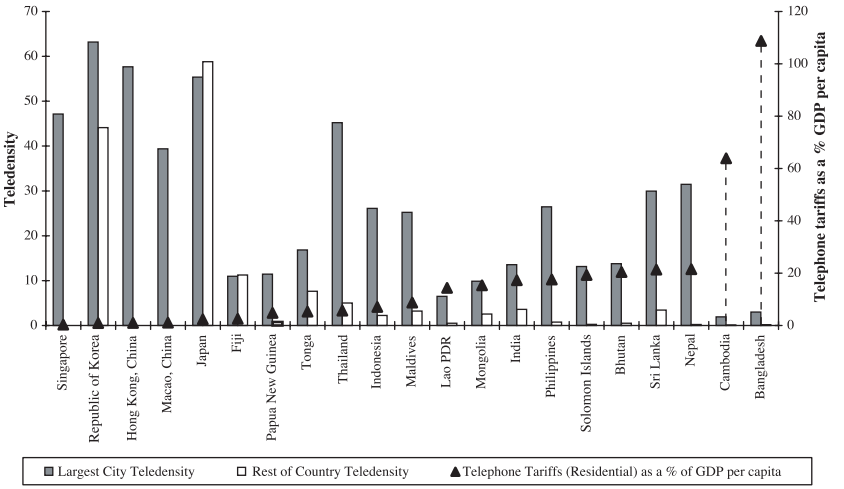
ITU also collects data that may be used to develop indicators on access to and use of ICT from government regulators and telecom operators in most countries of the world. Map 3 may be seen as illustration in this regard. It shows the percentage of Internet users, as estimated by the number of Internet subscribers, in Latin America and the Caribbean in the year 2001. It can be seen from the Map 3 that many countries in South America generally have a higher number of users than in the Caribbean.

Map 3: Internet Users per 100 Inhabitants for Latin America and the Caribbean, 2001



Sources: ITU World Telecommunication Indicators Database (2003); UNPD World Population Prospects: The 2000 Revision (2001).

Graph 2: Telephone Access Indicators[2] for a Selection of Asia Pacific Countries[3] , 2001[4]



Sources: ITU World Telecommunication Indicators Database (2003); UNPD World Population Prospects: The 2000 Revision (2001); World Bank Online Database (2003).

See also Graph 2, which gives telephone access indicators for Asia-Pacific countries for 2001. Graph 2 illustrates the fact that access to main telephone lines (teledensity) not only varies across countries in the same region but also within individual countries themselves. That is, for some countries, population access to main telephone lines occurs primarily in the large cities. Furthermore, in countries such as Cambodia and Bangladesh, annual telephone tariffs exceed 50 % of the GDP per capita!

Much progress has been made in developing cross-nationally comparable ICT statistics by organizations such as the Organization for Economic Cooperation and Development (OECD) and Eurostat (the Statistical Agency

2. Annual residential telephone tariffs include the connection charge for basic telephone services and the monthly subscription charge in US dollars (multiplied by 12). This charge refers to the recurring fixed charge for subscribing to the public switched telephone network. Teledensity refers to the number of fixed telephone lines per capita expressed as a percentage.
3. Abbreviated countries include Hong Kong Special Administrative Region (SAR) of China, Macao Special Administrative Region (SAR) of China, and Lao People's Democratic Republic (PDR).
4. Data on teledensity for Japan, Papua New Guinea, Mongolia and Solomon Islands refer to 2000.

of the European Union). As a result, common definitions, standards, and methodologies, as well as both household and business survey vehicles for data collection on ICT have been developed for member countries.

Eurostat (Lumio, 2003) has sponsored both household and enterprise surveys on ICT usage for countries within the European Union. The household surveys consist of four modules, which include components on: access to selected ICT; use of computers, their location, and their frequency of use; use of the Internet; and e-commerce details on activities. The enterprise surveys consist of six modules, which include components on: ICT systems; use of Internet; e-commerce via Internet; e-commerce via Electronic Data Interchange (EDI) or networks other than Internet; confidence building practices for the Internet-commerce; and barriers on Internet sales. Eurostat has used the basic definitions for the telecommunications statistics developed by ITU. For the ICT usage survey methodologies, Eurostat has relied upon OECD, especially through participation in the Working Party on Indicators for the Information Society (WPIIS), as well as consultations with the Voorburg Group on Services Statistics.

The OECD collects systematic data on access and use of ICT for its 30 Member States (mainly developed countries). The OECD-WPIIS has developed a methodology and collected information on:

- the resources devoted to new information technologies in terms of consumption and investment of ICT goods & services, investment in ICT equipments & software, ICT patents, occupations and skills in the Information Economy;
- the size, growth of the ICT sector, as well as ICT employment and sector trade;
- infrastructure barriers and price, as well as both household and business use of the Internet, through both household and business surveys developed by national statistical offices;
- the volume and nature of e-commerce transactions.

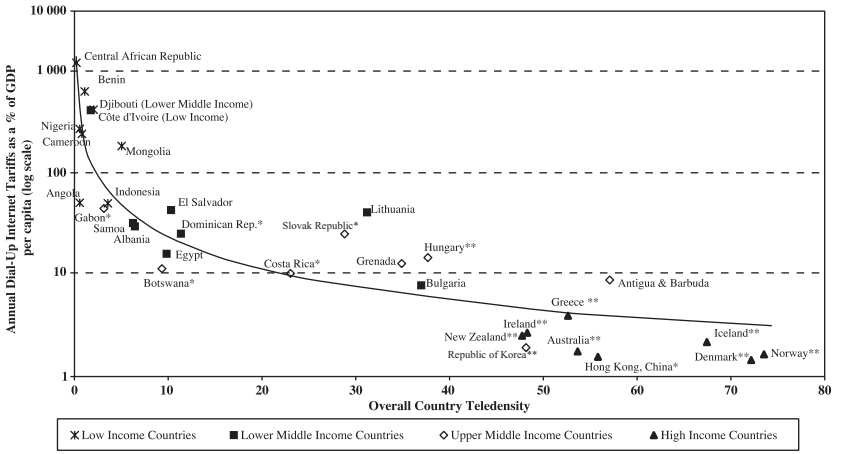
The WPIIS have considered some common issues faced by statistical systems particularly those in Europe with regards to the collection of ICT data. According to the WPIIS, the major drawback of using Official Statistics on Internet use is that they are based on different definitions

depending on the country in question. A second problem is that they attempt to measure rapidly changing behaviour but given that different countries adopt different reference periods, this limits the comparability of data sets. Thus the timeliness, scope and coverage of indicators adopted by the offices of Official Statistics of different countries need to be addressed in order to allow for international comparability. The WPIIS is currently addressing these issues of international comparability and working to develop a pilot household survey methodology to obtain information on ICT use in households by individuals.

The OECD report on the information economy (2002a) discusses barriers to the use of ICT. The report, which gives some of the findings of the WPIIS, states that responses on perceived barriers and on their evaluation are inevitably qualitative in nature and thus need to be used with caution in international comparisons. Nevertheless, consideration of these social and behavioral issues can be of great interest and immense value to policy makers from developing countries. For example, indicators of barriers can help in monitoring the digital divide, point to potential bottlenecks related to adopting the technology under difficult conditions and in remote areas, identify the problem of lack of appropriate ICT skills among users such as the poor and help address concerns about security and logistics. Problems in the measurement of penetration rates are also discussed in the OECD report. Earlier methodologies for the collection of these rates were limited to including standard access lines. The current methodology takes into account the development of mobile communication networks as well as broadband Internet access.

Given that affordability of Internet is one determinant of access, it is interesting to view Graph 3 which gives an indication of annual Internet tariffs for various countries of the world. It demonstrates that at lower income and teledensity levels, Internet tariffs (dial-up) are substantially higher than for higher income countries. More specifically, any incremental increase in teledensity at the steepest portions of the curve (lower income/ lower teledensity countries) coincides with substantial Internet tariff reduction. However, at higher levels of teledensity, which is characterized by the flat portion of the curve, any increase in teledensity coincides with a minimal tariff reduction. Further analysis of national market structures would enable possible explanations for the price variation among countries.

Graph 3: Annual Internet Tariffs[5] as a Percentage of GDP (in current US dollars) per Capita Against Teledensity for a Selection of Countries from Different Income Groupings[6] , 2001



Sources: ITU World Telecommunication Indicators Database (2003) ; UNPD World Population Prospects: The 2000 Revision (2001); World Bank Online Database (2003).

As a final note, it is important to note that the source of data often dictates the content of the data collected. For instance, the primary source of data for ITU is through national regulators and telecom operators. These telecom regulators cannot collect data on usage since their information is based on administrative records. Data on usage are collected from household, school or business survey vehicles since questions can be asked directly of the population of interest. These latter types of surveys tend to be conducted by a handful of national statistical offices (NSOs) given that the

5. Annual Internet tariffs are calculated based on 30 hours of dial-up use per month in US dollars. They incorporate the public switched telephone network (PSTN) monthly subscription charge, the PSTN usage charge during peak periods, and Internet service provider monthly charge for peak periods. An annual tariff is obtained by summing the above three charges and multiplying by 12.
6. In Graph 3, * refers to unlimited Internet access and ** refers to data from OECD. In addition, abbreviated country includes Hong Kong Special Administrative Region of China.

surveys are very expensive, resource intensive and time consuming. Broader issues can be covered by such NSOs; however, their reach is much narrower, i.e., a small number of countries are covered off at most. Therein lies the trade off.

3. Data Relating to UNESCO's Areas of Competence

This sub-section reviews the existing data on ICT in selected areas of UNESCO's competences, namely: Education, Culture (and Communication), Social and Human Sciences and Natural Sciences.

3.1 ICT and Education

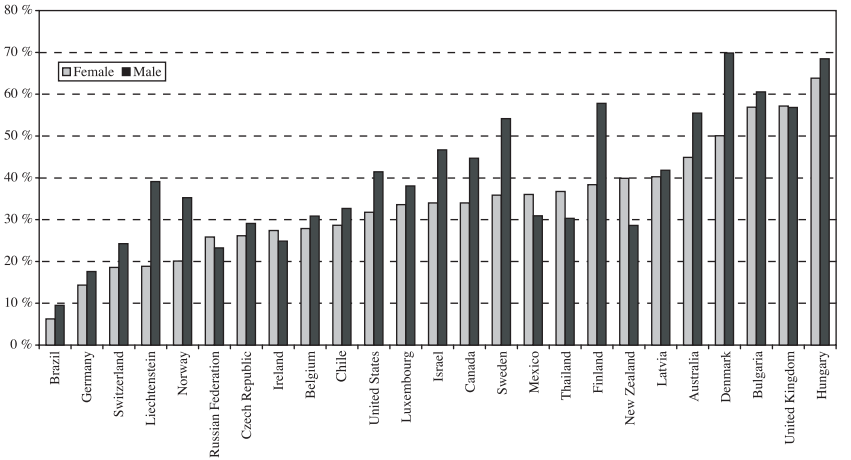
In the area of ICT and education, some illuminating data exist on the use of ICT for education at the primary and secondary levels, where the underlying assumption is that the education occurs in a physical building. Much less data and information exists on the use of ICT for the tertiary level of education, since some of the interesting applications of ICT in this area do not assume such an infrastructure (e.g. open universities) and so it is far more difficult to collect the data.

For the former case (primary and secondary education), an important source is the Programme for International Student Assessment (PISA) with respect to the 28 OECD and 15 non-OECD countries. A total of 32 countries (28 OECD and 4 non-OECD) participated in the first cycle of PISA in 2000; an additional 11 countries participated in the second cycle in 2002. PISA used student and school questionnaires to collect data and to construct indicators on social, cultural, economic and educational determinants of student achievement (see Box 1). The PISA 2000 Technical Report describes the complex methodology underlying the data collection programme, along with additional details on the implementation of the project that allow researchers to replicate its methodology. The programme issued four questionnaires, one of which was on computer familiarity. It was used to collect information about the students' use of computers, the availability of computers and the students' self-assessment of their computer skills. This important study is the first to provide a good picture of access, usage and impact of ICT in schools, disaggregated by gender for 15 year old students.

The study could serve as a good model for use by developing countries having the basic infrastructure to support school-based surveys. This idea will be discussed later on in this report (OECD/UIS, 2003).

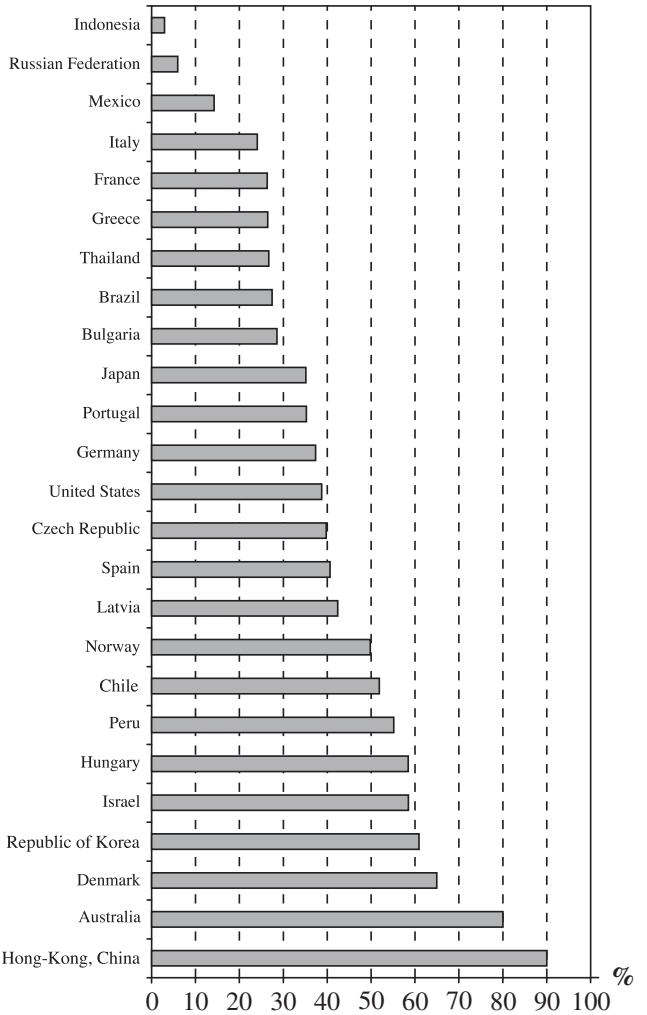
Graphs 4 and 5 give a flavour of the type of information collected under the PISA programme.

Graph 4: Percentage of Students that Use Computers at Least a Few Times a Week by Gender for a Selection of Countries, 2002



Source: OECD PISA Database (2003).

Graph 5: Percentage of Computers Within Schools Connected to the Web for a Selection of Countries[7] , 2002



Source: OECD PISA Database (2003).

7. Abbreviated country includes Hong Kong (SAR) China.

Box 1: Main Activities of the UNESCO Institute for Statistics - Education Statistics Programme

Annual Education Survey

The UIS education survey collects the data used to calculate the key indicators for education from pre-primary to tertiary level, from all Member States of UNESCO. They include indicators such as gross and net enrolment ratios, student-staff ratios and selected indicators on education finance. This data forms the comprehensive global database on education that is the basis of international monitoring of education throughout the world. The Annual Education Survey includes both the UOE and WEI programmes described in more detail below.

UIS-OECD-Eurostat (UOE) Programme

The UIS partners with Eurostat and OECD to plan, organize and conduct an education statistics programme designed to provide policy-relevant indicators for countries that are Member States of these organizations. Data are collected and processed by one of the international organizations and the resulting data sets are shared to ensure that subsequent analysis and dissemination by each organization is based on the same statistics. The UIS incorporates the data from these countries into the global database on education.

World Education Indicators (WEI) Programme

The UIS and OECD jointly direct the WEI programme with financial assistance from the World Bank. The programme was initiated in 1997 with the objectives of developing policy-relevant indicators and of implementing systems to produce them. Nineteen middle-income countries representing over 70% of the world's population volunteered to participate in the programme and to devote the extra resources needed to ensure its success. The core data and indicators are fed into the global database. In addition, the group takes on special projects that improve the comparability or broaden the scope of international education indicators. Currently, a sample survey of primary schools is being developed that will include information on equity and quality issues as well as the availability and use of ICT resources. The survey will be conducted in 2004.

The Programme for International Student Assessment (PISA)

PISA obtains results on student performance in reading, mathematical and scientific literacy, with the aim of assessing the extent to which students near the end of compulsory education have acquired some of the knowledge and skills that are essential for full participation in society. With the report "*Literacy Skills for the World of Tomorrow- Further Results from PISA 2000"*, OECD and UIS extend the picture that PISA provides to additional non-OECD countries that have recently joined the programme: Albania; Argentina; Bulgaria; Chile; Hong Kong (SAR) China; Indonesia; Israel; FYR Macedonia; Peru; Romania and Thailand.

The UIS Education For All (EFA) Observatory

The UIS is responsible for the collection and dissemination of the key data and indicators being used in the monitoring of the six international goals of Education for All (EFA), as well as the education targets of the Millennium Development Goals (MDGs). The annual EFA Global Monitoring Report, which was first published in 2002, draws on statistics and analysis provided by the UIS. It is the definitive international report on progress towards Education for All.

The Literacy Assessment and Monitoring Programme (LAMP)

This initiative is seeking to improve current literacy measures, which are based principally on a mix of self-declarations and educational attainment proxies. LAMP is developing a methodology to evaluate, through direct assessments, people's literacy skills as a spectrum from basic reading and writing, to higher level skills. The programme will be pilot tested in four or five countries in 2004.

UIS activities in Non-formal Education

The UIS, in collaboration with the UNESCO Basic Education Division and the "Asia-Pacific Cultural Centre for UNESCO" (ACCU) of Japan, has launched pilot projects to establish management information systems for non-formal education in three countries (Tanzania, Cambodia, and India). The UIS is also a member of the Eurostat Task Force on Adult Education, which is developing a classification of adult learning activities.

Statistical Capacity Building (SCB)

The UIS established a Statistical Capacity Building Programme in early 2002. A major project funded by the European Union has as its objectives statistical capacity building in eleven EFA Fast Track countries, to enable reliable monitoring and evaluation of progress towards EFA and national education development goals. The programme is being implemented through a consistent international strategy and a common tool kit of diagnostic and methodological training modules. The programme has already been launched in four countries: Guinea, Niger, Tanzania, and Mauritania.

The International Association for the Evaluation of Educational Achievement (IEA) located in the Netherlands and Germany also collects information on the availability and use of ICT through background questionnaires administered to students and school administrators. Some of the recent IEA-organised studies include the Third International Mathematics and Science Study (TIMSS) in 1995 (IEA/ISC, 1995), Trends in Mathematical Science Achievement Around the World (TIMSS) in 1999 (IEA/ISC, 1999) and Progress in International Reading Literacy Study 2001 (PIRLS) in 2001 (IEA/ISC, 2001). TIMSS encompasses a wider range of

developing countries than PISA and draws its sample based on both age and grade levels.

IEA has also conducted school surveys that collect information on ICT in schools, the most recent of which is the Second Information Technology in Education Study (SITES), an international comparative investigation of the use of ICT in primary and secondary schools in more than 30 countries around the world. The purpose of the project is to describe infrastructural ICT conditions (hardware/software), organization and management, teacher qualifications, as well as the place of ICT in the school curriculum. It monitors changes across time in these variables and gives an assessment of the Information Society 'literacy' of students and the way schools and teachers offer opportunities to students in this domain.

The Southern African Consortium for Monitoring Education Quality (SACMEQ) is a collaborative network of 15 Ministries of Education in the Southern Africa sub-region, launched in 1995 to conduct educational policy research that can be used by decision-makers. Acting as a regional model, SACMEQ contributes not only to statistical capacity building in the realm of education at the national level but it also encourages cross-national initiatives on analyses and comparisons. Recent school surveys conducted in member countries address the issues of education quality in primary education, including: the characteristics of teachers and pupils, access to educational documentation, technology (including ICT) and infrastructure, literacy levels of pupils and indicators of equity (SACMEQ, 2003).

3.2 ICT and Culture

Data on the use of ICT in the area of culture is rather limited at present. There is a paucity of systematic data on the use of ICT in the different areas of culture. That which exists is mainly in the form of qualitative studies and anecdotal information at best.

Some information exists regarding the number of museums online and the number of dot.museum registrations, as well as on digitized library and archive collections. Musee is an example of an online facility that has links to about 37.000 museums around the world through a search engine. It has museum information pages, a museum category directory and a homepage

featuring museum exhibitions, random museum picks and more museum links (Musee, 2003). Museumland is another such portal to online museums and cultural heritage. It offers more than 10.000 links from about 130 nations (Museumland, 2003). However, the two sites contain no overall summary data regarding the number of museums online and other statistical information on digitized collections. A systematic compilation of data of this type could be of interest to many data users interested in this area.

Box 2: Main Activities of the UNESCO Institute for Statistics - Culture and Communication Statistics Programme (2003)

Up until recently, the UIS has collected data through 6 survey vehicles covering areas such as book production, films and cinemas, libraries, museums, the press and broadcasting. The culture and communication programme is currently under review and re-evaluation, and consideration is being given to the possibility of new data collections that will help inform policy makers within UNESCO's Member States in this area. The first steps in this process have included:

- the development of an inventory of existing indicators and data sources on a global scale, as well as the identification of some of the data gaps;
- the co-sponsoring with "l'Observatoire de la culture et des communications du Québec" of a "think-tank" type symposium involving 80 or so participants in Montreal in October 2002: "*International Symposium on Culture Statistics*"; see the site http://www.colloque2002symposium.gouv.qc.ca/;
- consultations with international organizations, Member States and other producers of culture and communication statistics as well as participation in a number of international meetings to explore ideas for future data collections and indicator development.

Expected outputs of this review include the drafting of a framework on international culture and communication statistics that will suggest new areas of collection. New methodologies for data collection may be developed based on this framework, setting in motion a new programme of work for the UIS in this area.

Culture and ICT: Initiative B@bel

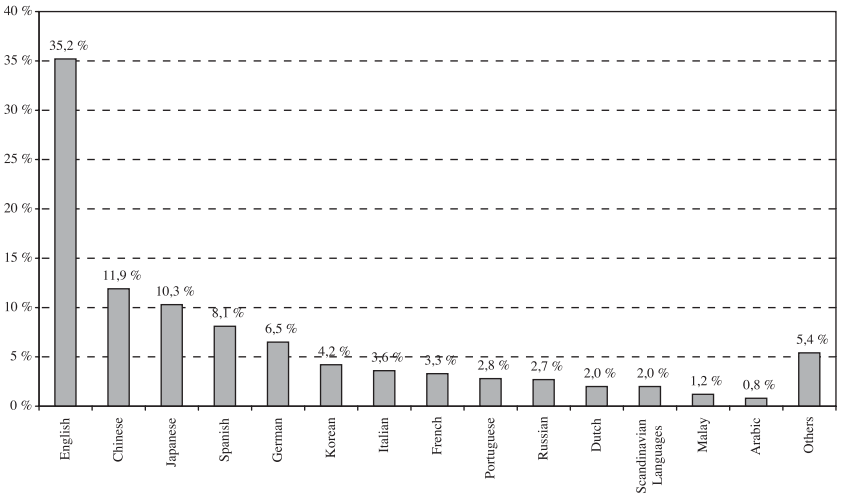
UIS is participating in the UNESCO cross-cutting project Initiative B@bel which seeks to enhance more equitable access to information in cyberspace, particularly development information, by promoting multilingualism as well as using ICT to preserve endangered languages. Within the framework of this project, the UIS is sponsoring a report on the status of multilingualism on the Internet. Special attention will be devoted to the change in the balance of languages on the Internet over time, and the impacts of language use on the Internet.

Fundacion Redes y Desarollo (FUNREDES), a non-governmental organization, located in the Dominican Republic, promotes the adoption of ICT in Latin America. It has conducted a series of studies since 1995 to assess the distribution of language and national influences on the Internet. These studies employ the technique of counting the number of web pages indexed by popular search engines containing selected words and phrases from different languages. However, such page counts are subject to a range of confounding influences concerning the technical characteristics of the particular search engines used. Furthermore, the linguistic characteristics of the selected terms, and the statistical distributions of such search terms have not been studied well enough to generalize from such studies. Notwithstanding these limitations, the results suggest that the proportions of web pages in a given language are approximately equal to the proportion of Internet users for that language. Furthermore, their data indicates that between 1998 and 2003, the presence of the English language on the web has declined from 75% to 45% (of the total presence) whilst remaining the most dominant language (Pimienta, 1999).

Alis Technologies adopts a different methodology than FUNREDES, focusing particularly on data processing. It uses a programme that automatically recognizes seventeen languages on the web space. Compared to the FUNREDES work, the results of the Alis study show a stronger presence of English (82%). However, both studies show roughly the same proportion of French and Spanish presence on the Internet.

Global Reach provides the following graph on the number of people online by native language zone. (See Graph 6.)

Graph 6: Percentage of World Online Population[8] by Languages, 2003



Source: Global Reach, Global Internet Statistics (2003).

3.3 ICT and Science &Technology (S&T)

Much of the current data in Science and Technology is limited to the measurement of Research and Experimental Development (R&D), generally based on the guidelines set by the OECD's Frascati Manual (OECD, 2002b) which in turn used UNESCO's Recommendations concerning the International Standardization of Statistics on Science and Technology (UNESCO, 1978). The R&D "input" data, specifically personnel and expenditure in R&D, are complemented by "output" indicators based on the count of scientific publications and patents (OECD, 1994), and proxy measures of impact, such as the technology balance of payments (OECD, 1990), and statistics on trade in high technology goods. More recently other manuals have been developed such as the Oslo Manual (OECD/Eurostat,

8. "World online production corresponds to the number of people online in each language (i.e. native speakers) and is not meant to represent the number of people who speak the languages in general. There is some overlap between English and non-English figures, since many Americans access the web in two languages". (Global Reach, 2003).

1997) on innovation and the Canberra Manual (OECD/Eurostat, 1995) on human resources in S&T. OECD manuals are intended as methodological guidelines to be applied in member countries, which broadly share a common economic structure and a higher level of development. The extent to which they can be applied without any modifications to suit the needs of non-OECD countries is still matter of debate.

The relationship between S&T and ICT has been identified by many different international organizations as an important area for development. To this end, the UN Commission on Science and Technology Development (UNCTAD, 2002), has established a framework of indicators on Technology Development, including aspects where ICT play a leading role. See Table 1 for a summary of these. In the framework of NESTI (National Experts on Sciences and Technology Indicators), the OECD has established a working group on S&T statistics. Furthermore, OECD included an annex dealing with measuring ICT-related R&D in the 2002 edition of the Frascati Manual (OECD, 2002b).

Table 1: Indicators Proposed for Use by UNCSTD

Measure	Aspects of Development	Indicators
Technological Development	1. Innovation 2. Human Capital 3. Export Structure	- R&D expenditure (% GNI) - Number of technical personnel in R&D - Tertiary enrollment (% population) - High-tech exports as a percentage of total exports
ICT	1. Connectivity 2. Access 3. Policy 4. Usage	- Internet hosts, PCs, mainlines, mobiles - Number of Internet users, literacy, GDP per capita, cost of a local call - Internet exchange, competition in local loop, long distance, ISP market - Average incoming/outgoing telecom traffic

As guardian of the international database on Science & Technology statistics, the UIS contributes both to the conceptualization and the development of a methodological framework for the collection of internationally comparable data and indicators. As such, the UIS recently conducted the International Consultation on S&T Policy Priorities and Information Needs, during which a number of priority areas of work were identified. See Box 3 for a summary of the UIS programme of work in this area.

Despite the above efforts, comparable S&T statistics focussing on ICT are not available worldwide. Much work is needed in the areas of awareness-raising for policy makers, statistical capacity building, and adoption and development of methodologies to foster the production of these statistics in developing countries.

Box 3: Main Activities of the UNESCO Institute for Statistics - Science and Technology Statistics Programme (2003)

During 2002, in cooperation with the UNESCO Division for Science Analysis and Policies, the UIS conducted the International Consultation on S&T Policy Priorities and Information Needs, with the aim of redefining its S&T Programme, based on the views of Member States and experts in the field of S&T statistics.

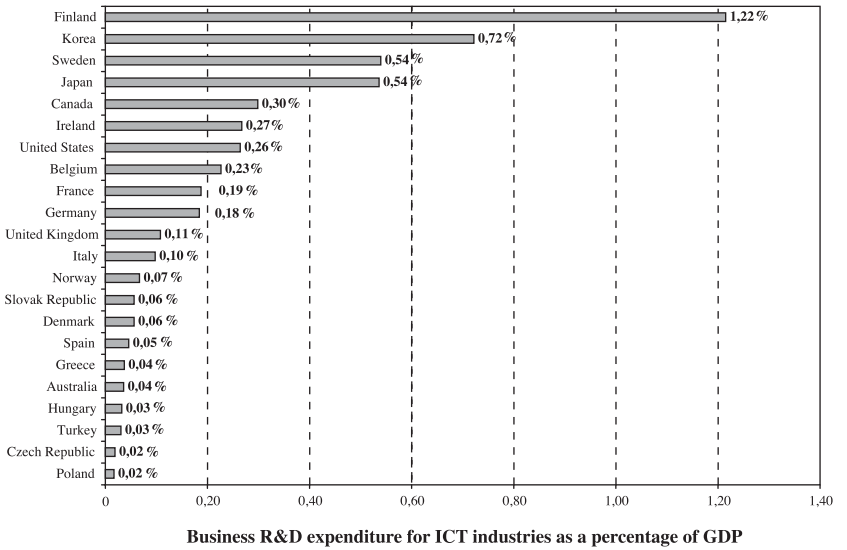
The Consultation process resulted in a series of priorities for the immediate, medium and long-term work at the UIS. In this framework, Human Resources emerged as the first priority area, including not only the measurement of R&D personnel, but also other highly important related issues such as the "Brain Drain", S&T employment, science education; recruitment to science, engineering and technology careers, retention of scientists, and gender issues. Furthermore, having more disaggregated data on researchers (for example, more detailed "Fields of Science" classifications) at policy maker's disposal was stated frequently during the consultation as being important.

The UIS is seeking to increase the coverage and quality of the S&T statistics database through a process that involves complete redesign of the data collection process, a greater concentration on the production of analytical reports and a focus on statistical capacity building. Collaboration with regional organizations and networks, as well as direct relation with the institutions in charge of producing S&T statistics in the Member States, will also be part of this process.

Following the results of the Consultation process, the UIS will focus on the immediate priority of improving the coverage of "input" indicators based on available international standards, such as R&D personnel, human resources devoted to S&T, recruitment to Science, Engineering and Technology careers, and financial and institutional resources for R&D. (See Graph 7, for example.)

In the medium term, innovation indicators will be added to the core of the UIS activities. Longer term plans for this programme of work include work on "output" indicators (see Graph 8, for example), and methodological studies related to the measurement of social impact of Science & Technology, as well as other related impact considerations in the areas of agriculture, health, energy, and the environment.

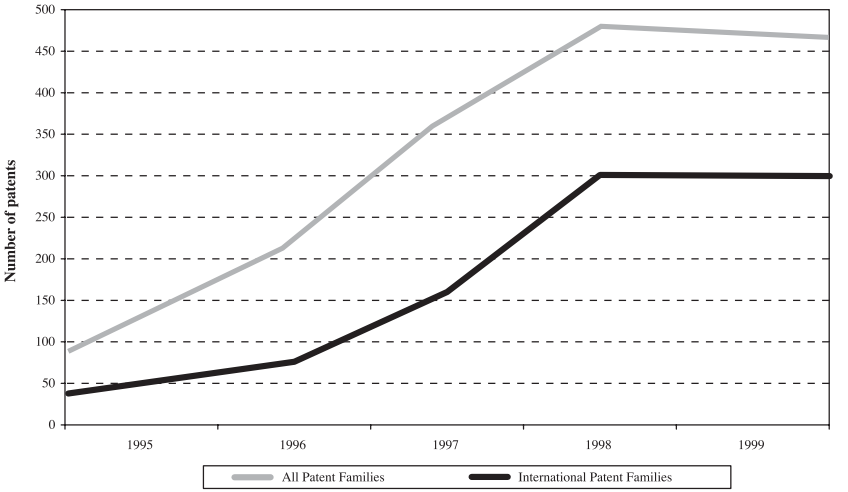
Graph 7: Business R&D Expenditure in ICT Industries as a Percentage of GDP for a Selection of Countries, 2000[9] (Constant Price 1995 and PPPs[10])



Source: OECD ANBERD Database (2003).

9. Data for Sweden, Ireland, Germany, Norway, Denmark and Greece refer to 1999.
10. Purchasing Power Parities.

Graph 8: Number of New Internet Related Business Method Patent[11] Families, 1995-1999[12]



Source: Mogee Research and Analysis Associates, International Analysis of Internet-Related Business Methods (2001).

4. A Selection of Regional and National Initiatives Involving ICT Data

We have chosen a number of national or regional studies that complement some of the international initiatives described above. The next two studies showcase data collections on national or regional levels that have some innovative or new element to them. Although these studies may not be too useful for cross-national comparisons because their scope is limited geographically, they offer suggested models that might be extended to other countries or regions. Obviously they have value within their own borders in that they can be used for evidence-based policy-making at the

11. Patent families consist of all patent documents published in a country associated with a single invention. The first application filed anywhere in the world is the priority application . Similarly, the priority year is the year the priority application was filed. Inventions for which patent protection has been sought in more than one country are counted separately here and called international patent families (Mogee Research and Analysis Associates, 2001) .
12. Due to the time lag between patent application and publication, data for 1999 should be regarded as incomplete.

national or regional levels. One such study was conducted by the United Nations Development Programme (UNDP) on the Yemeni Internet population. This study is important because, although OECD and Eurostat have implemented household and business surveys with Internet usage components, little has been done of this nature in countries that fall outside the purview of these two organizations.

UNDP Study on Yemeni Internet Population (Noman, 2002)

This UNDP study, conducted in 2002, identifies the demographic profiles of the Yemeni Internet population and measures and defines their usage patterns, online activities, and interests. It offers a better understanding of how issues such as poverty, high illiteracy, poor telecommunication systems, and a lack of institutional support affect the characteristics of Internet users and their online behaviour.

Two methodologies were applied in this study: a top-down approach that analysed the log files of the two ISPs in Yemen, and a bottom-up approach using surveys that covered two segments of Internet users and non-users from main Internet-using cities: Sana'a, Aden, Taiz, Hodeidah, and Hadramout. The study yielded 2.000 completed questionnaires from Internet users and 2.000 from non-users. The researchers also conducted interviews with 10 to 20 Internet cafés operators in the same cities and collected data based on an 8-item questionnaire.

The main results showed that browsing "entertainment sites" was the top online activity (45%) followed by browsing "news and information about politics" (23%) and "Islamic sites" (19%). The very low percentage of online "academic research" (5%) can be attributed to the following reasons:

- Yemeni educational institutions have not integrated the Internet into the education system;
- specialized Internet training for academic research is virtually absent in most of the state and private academic institutions;
- English, the language of the majority of the research materials published on the Internet, is not widely spoken in Yemen.

Young male users who use the Internet primarily for electronic communication and entertainment dominate the Internet population in

Yemen. Online activities such as academic and scientific research, online shopping, and e-governance activities are either underutilized or are virtually non-existent due to lack of institutional support, low gross national income (GNI) per capita, and poor telecommunication infrastructure.

A second study is given below.

User Survey in Selected Cabinas Públicas in Peru and Latin America (Proenza et al., 2001)

The study conducted by ITU, Food and Agriculture Organization (FAO), and Inter-American Development Bank (IADB) examined the usage of telecenters in Latin America and elsewhere in the world. The Peruvian experience was studied in greater detail than other countries because Peru has the largest proportion of users connected to the Internet from public access points. Many of these do so from *cabinas públicas* (community telecentres), which are operated entirely by private enterprise without any government subsidy. The basic telecenters that are common in Peru and elsewhere in Latin America are mainly situated in the urban areas. These telecentres have fairly standard features such as furniture, computers, and Internet connection. They offer elementary software (e.g. word processing, spreadsheet). Administrative and support staff oversee the use of the machines, collect payment for the services, and provide rudimentary technical support to the users.

In Peru, the study administered over 1900 survey questionnaires among users of 14 *cabinas públicas*. The *cabinas* were selected by the *Red Cientifica Peruana* (RCP) and its collaborators. The selection purposely sought to include *cabinas* operating in low-income urban and rural areas and variety in forms of management. The objectives of the survey were to:

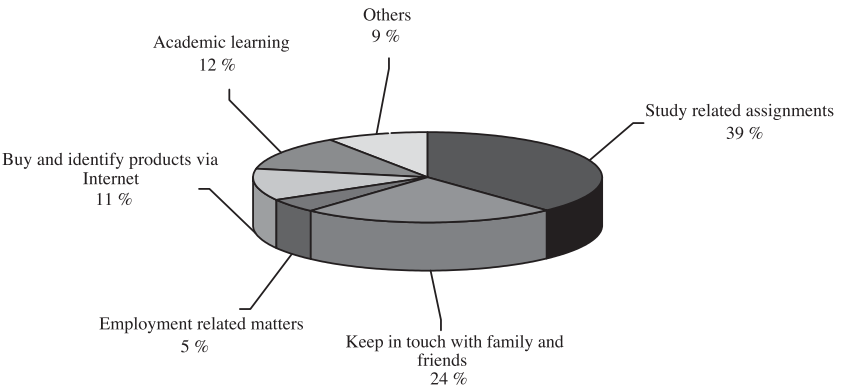
i) identify the characteristics of the users of the 14 *cabinas* selected and determine whether they serve low-income users and;

ii) identify the ways in which the *cabinas* are used and determine users' needs and expectations from using the *cabinas*.

The results of the survey, though not statistically representative, are probably indicative of the profile of users of *cabinas públicas* located in

low-income and relatively remote areas of Peru. Given that a majority of users were students, the type of usage patterns in these telecentres and computer facilities indicates that the Internet was primarily been used for educational purposes with 39% of use being attributed to study related assignments and 12% for academic learning (see Graph 9).

Graph 9: Purposes for Using Cabinas Públicas Expressed as a % for Peru, 2000



Source: Proenza, F.J. et al. (2001).

In the two studies below, we have highlighted the analytical results that come from regional data collections in South Africa and Thailand, respectively.

Computers in Schools: A National Survey of Information Communication Technology in South African Schools (Lundall & Howell, 2000)

This study, conducted by the Education Policy Unit of University of the Western Cape, asked schools both with and without computers to return a questionnaire on factors relating to computer usage. The information obtained through survey was supplemented by interviews with key stakeholders and site visits to schools in three provinces. A brief survey was also undertaken with important players in the private sector to explore the nature and extent of their involvement in ICT provision and support in

schools. Out of the 2.311 schools registered as having computers, 962 returned the questionnaire. Out of 2.480 schools without computers only 444 responded.

The results showed that the schools that successfully acquire and use ICT demonstrate a number of enhancing preconditions and capacities, such as relatively smaller class sizes; the ability of parents to meet additional financial costs involved; and the ability to integrate ICT effectively into the normal school routine.

The comparison of schools without computers to those with computers shows clearly that the former group is disadvantaged through low levels of resources, making effective start-up nearly impossible. High use also correlates with the provision of e-mail facilities to teachers, greater "after hours" use by students and teachers, access by a greater percentage of learners at home, and a propensity among secondary schools to offer computer studies.

In addition, the study showed that teacher attitudes are both affected by and impact directly on levels of ICT usage, with high level usage clustered closest to positive teacher attitudes. The analysis also shows that where there are a number of barriers towards the use of ICT in schools (e.g. lack of funds), it is more likely that teacher attitudes towards ICT usage will be negative. Positive attitudes to ICT in schools appear to be enhanced through the access of teachers to relevant ICT training.

Internet and the Problem of Language in Thailand (ITU, 2002a)

One barrier to Internet penetration in Thailand is language. There is a dearth of Thai language content on the Internet, and manoeuvring through cyberspace requires some degree of English fluency. According to a survey conducted by the National Electronic and Computer Technology Centre (NECTEC), only 38% of Thai Internet users have good English proficiency; this is reinforced by another finding showing that about one-fifth of Thai Internet users cited language as a problem with the Internet. With English spoken by only an estimated five per cent of Thai people, this language barrier severely restricts the potential of expanding the Internet market.

Recognizing this market potential, some foreign information technology companies are developing Thai language support and portals. One major

development that will assist Thai Internet users is the creation of an English to Thai web site translator (called 'ParSit'), developed by NECTEC and the Nippon Electric Company (NEC) of Japan. Nevertheless, Thailand faces the dilemma of whether to invest resources to either increase Thai content or to expand English language learning among its citizens, or a combination of both. Indeed many Thai web sites today have English menu choices such as "About Us" or "FAQ" mixed in with text, a sort of 'Thailish' of cyberspace (ITU, 2002a).

II. Issues Related to Data, Indicators and Data Quality for Cross-National Comparisons of ICT data

This chapter will discuss some of the issues relating to data quality when attempting cross-national comparisons of ICT data. The first section will focus on some of the specific conceptual and methodological problems that have been identified relating to the existing data and indicators in the area of ICT, with particular reference to the material in section I. The second section will highlight some issues to take into consideration in the creation of future ICT data systems. This section will include a discussion on the caveats regarding indicator use in general.

1. Conceptual and Methodological Problems with Existing Data

The measurement process involves certain methodological paradigms: "conceptual clarity of the item to be measured; precise definitions of relevant terms that can be applied in practice; precisely defined classification systems; a clear specification of the target population to which the estimates apply; and development of appropriate sources, methods, and questionnaires, to obtain the data and compile them into the estimates required. If these measurement processes are controlled, comparable outputs follow." (Holt, 2003). Despite all efforts to control such processes, there are issues, both conceptual and methodological, that pose problems with the current ICT data, including those discussed in the previous section.

For instance, it is often of interest to utilize data sets from official statistics agencies of different countries, bringing them together for the purposes of cross-national comparisons. This is often carried out in order to

provide a global or regional picture and can provide information valuable for monitoring international goals. Unfortunately, different national systems may employ varying concepts as well as a variety of methodological approaches for data collection and analyses. Even basic definitions of indicators can widely differ from one country to another. In the area of ICT, for instance, the definition of 'Internet user' varies across countries. This may be because the "frequency of use" (daily, weekly or monthly), imbedded in the definition, varies depending on the country. Therefore, it is important in such cases to understand the definition of "user" employed in each context to see whether or not the definition is uniform across all the countries considered.

A second issue is related to the lack of availability of data. For instance, with 'Internet 'traffic', there is difficulty even obtaining such data since most operators do not report them and few government agencies compile the data. Furthermore, there is no conceptual agreement on what should be measured: the volume of data transferred across the Internet or the user session time. From a usage point of view, perhaps the latter one is more important, however.

A third issue is the relevance of a chosen indicator to measure a particular concept. For instance, it is becoming increasingly obvious that the use of 'Internet host' as a country-level indicator may not be useful because a host cannot always be linked to a geographic region.

A fourth issue is the lack of inclusion of appropriate questions in survey vehicles that capture all pertinent aspects to be measured. For instance, data on Internet access and usage within the home is often collected through household surveys (and sometimes through school surveys). Users in developing countries will often access the Internet through community Internet services or through public service points such as cybercafés (also known as 'Internet kiosks'). This aspect is often ignored in the questionnaire formulation of such household surveys. Even if this is included, auxiliary information on costs and distance of such facilities from the user's home is often missing. The inclusion of such information would enable policy makers to identify those who are excluded from joining the mainstream of Internet access along with the reasons. Furthermore, the use of survey methodology to measure Internet access and usage can also have problems

with regards to social desirability response bias due to the subject matter (e.g. questions on purpose of use of Internet leading to untruthful answers due to embarrassing nature of the content browsed), response incentive distortion, language or cultural bias, survey sponsorship bias and geographic imbalance (Wilson & Li, 1999).

International organizations having associated statistical arms, such as UIS (for UNESCO) and ITU, are largely secondary collectors of data from their Member States and beyond. That is to say, they generally send out questionnaires to all countries of the world to the relevant ministries, NSOs or other agencies (such as telecom operators), which in turn collect national data either through administrative means or through sample surveys. Then, either the countries are asked to consolidate the internal responses in order to achieve single overall figures for the country in question, or the consolidation is carried out by the international organizations. International organizations operate in this manner since it is recognized that primary data collections rightfully belong within countries. This situation can pose a number of problems, however. It is often the case that the international statistical agencies will receive a series of non-consolidated response questionnaires from the countries and, even if the choice is made to do the consolidation themselves, there is no assurance that a complete set of responses has been sent in the first place. The results of a consolidated set of partial responses can be more misleading than no response at all in the case where those partial responses lead to biased results. A useful recommendation in this regard might be to institute the formation of a road map of data providers for each country in order to be able to verify that data coming from a variety of sources within a country is indeed a complete set.

International statistical agencies face other challenges with respect to collection of cross-nationally comparable data as well, such as:

- incomplete data within a country at a particular time point relating to particular data items within the overall questionnaire;
- incomplete data over time (countries responding for some time points but not others);
- inconsistencies with data from a country either within a questionnaire over related data items or over time on the same data item (for example, unusual fluctuations in values for the same data item over time);

- inability of some countries to provide any data at all (since not all statistical agencies have the resources to collect ICT statistics);
- inadequate implementation of the international standards and classifications leading to data which are not comparable across countries (sometimes changes in such classifications lead to inconsistent data over time);
- poor or incomplete meta data;
- internal over-reliance on data from administrative sources and the lack of other data with which to validate the information;
- long time lags before data are processed and made available.

2. Issues Relating to the Collection of Cross-Nationally Comparable Data

Before discussing the broad issues that need to be considered in the creation of cross-nationally comparable data sets, a short discussion outlining some caveats on the general use of indicators is given below.

2.1 Caveats on the Use of Indicators

There is much debate regarding the use of indicators to help policy-makers make informed decisions in policy formulation. The general argument that is made in favour of the use of indicators is that policy-makers need complex systems distilled or reduced to a few figures that they can quickly grasp and act upon. They cannot be expected to wade through a myriad of analyses. Those more cautious with regards to their use claim there is an over-reliance on analytic statements based on overly simplistic single indicators, which may lead to spurious results or distorted final conclusions. At a minimum, it should be ensured that indicators are not analysed one-at-a-time, without the underlying context or confounding factors being taken into account, particularly when grappling with complex, multi-faceted phenomena such as the Information/Knowledge Society and ICT. Moreover there should be a promotion of statistical modelling, built on a series of indicators, where it may even be possible to include some auxiliary information on context directly into the model. At a minimum, there is the need for thorough

analyses and interpretation of the indicators (and the raw data on which they are based), grounded not just in the technical aspects but also with an in-depth knowledge of the subject matter and the country context. In summary, the focus should be on robust and careful analyses, to replace the current obsession with monitoring single indicators.

Related to the above issue is the use of qualitative data to enrich analyses based on indicators from quantitative data. Qualitative and quantitative data are both important and can play a role in giving a complete picture of whatever issue or phenomenon is being studied. In general, data collected using qualitative research methods attempt to understand socio-cultural behaviour and social psychological aspects of a defined group within a community, cultural area or region. Qualitative studies can be a useful complement to quantitative studies because they enable a greater in-depth understanding of situations; however, they cannot be generalised to a broader population beyond those individuals studied without external validation. In contrast, data collected using quantitative research methods tend to describe phenomena at macro level and results are generalizable with reference to a larger population of interest by design. Quantitative research methods are therefore preferred as a tool for data collection by national or international statistical offices and are the main preoccupation of this report.

Another issue to be considered is the need for sound, reliable auxiliary data essential for indicator calculation. Examples of such data are population data, Gross Domestic Product (GDP) figures and Purchasing Power Parity (PPP)[13] figures, which are often used in the denominators of indicators. There can be problems relating to quality, coverage, periodicity, consistency, and availability of these supporting data. For instance, population data provided by different agencies are not always in agreement with each other due to the use of differing methodologies.

13. As an aside, but on a related note, when making cross-national comparisons using GDP figures, currency denominations should be expressed in terms of Purchasing Power Parity (PPP), rather than in terms of exchange rates (for those countries where PPPs are available). PPPs are ″price relatives″, which show the ratio of the prices in national currencies of the same good or service in different countries.

The final issue involves a cautionary note on the use of composite indicators. These may be a composition of a series of indicators, weighted or not, whose objective is to describe an overall phenomenon. Examples of such composite indicators are the "Infostate" Index described in "Monitoring the Digital Divide" (ORBICOM-CIDA) (Sciadas, 2002). This index attempts to measure and monitor ICT related gaps between the information-poor and the information-rich countries (the so-called "digital divide") using a series of indicators on "Info-density" (ICT capital and labour stocks) as well as a series of indicators on "Info-use" (uptake of various ICT and the intensity of their actual use). Another example of a composite indicator is the Technology Achievement Index, developed by the UNDP, that ranks countries based on an amalgamation of a series of indicators relating to Internet connections, telephones, patents registered and education levels (UNDP, 2001).

One of the problems with composite indices is that the relative standings of countries are dependent both on which indicators are included and which ones are excluded from the composite index. Decisions regarding inclusion and exclusion are often based on very subjective considerations. As an example, using a hypothetical Information Society Index, it can be shown that including such indicators as "Income Level per Capita" could result in lowering the ranking of countries that are doing well with regards to the Information/Knowledge Society in spite of their low incomes (e.g. South Korea). On the other hand, excluding certain key indicators such as "Broadband Subscription" could equally well raise the rankings of countries with limited broadband capability. The use of such subjectively formed composite indices (and particularly the ranking of countries based on these indices) often give an overly simplistic and misleading picture of country situations, and which typically do not take confounding factors into account. A non-obvious and rather frightening aspect of these types of rankings is that one country's ranking can be altered due to the way another country measures one of the buried indicators that form part of the overall index. Worse yet, as a result of such rankings, countries are often pitted against each other in political exchanges, where the focus is taken away from issues that warrant true attention in the world fora. A more sensible approach would be to group countries of similar economic status (say) together and to attempt analyses within these groups using the results coming from a multitude of well-chosen but different indicators that are not amalgamated

into one entity. This is preferable to the widespread practice of presenting separate and absolute rankings for each individual country.

2.2 General Data Quality Issues that Need Attention When Collecting Cross-Nationally Comparable Data

This section begins by discussing broad aspects of quality in the context of international comparability, giving some principles that might be followed and strived for in the development of any quality data collection development initiative. This is followed by a short discussion regarding some of the barriers often encountered by international and national statistical agencies in achieving these quality guidelines.

Quality has been defined in ISO 8402 as "the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs". However, the term quality as applied to official statistics is not easily defined, being comprised of many components including the following (Lievesley, 2001a): validity, reliability, relevance to policy, potential for disaggregation, currency, punctuality, coherence across different sources, clarity and transparency with respect to known limitations, accessibility and affordability, comparability through adherence to internationally agreed standards, consistency over time and space, and efficiency in the use of resources. These are attributes to be strived for in the development of any quality data collection development initiative, particularly in the context of cross-national comparability efforts. Excerpted definitions and a short discussion on each of these aspects, given in the context of cross-national comparability, follow (Lievesley, 2003):

- **Validity:** This refers to the extent to which the data are measuring what they purport to measure without the presence of bias.
- **Reliability:** This refers to the amount of (random) error present in the data.
- **Relevance to policy:** These may be local, national or international policies. A tension can exist between the relevance for national and international policies particularly in respect to the importance of harmonised classifications.
- **Potential for disaggregation:** It is vital to understand (in order to reduce) inequities across the world in relation to access issues for ICT. Relative

disadvantages may occur within countries and is not completely captured by examining differences between countries. It is therefore important to measure variability within countries and this requires that data can be disaggregated by key variables. The current emphasis on international monitoring of national level indicators undervalues disaggregated data.

- **Currency:** The availability of data relating to recent time periods is of critical importance if policy decisions are to be based on this evidence. Obviously this is more important in situations where there is a greater amount of change. The regularity of monitoring ought to take into account the rate of change of a variable.
- **Punctuality:** The collection of recent data is insufficient; they must also be processed speedily and access provided in a timely and regular fashion preferably with reliable release dates, which are publicised in advance so that users know when to expect the new data to be available. This also helps to guard against the withholding of data for political purposes, which must be seen to be unacceptable.
- **Coherence across different sources:** Since the value of combining data of different types and from different sources is increasingly recognised, their coherence is important so that they provide a representative and comprehensive picture of ICT. An investigation into the metadata and other documentation from each of the sources is essential to see whether or not it is reasonable to combine the data. This includes elements such as: the definition and concepts, the scope of the data collection, the methodology, the sample design, the data collection vehicle, the quality of training given to field investigators, the quality of data entry, error detection and editing, and the consolidation methods followed, among other issues.
- **Clarity and transparency with respect to known limitations:** Metadata, which describe the methodologies used for data collection and outline the various sources of error, are vital in order that the user can judge the quality of the data and thus determine whether they are fit for their purpose.
- **Accessibility and affordability:** The quality of information extracted from data improves the more the data are subjected to analysis from a variety of perspectives. Thus it is important to create a culture in institutions, and in societies more generally, in which access to data is

regarded as the norm. A pre-requisite for this is a climate of openness in which criticism of data collection or analysis is factual and temperate, and data are used responsibly.

- **Comparability through adherence to internationally agreed standards:** This is important otherwise comparability will only be 'skin deep' and unjustified conclusions may be drawn which are artefacts of the variations in methodologies between countries rather than 'real' differences. However international standards have to be sensitive to inherent heterogeneity, which can represent a genuine obstacle to the attainment of comparable data.
- **Consistency over time and space:** Methodological consistency is critical when making comparisons over time or between different areas or when aggregating data across time periods or across areas. Difficult compromises must often be made between preserving methodologies over time and updating them to keep abreast of advances in statistical science and of policy developments.
- **Efficiency in the use of resources:** It is feasible to reduce many of the biases or variability in the process of gathering statistical data by spending more time or money, thereby achieving data of higher quality. However resources are usually limited and the aim must therefore be to minimise error within a fixed outlay of resources. Occasionally we might seek to minimise costs to achieve data of a specified quality.

Some of the concepts discussed within the larger issues above warrant further elaboration.

Metadata Systems

Ensuring data quality depends to a large extent upon many of the factors mentioned above such as coherence across different sources, as well as clarity and transparency with respect to known limitations. Proper metadata systems provide information on methodology required in order to ascertain whether the data set in question is fit for use in cross-national comparisons. Users need to be able to understand when data differ from the international standards in ways which will affect their interpretation. Too often however, metadata is scattered, incomplete or missing. Even in the case of developed countries, the relevant information often resides only with the data

producers and is not well documented. The effective and efficient construction and management of statistical metadata greatly increases the usefulness of statistical data to researchers and analysts. Such a metadata system could include data dictionaries, record layouts, questionnaires, sample designs and standard errors.

With the increase in the dissemination of statistical information via the Internet, there is an urgent need for properly designed meta-information systems as tools for providing users with all the necessary information about the researched statistics. There are already a number of metadata web sites offering systems to users for identifying and seeking statistical information. However, the heterogeneity of such metadata systems and the apparent methodological differences and inconsistencies of statistics disseminated pose difficulties for the users as to which data are more reliable and why. The "Guidelines for Statistical Metadata on the Internet" (UNECE, 2000) has made certain recommendations on the harmonisation of the metadata accompanying the statistical information on the Internet. These contain recommendations for the designers of meta-information systems for dissemination of statistics via the Internet, suggesting a minimum set of metadata in the following groups:

- metadata assisting search and navigation;
- metadata assisting interpretation of content and;
- metadata assisting post-processing statistical applications after downloading the data.

Further work is going on in the following methodological area:

- common terminology of meta-information systems;
- recommendations on the formats relevant to the downloading of statistical data from Internet and;
- best practices in statistical web site design.

Data Storage and Dissemination

The collection of data for analytical studies can be very expensive and should be viewed as an investment in information. The proper storage and retrieval of such raw data can be beneficial in that it allows future researchers to attempt alternate analyses that are not contained as part of the

original study report. However, it is too often the case that the raw data collected for such studies are forgotten or improperly stored after the final report has been produced. Particularly in many developing countries, the storage of such sets may occur on inappropriate media such as floppy, spool tapes or hard disks. Other more durable forms that ensure longevity can be more expensive but should be built into the estimates of the resources required from the outset of the project. Furthermore, to facilitate widespread access to and usage of the data, they should be archived using digital technology and user-friendly formats.

Classification Systems

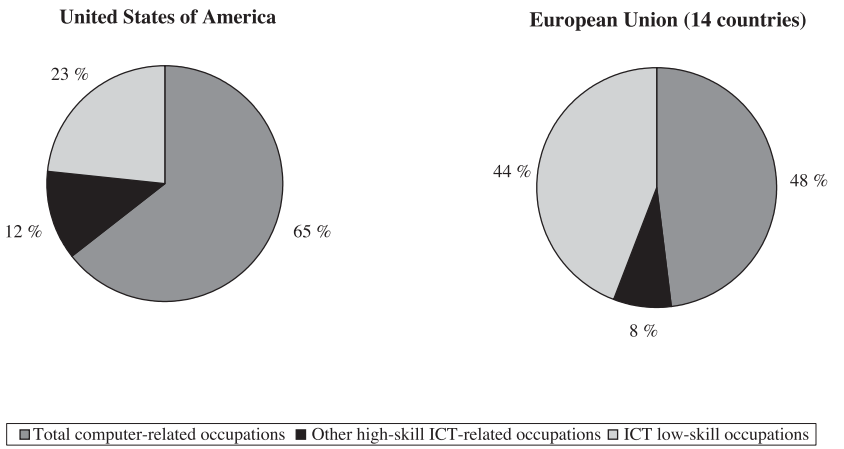
Agreement on the use of International Classification Systems is essential in order that data are cross-nationally comparable. However, different countries or regions often use different classification systems and it is often difficult to harmonize across the various systems to facilitate the cross-national estimations. One such example arises in the estimation of "ICT-related occupations". The ISCO-88 (International Standard Classification of Occupations), defined by the International Labour Organization (ILO) is the classification system used within the European Union for employment occupations, where SOC (Standard Occupational Classification) is used in North America. These systems are used to classify data on occupations gathered from labour force surveys into appropriate employment groups. In the context of the Information/Knowledge Society, "Occupations in Telecommunications Services[14] " are an identifiable group in both classification systems, and so it is possible to estimate employment in that specific area without much difficulty. However, the same cannot be said for "ICT-related occupations" since it is unclear what belongs and what should be excluded from the definition of this group. Although there is no internationally agreed list of ICT-Related Occupations, an attempt was made within the European and North American systems to form such a list by partitioning the group into two subcategories: "High-Skill ICT-Related Occupations" and "Low-Skill ICT-Related Occupations" (OECD, 2001).

14. Telecommunication staff refers to the total number of staff (part-time staff converted to full-time equivalents) employed by telecommunication enterprises providing public telecommunication services. In some cases where posts and telecommunication organizations are combined, no breakdown of telecommunication staff is available (ITU, 2002b).

The former group was then further subdivided into "Computer-Related Occupations" and "Other High-Skill ICT-Related Occupations". In order to have a concordance between the European and North American systems, only the 3-digit level of ISCO-88 was used; similar classes were selected from within the North American system. Thus, some of the Low-Skill ICT-Related Occupations were not included from the North American system because they could not be matched to the ISCO-88 3-digit classification.

After the harmonization exercise was complete, some interesting results emerged. Graph 10 shows the percentage of share of high and low skills within the ICT-related occupations in the European Union and the United States of America. It may be seen that the proportions of computer-related occupations (65 %) and high-skill ICT-related occupations (12 %) are higher in the United States of America, compared to the European Union (48 % and 8 % respectively).

Graph 10: Share of High and Low Skills[15] Within the ICT-Related Occupations in the United States of America and the European Union[16] , 1999



Source: OECD, Science, Technology and Industry Scoreboard (2001).

15. High-skill ICT related occupations refer to IT professional where low-skilled refer to electronic and mechanics.
16. Not including Ireland.

Much has been written on the principles that should be followed in the development of any international classification system. The experiences of national statistical offices are an important basis for the development and implementation of such international statistical classifications. Effective national practices provide the foundation for international classifications. Thus, if there is a reasonable agreement on 'best practice' among the national statistical institutions with relevant experience, it is best to adopt the corresponding general principles and common definitions for the international classifications (Hoffman & Chamie, 2002). It is also clear that good international and national practices with respect to these issues contribute significantly to ensure compatibility and comparability of the statistics using the respective classifications nationally as well as internationally.

Statistical Capacity Building

One of the main tenets followed by most international organizations that are secondary collectors of data from Member States is that ownership of the data should lie with the countries and that countries should be fully involved in determining what data should be collected within their borders. Donor-driven and funded data initiatives are not sustainable models of helping countries achieve high quality on-going data collection systems to inform their policy makers unless they involve national statisticians in determining the priorities. One problem is that the funding for such initiatives may have an apriori time limit, or such support may be discontinued when the political administrations of donor countries change, along with their political agendas. Thus, it is essential that donor resources are focused rather on helping countries to develop themselves, an essential aspect of which is statistical capacity building. Statistical capacity building can take many forms including helping countries to develop their statistical systems (determination of data needs, choice of collection vehicles, development of methodologies, survey designs, questionnaires, etc), as well as training the staff in all aspects of survey taking (collection, processing, analysis and interpretation, etc). This can also involve the development of internal Management Information Systems (MIS) to help develop capacities to monitor progress based on key indicators; the value of such systems is that they can offer early warning signals, enabling policy makers and other stakeholders to respond appropriately when necessary.

2.3 Barriers to Achieving Quality

Despite attempts to adhere to the principles outlined in the preceding section, both national statistical agencies and the international statistical organizations that collect data from them as secondary users often encounter a number of barriers in achieving the desired quality. A short discussion on some of these issues follows an opening section describing the roles of both national statistical offices and international statistical offices.

The Role of National Statistical Offices Versus International Statistical Agencies

National statistical offices and international statistical agencies need to work together towards the achievement of reliable and cross-nationally comparable data. Involvement of the national statistical offices by the international statistical agencies in determining the priorities helps to strengthen national capacities towards building evidence-based data collection systems.

What role do national data play and why are they needed? National data provide a picture of a country's internal economic and social status. This internal picture is essential for policy-makers who must decide where to invest country's scarce resources against competing demands. This is particularly true in the context of the Information/Knowledge Society, where there is a need for the establishment of official and reliable statistics in order to monitor the development of the different dynamic aspects of such a society. Prior to investing in public programmes, decision-makers must be convinced of both the benefits to the public as well as the cost-effectiveness through quantitative evidence. Advocacy can help attract increased financial and human resource mobilization for the policy issue in question. As stated in an overview article on the subject, "Raising the public and political profile of official statistics is vital in order to win support for the continued allocation of resources to data collection programmes and to ensure that relevant groups have a sustained commitment to supplying the information (Lievesley, 2001b)". National statistics can also be used for monitoring programme implementation and for assessment of the effectiveness of those programmes.

In contrast to national data, cross-national data can be used to provide a global or regional picture towards monitoring international goals (such as

the Millennium Development Goals (MDGs), mentioned later in this report). They serve as a catalyst for healthy debate between partner countries on the data themselves and their interpretation. The main objectives of comparable data across nations are: (a) to enable countries to gain a greater understanding of their own situation by comparing themselves with others, thus learning from one another and sharing good practice. 'They (cross-national measures) help to reveal not only intriguing differences between countries and cultures, but also aspects of one's own country and culture that would be difficult or impossible to detect from domestic data alone' (Jowell, 1998); (b) to permit the aggregation of data across countries to provide a global picture, thus enabling the design of international initiatives informed by evidence; and (c) to provide information for purposes of the accountability of nations and for the assessment, development and monitoring of supranational policies (Lievesley, 2001b).

The roles of national statistical agencies (in collecting nationally specific data) and international statistical agencies (in collecting cross-nationally comparable data) are both important and essential roles within their contexts. Nevertheless, tensions can exist between the two. Most international statistical agencies are secondary collectors of data given that the ownership of the data lies rightfully with the primary collectors, the countries. Furthermore it is (and appropriately so) the role of each country to decide what data should be collected within its borders. Oftentimes however, national collections may not be sufficient in terms of scope, coverage or quality for the purposes of cross-national comparisons and the resources within countries dictate that national considerations take priority over and at the expense of cross-national needs. Thus there exists a "tension between respect for national sovereignty and the importance of ensuring access to national data of integrity" (Lievesley, 2001b).

Furthermore, the creation of cross-national data and the comparisons that ensue can create competition amongst countries, particularly when ranking systems are used, undermining the fundamental objectives of the cross-national comparison. In the previous section on the caveats of using composite indices, there was a discussion on the dangers of ranking systems based on such composite indices.

We now continue by discussing separately some of the limitations encountered by both National Statistical Agencies and International Statistical Agencies in collecting data for cross-national comparisons.

Limitations Encountered by National Statistical Agencies: Resource Constraints

There is no doubt regarding the need for data of good quality at the country level, in order to accurately measure and monitor progress towards integration into the Information/Knowledge Society, and to inform policy-makers of the progress or lack of it. However, collection of such data at the country level, particularly in the context of many developing countries may be hampered by lack of resources in all areas- financial, human capacity and basic infrastructure. An obvious first step in attaining such resources is to convince political administrations of countries of the importance of having high-quality data collection systems on a sustainable basis. It is essential that any donor-driven initiatives adhere to the principle of sustainability, and that, however well-intended, situations of long-term dependency on the funding do not result in initiatives collapsing after a few years.

Limitations Encountered by National Statistical Agencies: Difficulty in Obtaining Certain ICT Data

Much of the data relating to ICT infrastructure is relatively easily obtained mainly from national telecom regulators. However, ICT data on aspects such as access, usage and impact must be gleaned through other sources, such as, household surveys, school surveys, business/enterprise surveys and censuses, in order to be able to query respondents directly on these aspects. The problem is that such surveys and censuses are far more expensive, difficult to execute, complicated and time consuming than the process of collecting administrative data from telecom operators. Yet, obtaining ICT data on these complementary topics of access, usage and impact are likely among the most important in order to inform the creation of a progressive Information/Knowledge Society.

Limitations Encountered by National Statistical Agencies: Problems with Internal Sources of Data

National-level data from countries can be obtained from a number of sources. One of the main sources is from national statistical agencies (in a

centralized model) or from the various line ministries responsible for the various portfolios within countries. "Official statistics are essential for obtaining a transparent picture of societies and how they are developing across the world. They also serve as a basis for the efficient and appropriate implementation of political decisions and for the effects of these decisions to be monitored" (Lievesley, 2001b). However, even official statistical systems within countries can be fragmented with little coordination between line ministries/internal agencies. Duplication of effort and the resulting issue of contradictory data can arise. For example, the number of children out of schools as reported by different line ministries such as education, labour and health may be different within a country. In addition and particularly with respect to large countries, there may be such discrepancies between the data reported by the central and the state governments. It is clearly essential that internal coordination within countries be given more attention.

Box 4: On UN Fundamental Principles of Official Statistics

"In recognition of the importance of establishing national statistical institutes which are capable of providing data of integrity, in 1992, Fundamental principles of Official statistics were adopted by the Conference of European statisticians (UN, 1992). These Principles were devised in part to assist in the creation of national statistical institutes in the new environment of post-communist Eastern and central Europe underpinning the moves to more democratic systems. The Fundamental Principles have served to foster a common understanding about the importance of statistical integrity, raised consciousness, and in doing so strengthened the international bonds. In addition to the countries in transition, others have also been prompted to look afresh at their own frameworks of statistics to see how they stand up to scrutiny against the principles." (Lievesley, 2001b). The international agencies, together with national and international statistical societies, play an important role in promoting adherence to the Fundamental principles and in providing a supportive forum where national statisticians can share their concerns and solutions.

Furthermore, it is acknowleged that "official statistics no longer have a monopoly over statistical information production, particularly in the field of ICT. Other players are entering the arena. Commercial ICT statistics is one such other player. In this case, the focus is on information for which the clients are willing to pay. The indicators produced by private research companies focus on future developments and expectations instead of quantitative figures of the past or present situation. For instance, a number

of consulting groups have published estimates on e-commerce transactions. But then these vary widely and are useless as official statistics" (Jeskanen-Sundström, 2001). Furthermore, from an international comparability perspective, data from the private sector is very limited in use since it is too piecemeal: available for some countries only, available for different time points depending on the country or a few time points in general, and, as mentioned above, having a focus driven by corporate or client needs.

Limitations Encountered by International Statistical Agencies: Potential for Lack of Co-ordination amongst Organizations

International statistical agencies are concerned with activities such as:

- tracking of international development aid and charity;
- monitoring the effectiveness of aid and evaluating the success of different aid paradigms;
- collection and dissemination of cross-nationally comparable data, guardianship of such databases and support of and consultation with the users;
- analysis and interpretation of cross-national data;
- special methodological and technical projects including the development of statistical concepts;
- development and maintenance of international classifications and standardised procedures to promote comparability of data;
- technical capacity building and other support for users and producers of data within countries;
- establishing and sharing good practices in statistics, supporting activities which improve the quality of data and avoiding the need for countries to start from first principles;
- advocacy for evidence based policies (Lievesley, 2001b).

A fundamental question to be considered is: to what extent should international statistical agencies coordinate their work? One of the main dangers in not doing so is the potential for duplication of effort. As mentioned earlier, UIS is the statistical arm of UNESCO and is the lead UN agency responsible for communication, among other things whereas ITU is

the lead UN agency having a statistical arm responsible for the collection of cross-nationally comparable data in the area of telecommunications. The potential for overlap is obvious. In defining its new programme of statistical work in the area of communication, the UIS must take care not to duplicate the work of ITU, instead perhaps focusing its effort where it can "add value" in other aspects such as usage and benefits of ICT. Therefore, it is essential that the two agencies initiate dialogue and continuously exchange information in order to optimise the benefits of the work that each carries out.

The Inter-Agency Committee for the Coordination of Statistical Activities (CCSA) was formed in 2002 to continue the work done by the former Administrative Committee on Coordination (ACC) Subcommittee on Statistical Activities. CCSA tries to promote better coordination, integration and complementarity among the statistical programmes of the international organizations, including the avoidance of duplication and reduction in reporting burdens on Member States (UN, 2003). It also promotes consistency in statistical practices and development, and provides coordinated treatment of statistical issues to achieve integrated systems in the collection, processing and dissemination of international statistics. Apart from working on standard definitions and classifications, it also fosters good practices in the structuring and programming of statistical activities in international organizations.

Limitations Encountered by International Statistical Agencies: Balancing the Data Needs of the Developing World With Those of the Developed World

The situations within countries from the developing world are often very different from those in the developed world. For instance, the statistical staff in some developing countries may have inadequate expertise, lack of training, may move from post to post too frequently to allow for stable systems to be built, or may be too isolated from the rest of the statistical world to have opportunities to meet with others, compare notes, discuss methodological issues, and best practices for quality improvement. Furthermore, some developing countries have far too few resources for data collection and the least developed countries not have any resources at all, given that even basic infrastructure within these countries may be lacking

(electricity, clean potable water, sufficient availability and access to food, adequate health care, and basic education). In this context, it is no surprise that the level of ICT infrastructure and use are limited in some of these countries. It seems reasonable that the internal data needs for such countries will be very different from those countries that have well developed systems in place. Furthermore, from the perspective of international statistical agencies attempting cross-national comparisons, it seems worth asking the question whether cross-national comparisons on a global level have any value and whether agencies such as the UIS should even be considering the collection of a "universal" core of ICT on any level (albeit through secondary means). What might be of more value is the creation of tailor-made regional core collections, to enable the comparisons between countries within regions having similar economic, political and social structures.

Limitations Encountered by International Statistical Agencies: Data Quality Issues

Missing Data for Entire Countries

As secondary data collectors, international statistical agencies will often attempt to collect data on the same topic over time. As mentioned earlier, they send questionnaires eliciting data to every country of the world, and consolidated returns are requested of each of these countries. Too often, however, no response at all is received from a country, either at one time point or for many or all time points. The reason for this varies - it might be that the data is not currently being collected within the country because it is not considered relevant, or the data is considered relevant but resources do not exist to collect them; it could also be that the country has the data available but does not have the resources to respond, or simply that the questionnaire has been lost. Nevertheless, this missingness creates problems for international statistical agencies that may attempt to form estimates at the regional level as summary statistics. Regional estimates that have missing component parts can be misleading or even wrong. This is particularly problematic when the countries that are missing are key countries with large populations (China or India) or countries that exhibit tendencies different from other countries within the same regions. (For example, in a regional estimate of broadband access in Asia, South Korea will not behave like an average country within the region.) Furthermore, the

situation is exacerbated when an attempt is made to form such estimates over time, particularly if the countries that are missing at some time points are different from those missing at other time points. Care must be made in compensating for such missingness, since traditional statistical methods for treating nonresponse, such as imputation, are not straightforward in this context.

Missing Benchmark Data

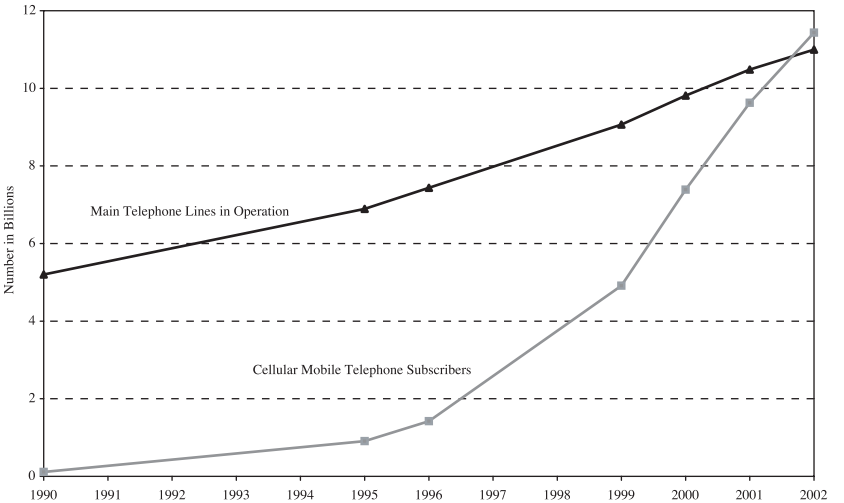
On a somewhat related note, there are often calls for data collections to support the monitoring of international goals, such as those that may result from the WSIS in Geneva in 2003 and Tunis in 2005. Such goals are often stated in terms of a diminution of a world problem (e.g. lack of access to ICT) or an increase in a basic need (e.g. availability of basic ICT infrastructure) by a certain time point in the future relative to the present. For example, one such goal could be to diminish by half the number of primary school-aged children that do not have access to computers by 2010 within each country. In monitoring the progress towards such a goal, it would be necessary to know how many primary school-aged children have such access at present. Otherwise, a diminution by half cannot be measured. The problem is that such needed benchmark data may not be readily available or exist at all. This problem only highlights the importance and urgency of bringing the collection of basic ICT data squarely into the policy agenda of each national official statistics system of the world.

Need for Differential Periodicity of Data Collection

In the analysis of cross-national data, there is often an interest in monitoring the trend of some phenomenon over time, and thus it is essential to institute data collections at various points in time. However, change may occur at very different rates depending on the phenomenon being measured. For instance, the number of television receivers per 1.000 inhabitants exhibits a rather flat trend in recent years (1990 onward) for most continents (see Graph 1), whereas the number of cellular mobile telephone subscribers has dramatically increased (on a global level) over the same time period (see Graph 11). International statistical agencies such as the UIS and ITU that embark on secondary collections should ideally institute vehicles at varying periodicities to account for this. As illustrated above, it would appear not to

be necessary to collect data on television receivers as frequently as for cellular mobile telephone subscribers. However, such needs for differential periodicity complicate the data collection design issues.

Graph 11: Evolution of Main Telephone Lines in Operation and Cellular Mobile Telephone Subscribers for the World, 1990-2002



Source: ITU World Telecommunication Indicators Database (2003).

Feasibility of Measuring Some ICT Data

When an international statistical agency decides upon statistical indicators for measuring international trends or monitoring progress towards international goals, the choice of indicators to be used is crucial. Such monitoring indicators should:

- measure the real policy objective (or an adequate proxy);
- normally have global policy relevance;
- be straightforward to interpret: changes over time in any direction, and unambiguous and significant differences between countries should be meaningful in terms of policy goals.

Such indicators should also possess certain technical properties, such as the following:

- be adequate for the purpose, recognising that change over time is often more important than the level (measurement at a particular fixed point in time) of the indicator;
- have sufficient coverage to ensure that the indicator values are unlikely to mislead policy users if they fail to cover the target population fully;
- be simplified alternatives in cases where internationally agreed upon indicators are difficult to measure for countries with less well-developed statistical capacity, until the statistical capacity can support the more demanding measure;
- be robust to institutional and cultural differences between countries and over time;
- exhibit change over time at a rate that would support policy monitoring;
- be produced with sufficient frequency and timeliness for policy monitoring;
- conform to international standards if these exist.

Having said that, there are phenomena or trends that are desirable to monitor, for which underlying indicators may not be feasible to measure. There are many reasons for this, ranging from a lack of resources or infrastructure to measure the indicators, to a lack of feasibility from a conceptual point of view.

In the first case, and from much of the discussion earlier in this report, it is clear that there is a lack of systematic data on ICT access and usage. For instance, it would be of use to investigate which groups are marginalized and why, in order to inform policy makers about such disparities. Yet there exist, at best, some case studies, but no regular monitoring systems based on universally accepted standard classifications.

There are examples of phenomena that would be useful to monitor, the measurement for which are difficult or even intractable. One such example might be an attempt to measure the differential representation of the world's

languages on the Internet by country. It is an extremely complex problem to marry the notion of the number of languages being used within a country with the notion of an online population and their predominant language use, in order to be able to obtain such a measure.

III. What Data Might be Useful to Collect in the Future?

This section will focus its discussion on data gaps and give recommendations on the cross-national data that might be of interest to collect and the corresponding indicators that could be developed in the future, from the perspective of international and national statistical agencies. Because of UNESCO's particular interest in the areas of education, culture (and communication), and science & technology, ICT applications in these domains will be given special attention.

First, it is of interest to have a short discussion on some of the principles that might be followed when making a determination regarding what data should be collected. Fundamental questions need to be asked before making such determinations, such as: under what circumstances should data be collected and by whom, how often, and by what means?

In terms of the first issue, it is important that the agendas of national statistical offices (NSOs) or other statistical agencies in countries are not disrupted by the introduction of internationally-driven data collections or ad-hoc external requests despite their possible relevance to the countries in question. Unfortunately, international and national needs sometimes do not coincide exactly. Furthermore, various differences between national and international needs can exacerbate the above situation. These include: framework or classification system differences, non-equivalent concepts, ethnocentric biases, international standards of practice being incompatible with the national legal or ethical norms, and response burden issues (length of survey instrument, sensitivity of some topics, etc). Thus it is clear that if NSOs are struggling to meet their own internal requests, they may not be able to meet international demands. However, there is a risk that the NSOs may comply with external requests, but may choose to halt ongoing internal programmes in order to accept the funding that is tied to the international demands. Nevertheless, there are often positive outcomes to such exercises

as well, such as the potential for capacity building within countries, a benefit that cannot be undervalued. Thus, such international programmes can be crucial to the development of national statistical competencies. However, international agencies need to exercise caution when making such requests, recognizing that some of the factors mentioned above can have long term consequences on countries.

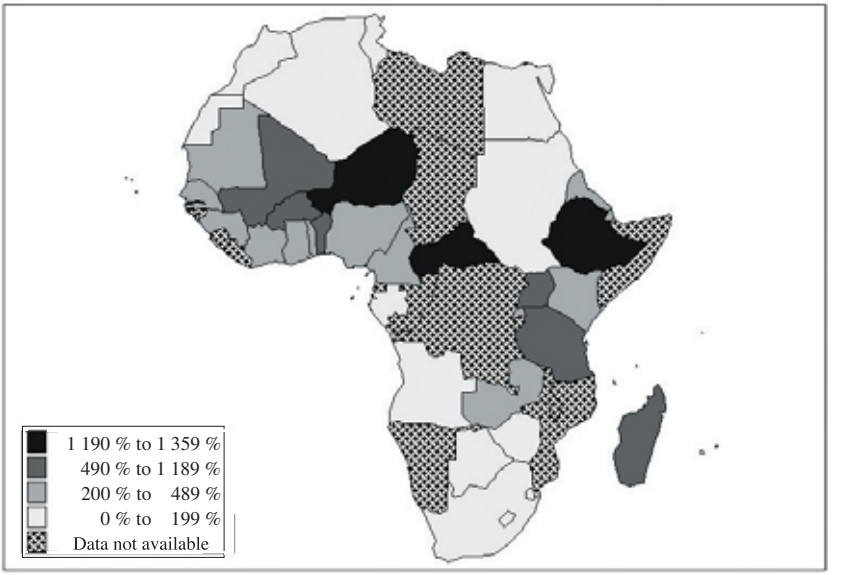
How often should such data be collected? As mentioned in an earlier section, this depends upon the type of data and the reasons behind its collection. For instance, data on applications of ICT in education (for example, distance learning) may need to be collected more often in view of the fast pace at which the developments in this area may change.

In terms of this last question, the choice of appropriate within-country data collection vehicle is very important, particularly in the case of developing countries. The resources required to collect data via household or school surveys are much greater than those needed for data which are a by-product of administrative sources. From the standpoint of international statistical agencies collecting secondary data, it is not appropriate to encourage developing countries to use expensive and sophisticated data collection mechanisms internally (i.e. survey vehicles), unless truly warranted. Often administrative sources within countries can provide cheap and reliable data sets, particularly when the countries in question are maintaining administrative records as a matter of course. Alternatively, there are instances where questions related to international programmes can be inexpensively incorporated into existing national surveys. In the case where more complex survey vehicles are truly warranted (for instance where there is a need to elicit data directly from individuals on ICT usage), care should be exercised in promoting models where donors provide funding for the construction of these survey vehicles. These efforts are often unsustainable owing to the fact that such funding can abruptly end for political or economic reasons. Using the same funding for statistical (and general) capacity building in the countries exhibiting the greatest need (along with assisting countries to more use of such data internally, and perhaps providing some relatively small seed funding for the infrastructure) is a more sustainable, long-term investment in the building of national data systems. This approach is based on the premise that education is always the key to development.

To elaborate on the notion of ”data gaps” mentioned in the first paragraph of this section, these refer to: i) existing data that only weakly describe an important phenomenon to be measured in contrast with other data that might do a better job, or ii) data that are not being collected at all but might be valuable.

As an illustration of essential or useful data that are not being collected, Map 4 on annual dial-up Internet tariff illustrates that ICT data do not exist for a large number of countries particularly developing ones. Sometimes ICT data are hard to obtain from developing countries since either the national statistical offices or the telecom operators do not collect them. And for some countries the situation is even worse: the GDP per capita figures are not even available. The feasibility of collecting such data in the future depends upon three factors, namely, the motivation or perceived need for the data on the part of the national statistical agencies; the availability of capacity in such agencies to collect such data; and the availability of the financial resources for such efforts. The most alarming aspect of Map 4 is that, for many developing countries where the data are available, the “annual dial-up Internet tariff as a percentage of GDP per capita” gives percentage figures in the thousands! In the worst category, this means that for some countries (such as Niger, Ethiopia and Central African Republic), it takes between 11.9 and 13.6 times (1190% -1360%) the annual GDP to pay for one year of Internet tariffs. This is in contrast with some developing countries where the figure is more of the order 2%! It is important to note that Purchasing Power Parities (PPPs) were not available for many of these countries, and so could not be integrated into the calculation. Nevertheless, had the analysis included both tariffs and GDPs expressed in terms of PPPs the same results would have been attained due to cancellation of the PPP adjustment in the numerator and the denominator.

Map 4: Annual Dial-up Internet Tariff (Peak Rates) as a Percentage of GDP per Capita (in current US dollars) for Africa, 2001



Sources: ITU World Telecommunication Indicators Database (2003); UNPD World Population Prospects: The 2000 Revision (2001); World Bank Online Database (2003).

International organizations such as ITU and OECD currently collect ICT data relating to aspects of infrastructure and economy. However, it is widely recognized that there is a paucity of data relating to social aspects and impacts on development, including issues of equity in access and use, and the relationship between investment in ICT and impact on development. As mentioned earlier, the UIS is undergoing a fundamental review of its own statistical programme of work in the area of communication and proposes to launch a new Communication Statistics Programme in the near future focusing on these areas where the most added value could be achieved.

With regards to the OECD, this organization focuses its current programme of work on measuring the Information Economy including access to and use of ICT by businesses and within households, for all OECD countries. However, there is a recognition that a dearth of

information in this area exists in many other parts of the world. As part of its Outreach Programme, the OECD (Schaaper, 2003) has started investigating the extent to which OECD methodologies can be extended to some non-OECD countries, such as China, Russia, Singapore and Israel. The first phase of this programme, which is still ongoing, involves an investigation into which ICT indicators are available from official sources in these countries. Future work will involve the adaptation of OECD definitions and model questionnaires in both the household and business context by some of these countries to their own contexts, working with one or more lead (preferably OECD) countries to keep abreast of the latest development of the Working Party on Indicators for the Information Society (WPIIS). It may be noted that more than 50 countries of the world use, to some extent, the methodologies developed by WPIIS. There are also networks in other parts of the world that serve a function similar to that of WPIIS, such as: the Asia-Pacific Economic Cooperation (APEC), eEurope+ and the Conference of the Ibero-American Authorities on Informatics (CAIBI).

The next three sections are focused on suggested future data collections in the area of ICT as they relate to UNESCO's domains of competence.

1. ICT and Education

One of the uses of indicators is to provide a global or regional picture towards monitoring international goals. In September 2000, the General Assembly of the United Nations formally recognized the MDGs as part of the road map for implementing the Millennium Declaration. This Declaration mainstreamed a set of 8 inter-connected development goals and 18 related targets into a global agenda (World Bank, 2003b). These goals cover the areas of: poverty and hunger reduction, education, gender equality, child mortality reduction, maternal health, HIV/AIDS, the environment and partnerships for development. In an attempt to monitor these goals, 48 quantitative indicators have been defined, the production and maintenance of which are the responsibility of a number of international organizations depending on their area of expertise. As such, UNESCO, and in particular the UIS, is responsible for 5 of these indicators relating to education and gender equality. Although there is no specific mention of ICT in the targets

relating to education, there have been several innovative programmes involving the use of ICT for accelerating the progress towards the achievement of the above goals. Future development of indicators to monitor the benefits of such initiatives would be of use and would serve as a catalyst for other such endeavours.

Under "partnerships for development", however, there is specific mention of ICT in MDG number 8, target 18, which is stated as follows: "In cooperation with the private sector, make available the benefits of new technologies, especially information and communications". ITU is the UN agency responsible for providing three indicators to monitor this goal at a country level, namely, the number of telephone lines and cellular subscribers, as well as the number of personal computers in use and Internet users – all expressed either per 100 or 10.000 inhabitants. Thus it is important that national statistical offices and telecom operators support the monitoring of this target through the provision of comprehensive national data with appropriate periodicity.

A related set of international goals that are confined to the area of education, are those associated with the EFA initiative. The World Education Forum that met in Dakar, Senegal in April 2000, reaffirmed the vision of the World Conference on EFA in Jomtien, Thailand in 1990, that all children, young people and adults have the 'fundamental human right' to a basic education that will develop their talents, improve their lives and transform their societies. Within the Dakar Framework for Action, six goals were identified in the area of education, including issues of access to primary education, the eradication of gender and other inequalities, the assurance of education of good quality, the provision of appropriate learning and life skills programmes, and the achievement of adult literacy. The EFA Observatory, responsible for the production and maintenance of the indicators for monitoring these goals, is located within the UIS. Although there is no specific mention of ICT in any of these EFA goals, the use of ICT could be related to progress towards the achievement of all of them through the teaching of ICT skills and the extensive use of e-learning and distance education. Related indicator development would be a useful part of this endeavour.

Applications of Radio, Television and the Internet to Distance Learning

One potential area of development in education sector would be the development of data and information on the use of ICT for distance learning, which includes the case of e-learning where Internet technology is involved. Other media such as radio and television are also used in the pursuit of distance learning, and several applications are not only for use at the tertiary level of education but also at both the primary and secondary levels as well. Below are a few examples of the uses of various ICT mentioned above (radio, television and the Internet) in the application of distance learning. As can be seen from the examples, the uses are not limited to the development of student education, but also include teacher training as well.

Use of Radio in Distance Education

More data need to be collected systematically on the use of radio and audiocassettes for distance education programmes. These are being widely used and have been found to be generally effective. Traditional radio broadcasting and Interactive Radio Instruction (IRI) have been used to provide teacher training at a distance. An early example was Nepal's Radio Education Teacher Training Project (RETTP), which used radio, broadcasts and other instructional media to target 5.000 untrained primary school teachers yearly. IRI projects in Bolivia and El Salvador currently provide mathematics instruction, and at the same time help teachers improve their knowledge of mathematics and provide them with skills in improved methods of teaching mathematics to students. In Nepal and South Africa, radio is being used as a hands-on training tool for caregivers and kindergarten teachers. All India radio has used instructional radio for training teachers in English language and to train day care providers in collaboration with the National Council for Educational Research and Training (NCERT). In the Dominican Republic, radio is helping in the teaching of a 72 credit-hour in-service associate degree programme consisting of subject matter and pedagogy.

Use of Television in Distance Education

The use of television for distance education has gained momentum in the developing countries. China has been a major user of television for over

30 years for this application. Thailand has been using in-service programme for the professional upgrading of teachers. Two programmes of Brazil use television broadcasting for teacher education. India's NCERT operates an ambitious programme of providing short-term training to about 1.8 million primary school teachers. See Box 5 for the example of Mexico, where *Telesecundaria* is prevalent.

Box 5: Case Study on Telesecundaria (Calderoni, 1998)

This case study involves the use of television to bring education to rural Mexico. It is a comprehensive instructional model that enables schools to deliver a complete junior secondary curriculum at costs comparable to those provided in more populated urban areas.

During the 1960s, the Mexican government was confronted by a shortage of trained teachers willing to work in remote rural areas and an inadequate supply of schools to accommodate secondary students, particularly in 200.000 rural communities with populations less than 2.500 inhabitants. The Mexican government decided to use television as the solution to the problem. In 1968, Mexico's Ministry of Public Education began broadcasting educational programmes to 6.500 students living in rural *pueblos* in seven states centered around Mexico city. Thirty years later, almost 800.000 students in grades 7 to 9 are enrolled in this highly successful national programme. The programme is now available in 12.700 rural communities. *Telesecundaria* constitutes 16% of the overall junior secondary enrollment, with traditional general schools accounting for 50 % of the enrollment and technical schools the remaining 34 %. It offers the same curriculum as in the traditional schools, with the difference that it complements live teacher instruction with teaching by distance.

Instructions are delivered through three mechanisms: television broadcasts, teachers and texts. After watching a televised segment, which introduces the subject concept and the theme, students study the relevant material in a specially designed textbook, followed by teacher-lead discussions to help students consolidate and integrate the content and to address any unanswered questions or concerns. This is followed by the students engaging themselves in activities designed to apply the lesson to a practical situation or experiment, and closes with an assessment of student understanding by the teacher, by individual students and as a group.

Communities can initiate a *Telesecundaria* programme by providing at least 15 primary school computers and a place to study (sometimes donated private or community land and buildings). The remaining resources are provided by the National and State-level Education Ministries. These include a teacher, a television, a digital signal decoder, a satellite dish, wiring, the instructional programme and textbooks and teacher training. The typical *Telesecundaria* school has three classrooms and three teachers - one for each grade of 7 to 9 and an average of 19 students per grade, with students attending school for 30 hours per week, 200 days in a year, the same way as in the regular schools.

It has been estimated that almost 75 % of the students who enter *Telesecundaria* at grade 7 successfully complete grade 9. However, the 1994 figures shows that only 21 % of *Telesecundaria* students continue on to high school, compared to 85 % of grade 9 students in the urban areas. This may be due to the limited number of secondary schools located in the rural areas. A 1973 study conducted by the Institute for Communications Research at Stanford University and the Mexican Ministry of Public Education found no difference in the quality of education between the *Telesecundaria* schools and the regular schools. *Telesecundaria*'s success, buttressed by parental urging, has spurred the government to initiate two new television-based educational programmes, including a three-year high school programme for grades 10 to 12 and a 9-month junior high school programme for adults.

Use of Internet in Distance Education

One of the more innovative approaches to the use of new technologies in the area of distance education is through the Internet. The most ambitious of these is the attempt to link students from various parts of the (often developing) world with instructors located elsewhere. This can take the form of both asynchronous and synchronous (real time) modes. While the former is cheaper and does not require the dedicated lines and broad band width necessary in synchronous mode, the latter has the advantage of simulating real time teaching situations with all the benefits of a fully interactive classroom setting. Synchronous or not, this form of education is controversial due to its many inherent problems such as: the high cost of infrastructure, the perceived degradation in the quality of teaching and testing, issues of student motivation, the development of culturally sensitive and appropriate course material, the commercialisation of distance education as a "product", the commoditization of the research into proprietary "courseware", and the replacement of the real space (the "campus") with virtual space. The most active countries participating in this new innovation are Turkey, Indonesia, Korea, Thailand, China and India. Comparative studies and indicator development surrounding some of the above issues, particularly the issues of cost, quality and motivation, could be future pursuits worthy of consideration.

One of the key issues in planning data collection in this area is the choice of data provider. Should those who develop and maintain e-learning systems be approached to provide data on the students and their courses? Or should

students and teachers who are recipients of the learning be the ones approached for information? The latter group might be able to provide a richer source of data, but owing to the dispersed nature of the group (by definition), this could be more expensive.

Other Data Collections For ICT & Education

The Programme for International Student Assessment discussed earlier in the section ”Overview of Existing Data” collects data on ICT via a school-based questionnaire administered to 15 year old students in 28 OECD countries and 15 additional non-OECD countries. It would be useful to extend the PISA data to students coming from the other parts of the world, particularly the developing countries. However, there are limitations to doing this.

First of all there is the question of methodological appropriateness. The target of PISA is 15 year old students and in many developing countries most students in this age group have left school and, therefore, the value of administering such a study may be quite limited. Extension of this project to other ages particularly the lower ones, where the children are in primary school, would obviously require an entirely different methodology. In addition (as mentioned before) sample school surveys require resources to develop and implement. Participating countries contribute to OECD towards the costs of instrument development, sample selection, and data processing, but resources are also needed to carry out data collection. Therefore, the benefits of obtaining the data desired must be weighed against the amount of resources (financial and technical) and efforts required to implement such surveys in the participating countries. Finally, there is a question regarding the sustainability of surveys as vehicles for data collection in less developed and developing countries. In addition to financial and human resources, the development and implementation of sample surveys also require a great deal of technical expertise, which may be in short supply in many countries.

There are other projects relating to ICT use in Education in other parts of the world, as well. For instance, the “Performance Indicators for ICT in Education in Asia and the Pacific Project” (UNESCO, 2003), spearheaded

by the UNESCO Asia and Pacific Regional Bureau for Education in Bangkok and funded by the Japanese Funds-in-Trust, has the general objective of developing a structure of indicators that would measure ICT use in education for countries of Asia and the Pacific. The project includes phases involving indicator development, pilot testing and implementation. An initial consultative workshop took place in Manila in August 2002, during which the 8 participating countries (Australia, India, Malaysia, The Philippines, South Korea, Thailand, Uzbekistan, and Vietnam) offered papers on specific country experiences, and discussions took place on how best to identify performance indicators that could be applied in the region. A host of specific indicator topics were identified; these were related to: enabling environment, Internet connectivity in schools, available speed & bandwidth, systems and hardware, ICT curriculum, teachers & ICT training, and learning & outcomes. The piloting and implementation phases are due to follow in 2004.

2. ICT and Culture

In the realm of culture, ICT can be a powerful (and in some cases relatively inexpensive) means of creating a number of important opportunities. It can afford various ethnic groups a means of preserving and promoting both the tangible and intangible aspects of their cultures, thereby fostering cultural diversity. It can offer women, minority groups and other underprivileged and marginalized populations a medium through which they are given a voice, thereby ensuring freedom of expression. It can permit artists and other producers of cultural products (particularly from the developing world) a venue for entry into the market economy. It can permit society as a whole to have access to a number of cultural products that can be purchased electronically, such as tickets to cultural events. (As an aside, the Internet as a facilitator of such purchases abroad complicates the Systems of National Accounts of countries that try to take into account the flows of such products. It opens the debate regarding usual unit of analysis being “the nation” constrained by its physical borders.) And finally, it can enhance the development process by using the technologies as vehicles for the dissemination of basic information on a variety of socio-cultural topics, such as health, education, nutrition, the environment, agriculture and also promote tourism. Radio, television and the Internet all have a role to play here.

However, data and indicators to measure the impacts of using these technologies are practically nonexistent, thus suggesting broad avenues of possible exploration. Even basic data on the two broadcast technologies of radio and television is slowly disappearing, the focus being replaced with the newer Internet technology.

Community Radio

Much attention is given to the newest ICT technology, the Internet, often to the exclusion of the other two broadcast technologies, radio and television. It is often forgotten that these latter two technologies can play a highly important role, particularly in the developing world, where basic infrastructure (and even electricity) are scarce. Frederick Noronha in his article "Community Radio" in the 'Economic and Political Weekly' (Noronha, 2003), states, "According to the Bangladesh Coastal NGOs Network for Radio and Communication Trust (BCNNRC), this medium gets step-motherly treatment because (i) it is seen as old and outfashioned and hence is simply ignored and (ii) ruling elites in South Asia seem afraid of the humble radio's potential to build awareness among the citizens of this region".

Within every community, there is a wealth of indigenous knowledge and capacity for innovation. In the context of developing countries, it would be useful to understand the power or use of ICT in order to develop collaborative relationships between those who have such knowledge of local issues and those with the expertise and experience to help them (Wortley, n.d.). Community radio offers a cost effective means of broadcasting information and is easily accessible to community-based citizen networks. Its main advantage is that it is technologically quite affordable and the emerging trend in many developing countries is that the traditional monopolistic legislation barriers to community radio are gradually being removed, paving the way for the free establishment of such radio networks. A combination of community radio, mobile telephony and community-based ICT centres may offer a practical and affordable key to collaborative community development in the disadvantaged areas of the world.

Community radio systems have also been used to advantage for communicating social and health messages relating to the prevention of

HIV/AIDS, the combating of alcoholism, and the promotion of family planning. Community radios can play a vital role in informing the local community on various development subjects. One good example where community radio has integrated Internet into its community development initiative is the Kothmale Community Radio Project in Sri Lanka.

Kothmale Radio Browsing Project

The Kothmale Community Radio Internet Project in Sri Lanka, a project initiated by UNESCO, effectively uses community radio as an interface between the community and the Internet through a pioneering "Radio-browse" model, which permits mass access to cyberspace indirectly through a daily one hour interactive radio programme. Broadcasters of the community radio browse the Internet on air together with their listeners, and discuss and contextualize information in local language. Listeners request broadcasters to surf the web on their behalf, and the programme responds by transmitting information. In addition to these activities, the Radio station provides Internet access at two nearby public libraries (Jayaweera, 2001).

In a sample of 93 individuals using the Kothmale Internet facilities over a two weeks period, 48 % had heard about the project's Internet access because of the radio. Furthermore, 82 % of users stated that Kothmale computers are their only point of access. Interest in using the computer facilities was conveyed through the distance with which users were willing to travel to access the Kothmale facilities. Over a two-week period, 56 % of users travelled over 1 hour to reach the facilities while 33 % travelled over 30 minutes (Pringle & David, 2002).

Other Areas of ICT & Culture and Their Data Needs

As mentioned earlier, ICT can offer the means of preserving and promoting both the tangible and intangible aspects of various cultures. It can also permit artists and other producers of cultural products (particularly from the developing world) a venue for entry into the market economy. To this end, it would be of interest to initiate data collections on some of the following:

- online availability of mass media (number of online newspapers, number of online radio and television stations, as well as access statistics);

- online availability of e-publications, Internet presence of libraries and archives;
- artists' personal websites, virtual galleries;
- websites devoted to indigenous groups;
- digitization/preservation of cultural artefacts (rare books, historic documents, works of art, etc).

Box: 6 IFLA[17] /UNESCO – Survey on Digitization and Preservation

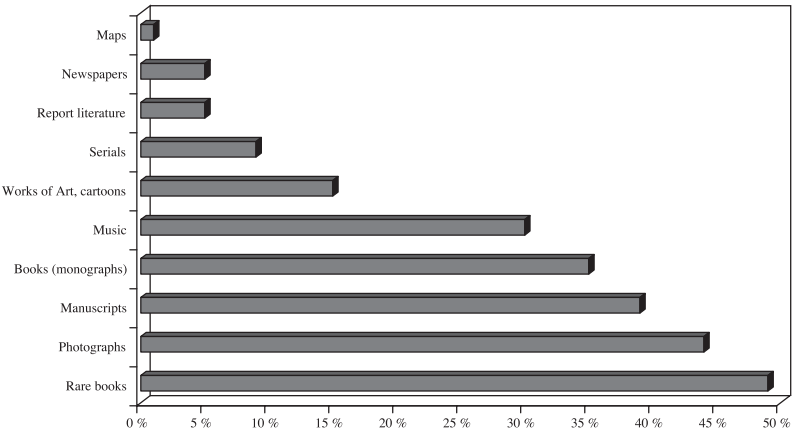
In order to establish the level of activity in the area of digitization, a survey was carried out within the framework of UNESCO's Memory of the World Programme. In 1998, questionnaires were sent to over 150 national libraries and other institutions (IFLA/UNESCO, 1999). The questionnaire contained sections on the following areas of interest:

- existing or planned digitization programmes and policies;
- selection of material for digitization;
- co-operation with other national institutions;
- staffing and costs;
- digitization techniques;
- format of digitized material;
- the documents themselves;
- access to the digitized collections, charges, reproduction and copyright;
- products produced from the digitized documents;
- policies for the preservation of the digitized documents;
- future developments.

Graph 12 gives a flavour of the information collected. Results at a more general level could not be attained since only 39 out of 150 responses were received.

17. International Federation of Library Associations and Institutions (IFLA), Core Programmes for Preservation and Conservation (PAC) and Universal Availability of Publications (UAP).

Graph 12: Percentage of Libraries/Archives that are Engaged in Digitization by Type of Document (Based on 39 Responses), 1998



3. ICT and Science & Technology

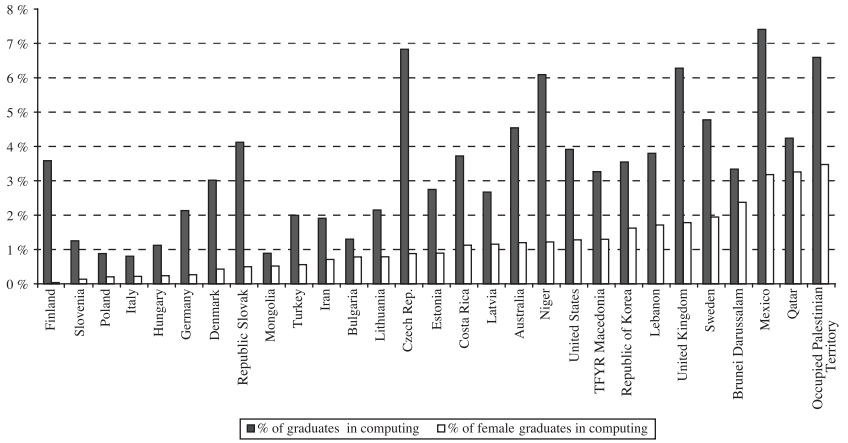
There is little data on the application of ICT to the area of Science & Technology. Some potential areas of future data collection are listed below. Some of these were suggested as a result of the UIS International Consultation on S&T Policy Priorities and Information Needs. See Box 3 for a further elaboration.

- ICT as drivers of innovation and technical change:
  - direct impact of ICT: specific analysis of ICT sectors (Communication, Informatics, Contents):
    - R&D personnel;
    - R&D expenditure;
    - patenting;
    - productivity;
    - turnover;
    - significance and impact on labour market, etc.
  - indirect impacts, through incorporation of ICT in commercial firms. Greater focus on ICT in innovation surveys:
    - incorporation of ICT to (new) production, administration and commercialization processes;

    - on-job training in ICT;
    - use of ICT in Innovation Activities (R&D, work on licences and patents, technology transfer, industrial design, product and process engineering, plant maintenance and updating).

- ICT skills in the S&T workforce:
  - data on Human Resources devoted to S&T differentiating those formally trained in ICT from those actually working in ICT (or ICT industries);
  - higher Education Statistics (students, graduates) in ICT related Fields of Study;
  - ICT as facilitators to the "brain-drain" (networking or finding employment abroad through the Internet);
  - ICT as amelioration of the effects of the brain drain by permitting a reverse transmission of information.
- ICT in the fields of Science & Technology:
  - data on personnel and expenditure on ICT-related R&D;
  - scientific publications and patents in these technology fields.
- ICT as tools for scientific research:
  - availability and use of computing and Internet infrastructure in (public and private) R&D labs and universities;
  - availability of supercomputing infrastructure;
  - availability of international and local (free access) electronic journals;
  - use of ICT for scientific networking;
  - availability of web-portals, scientific discussion fora, etc;
  - availability of specific ICT training for researchers;
  - research in ICT-related areas themselves.

Graph 13: Percentage of Graduates in Computing[18] by Gender at Tertiary Level for a Selection of Countries[19] , 2000



Source: UNESCO Institute for Statistics (2003).

Graph 13 shows that the proportions of female students opting for graduate courses in computing are much lower than males in every one of the countries displayed. Such proportions appear to be higher in countries such as Qatar and Brunei Darussalam, than in Czech Republic, Slovak Republic and Finland. There is certainly a need for further data collection on the causes of the low participation on the part of female students in this type of training.

4. Other Areas Related to ICT that Warrant Measurement

In the context of the United Nations (UN) framework, there are a number of broad tenets on which the UN organizations base their work. Among others, these are: the empowerment of all individuals particularly the most disadvantaged; the economic and social development of countries

18. Science is classified as a broad group under the International Standard Classification of Education (ISCED). It consists of the life sciences, physical sciences, mathematics, statistics and computing. As a field of education, computing comprises the computer sciences: system design, computer programming, data processing, networks, operating systems – software development only (hardware development should be classified with the engineering fields).
19. Abbreviated country includes The former Yugoslav Republic of Macedonia.

to ensure a reasonable minimum standard of living and quality of life for all; equity for women, minority groups, youth and the old and the empoverished; and basic human rights for all. Within these tenets lie cross-cutting themes that warrant data collection and development, as they pertain to ICT.

One crucial facet of the first tenet of empowerment is the upholding of democratic processes. This can be achieved in a number of ways; the use of ICT in so-called e-governance is one such way. Broadly defined, e-governance can include virtually all ICT platforms and applications in use by the public sector. For the purpose of this report however, e-governance is defined as: utilizing the Internet and the world-wide-web for delivering government information and services to citizens. E-governance can play a significant role given its potential use for stronger institutional capacity building, for better service delivery to citizens and business (thus increasing social and economic development), and for increasing transparency of government policies, procedures and social control. E-governance can also facilitate better participation of the civil society and business community in matters that concern the wider community (UNPAN, 2001).

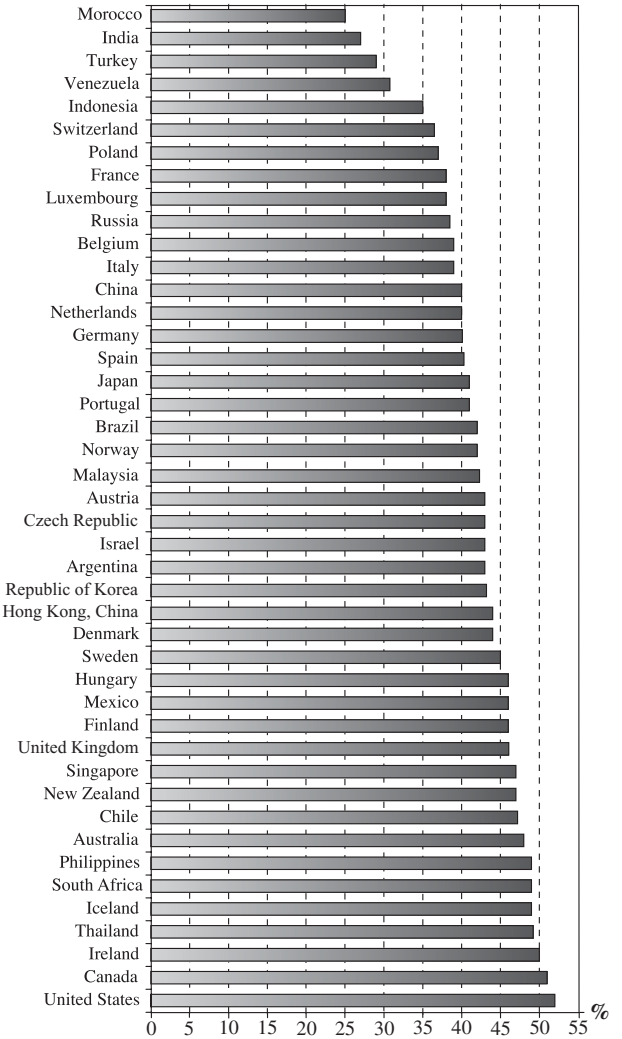
It is well-known that ICT have been used effectively to help mobilize some grass-roots movements in the political arena; the organization via the Internet of antiglobalization and alter-globalization protests in Seattle in 1999 and in Puerto Alegre in Brazil in 2002 is one such example. However, another important issue with respect to ICT and e-governance is that of access to data. The dissemination of data and information on the management and impacts of public education, health and other social programmes is an important part of any democratic process.

Related to the tenet of economic and social development, another potential challenge for statisticians is the attempt to measure ICT skills. ICT offer the promise of new business and employment opportunities along with higher productivity gains, but also make new demands on skills (Lopez-Bassols, 2002). Basic ICT skills are becoming a new category of "general" competency, like numeracy or literacy skills. However, it is difficult to define ICT skills – both in the context of the labour market as well as in the general population (the two notions are considerably different). In the labour market, the skill requirements of ICT jobs change rapidly. Therefore, one of

the requirements for the definition of skill is measurability in relation to technological change (Hwang, n.d.). The concept of ICT literacy should include both critical cognitive skills as well as the application of technical skills and knowledge. ICT literacy has been defined as "using digital technology, communications tools, and/or networks to access, manage, integrate, evaluate and create information in order to function in a knowledge society" (ETS, 2002). The collection of data on ICT skills is an area still in its infancy in most parts of the globe. Currently proxies are used to capture the observable characteristics using "educational attainment" on the supply side and "ICT occupations" on the demand side. While these proxies are a good starting point, more work is needed and this is an area that could be targeted for further development work (for more of a discussion on "ICT occupations", see the previous section on "Classification Systems").

Related to another of the UN tenets is a cross-cutting area of potential exploration for data collection: ICT and gender. Many researchers have noted that our knowledge of gender issues in ICT is hampered by the lack of reliable statistics (Hafkin, 2001). Even those agencies of official statistics in the developing world that have well-developed ICT data collection vehicles and systems often neglect to collect ICT data on gender. Worse yet, in some multipurpose surveys where data on gender is collected for other purposes, the resultant tables and analyses produced on ICT may not be disaggregated by gender. (And in some parts of the developing world, there are no basic ICT data collected at all.) Graph 14 on female Internet users as a percentage of total users is an example of the type of gender disaggregated data that would be useful to have for all countries of the world, but unfortunately they are only available for those in the graph.

Graph 14: Female Internet Users Expressed as a Percentage of the Total Users for a Selection of Countries[20] , 2000



Source: ITU World Telecommunication Indicators Database (2003).

20. Abbreviated country includes Hong Kong Special Administrative Region of China.

Nancy Hafkin and Nancy Taggart argue that it is essential that gender issues be considered early in the process of the introduction of information technology in the developing countries rather than as a corrective measure afterwards (Hafkin & Taggart, 2001). Furthermore, gender concerns should be included in the agendas of national ICT policies. A number of developing countries are indeed in the process of articulating such policies, but many dismiss the concern for gender and ICT in developing countries on the basis that development should deal with basic needs first. However, the choice should not be restricted to one or the other. ICT can be an important tool in helping meet women's' basic needs and can provide the access to resources to help women out of poverty (see Box 7 on the *Grameen* Bank efforts in Bangladesh).

The collection of data on ICT use by gender could be used to investigate a number of important research questions regarding issues of access. For instance: do women in some cultures have a problem of access to ICT due to gender bias? Gender disparity in access may be caused by several factors. Illiteracy, level of education, difficulties with language, lack of time, prohibitive costs, geographical location of facilities, and social and cultural norms can often contribute. In several developing countries, cultural norms relating to girls who have attained puberty may act as a barrier to access to Internet facilities, particularly when the facilities are located out of the home or in other communities. According to certain studies, even where there is no such gender bias, women have been found to be less interested in computers and the Internet than men. The causes might vary by ethnic group, culture, or geographic region. The underlying reasons for such attitudes need further examination to facilitate the understanding of differing cultural contexts.

Data are also needed on the causes of the lower participation of women in science and technology education at all levels. Furthermore, gender has increasingly become a significant issue in the various discussions related to the use of computers and instructional technologies in studies on higher education (Rajagopal & Bojin, 2003). The consensus is that gender-differentiated approaches and attitudes towards learning with the use of ICT need to be recognized in teaching and learning higher education courses that use ICT.

In order to obtain employment in core ICT sector areas, women in the developing countries need to be enabled to acquire the necessary training to move in to more technical, better paying, cognitively oriented jobs, the lack of which is a likely cause of the lower participation. Gillian Marcelle argues that, further, the growth and expansion of the global ICT sector are not necessarily aligned with the needs of women in developing countries who are likely to be disadvantaged by strategies that favour an elitist orientation to the ICT sector (Marcelle, 2000). A gender analysis is therefore advocated based on a social relations approach for an understanding of the effects produced by the rapid diffusion of the ICT. For many women in developing countries, the challenge is to overcome a double burden of marginalisation: the dominant ideology that governs practices and attitudes in the ICT area prefers profit over human well-being including that of women. Interventions are needed in the ICT industry, especially with regard to redistribution of power and the alteration of existing gender relations.

Box 7: ICT and Women's Empowerment
(Richardson, Ramirez & Haq, 2000)

This study was commissioned by the Strategic Planning and Policy division of the Asia Branch Poverty Reduction Project of the Canadian International Development Agency (CIDA). The objective was to investigate the impact of the *Grameen* Phone (*village* Phone) and *Grameen* Telecom provision of cellular phone service by the *Grameen* Bank in Bangladesh on poverty reduction and improving the socio-economic condition of women users. The idea was that, through the provision of cell phones to "housebound" women, an alternative would be offered to the status quo within these villages where one "village phone" operated by a "village phone operator" was limiting women from having access to this important means of communications. In an analysis of the results, it was seen that for a large majority of the cases surveyed, the cell phone was used primarily for personal and economic reasons by the women. Thus, ICT, when used in traditional societies along with other on-going development efforts, can play a significant role in improving the social (housebound women in this traditional society going physically outside their home to make call) and economic (calling local market or traders to sell products or receive order) conditions of women. However, more systematic data of such regional efforts need to be collected regularly to gain a fuller understanding of the potential impact.

Recommendations

The World Summit on the Information Society will be held in two parts: the first in Geneva in 2003 and the second in Tunis in 2005. This document is an interim report for the Geneva summit. Its aim is to foster debate on policy-relevant cross-nationally comparable data in the area of information and communication technologies (ICT). The recommendations below suggest areas where international statistical agencies and national statistical agencies should focus their attention.

1. In order to facilitate the creation of high quality cross-nationally comparable data on ICT, it is critical that ICT data be placed squarely on the agenda of every national official statistical system so that current gaps in the data can be identified and addressed.

2. All such data collection systems at both the national and international levels should adhere to high quality standards, comprising of: validity; reliability; relevance to policy; potential for disagreggation; currency; punctuality; coherence across different sources; clarity and transparency with respect to known limitations; accessibility and affordability; comparability through adherence to internationally agreed standards; consistency over time and space; and efficiency in the use of resources.

3. It is essential to recognize the resources needed (particularly within developing countries) to collect and analyse data at the national level on ICT that contribute to the global picture of the Information/Knowledge Society. Care should be exercised that the systems are sustainable even when donor agencies provide the funding. Statistical capacity building within countries is essential and mechanisms need to be devised to identify countries with particular training or infrastructure requirements, in order to ensure resources are adequate to meet them.

4. While recognizing the importance of international monitoring of progress, it is essential that the requests for data to provide the global picture of the Information/Knowledge Society made by the international agencies do not distort the national statistical agendas. Demands for cross-national data must take account of their value for comparative policy analysis.

5. It is critical that international statistical agencies take into consideration the weak statistical systems of many countries before making requests. Whenever possible, international databases should utilize existing sources of data within countries rather than requiring new data collections.

6. National and international statistical agencies should exercise their advocacy role for statistics. Raising the public and political profile of official statistics is vital in order to win support for the continued allocation or resources for data collection programmes and to ensure a sustained commitment to supplying the information.

7. International statistical agencies should collaborate closely in order to avoid the duplication of data collection or the over-burdening of national statistical resources, and to foster the sharing of cross-national data. These agencies must ensure they understand each other's mandates with respect to data and agree upon their respective roles wherever there are potential areas of overlap.

8. Since the collection of data relating to ICT is at an early stage, considerable resources should be devoted to develop and implement standard classification systems for cross-nationally harmonized data. Such systems will need to address concepts, definitions, methodologies, and the calculation of indicators. It will be essential to ensure that metadata systems are incorporated into such developments to capture information essential to informed use of the national data.

9. A particular problem in most countries in the collection of data relating to ICT is the lack of one central agency to take the responsibility for these data. Instead, the data are typically gathered by a range of public and private bodies. It can thus be very difficult to determine whether data relating to a country are partial or complete. Therefore, a roadmap of data providers for different elements of the ICT area is a pre-requisite for the verification of national pictures.

10. The analysis in this report has identified numerous aspects of the Information/Knowledge Society where few data are available globally. In the light of scarce resources, it will be necessary to determine the relative priorities of the gaps to be filled. Within UNESCO's areas of interest, the relationship of ICT (including older technologies alongside the new

electronic media) to education, science and technology, and culture will be key. It is essential to focus not only on infrastructure issues but also on the impact of ICT on social cohesion. It is important to be able to examine data below the national level in order to identify inequalities within societies, by gender and by other social factors.

11. Cross-national comparisons must be sensitive to the different circumstances of countries and in particular to the very disparate economic positions. Ranking of countries by composite indicators should be avoided, and instead, analyses should be conducted with a view to helping countries learn from one another in constructive rather than competitive ways.

Bibliography

Calderoni, J. (1998). Telesecundaria: Using TV to Bring Education to Rural Mexico. *World Bank Education and Technology Technical Notes Series, 3*. Washington, D.C.: World Bank.

Educational Testing Service. (2002). Digital Transformation: A Framework for ICT Literacy: Princeton.

Global Reach. (2003). Global Internet Statistics (by language). http://www.glreach.com/globstats/, http://global-reach.biz/globstats/refs.php3

Hafkin, N. & Taggart, N. (2001). Gender, Information Technology and Developing Countries: An Analytic Study. *Report to the United States Agency for International Development.*http://learnlink.aed.org/Publications/Gender_Book/pdf/Gender_Book_Photos.pdf

Hafkin, N. (2002). Gender Issues in ICT Policy in Developing Countries: An Overview. *United Nations Division for the Advancement of Women Expert Group Meeting on Information and Communication Technologies and Their Impact on and Use as an Instrument for the Advancement of Women*: Seoul.

Hoffman, E. & Chamie, M. (2002). Standard Statistical Classifications : Basic Principles. *Statistical Journal of the United Nations, 19*: 223-241.

Holt, T. (2003). Methodological Issues in the Development and Use of Statistical Indicators for International Comparisons. Southampton: University of Southampton.

Holt, T. (1998). The Fundamental Principles and the Impact of Using Statistics. *Cited in* D. Lievesley (2001a), *Making aDifference: A Role for the International Statistician?The Statistician, 50*: 367-406.

Hwang, G. (n.d.). Diffusion of Information and Communication Technologies and Changes in Skills. *Science and Technology Policy Research, Electronic Working Papers Series, (48).* Brighton: University of Sussex.
http://www.sussex.ac.uk/spru/publications/imprint/sewps/sewp48/sewp48.pdf

IEA/ISC. (2001). Progress in International Reading Literacy Studies (PIRLS). http://isc.bc.edu/pirls2001.html

IEA/ISC. (1999). Trends in Mathematics and Science Achievement Around the World (TIMSS). http://timss.bc.edu/timss1999.html

IEA/ISC. (1995). Third International Mathematics and Science Study (TIMSS). http://isc.bc.edu/timss1995.html

IFLA/UNESCO. (1999). Survey on Digitization and Preservation, 1999. West Yorkshire: IFLA Offices for UAP and International Lending.

ITU. (2002a). Bits and Bahts: Thailand Internet Case Study. Geneva: ITU. http://www.itu.int/ITUD/ict/cs/thailand/material/THA%20CS.pdf

ITU. (2002b). World Telecommunication Indicators 2002 *(TechnicalNotes)*. Geneva: ITU.

Jayaweera, W. (2001). Kothmale Community Radio/Internet Project: Expanding the Knowledge Base. http://www1.worldbank.org/publicsector/egov/kothmale_cs.htm

Jeskanen-Sundström, H. (2001) ICT Statistics at the new Millennium – Developing Official Statistics – Measuring the Diffusion of ICT and its Impact. *IAOS Satellite Meeting on Statistics for the Information Society 2001*: Tokyo.

Jowell, R. (1998). How Comparative is Comparative Research? *American Behavioural Scientist*, 42(2).

Lievesley, D. (2003). Improving the Quality of Data for Monitoring EFA and MDGs. *Paper presented at the International Working Group on Education*: Helsinki.

Lievesley, D. (2001a). Making a Difference: A Role for the International Statistician? *The Statistician, 50*: 367-406.

Lievesley, D. (2001b). The Challenge of Improving the Quality of Internationally Comparable Data. *Proceedings of Statistics Canada Symposium 2001*. Ottawa: Statistics Canada.

Lopez-Bassols, V. (2002). ICT Skills and Employment. *STI Working Paper Series*. Paris: OECD.

Lumio, M. (2003). Eurostat and Statistics on ICT (Eurostat). *Presented at the Third World Telecommunication/ICT Indicators Meeting.* Geneva: ITU.

Lundall, P. & Howell, C. (2000). Computers in Schools: A National survey of Information and Communication Technology in South African schools. Bellville: University of the Western Cape. http://education.pwv.gov.za/index.asp?src=docu&xsrc=repo

Marcelle, G.M. (2000). Transforming ICT for Gender Equality. *African Information Society Gender Working Group, ITU Task Force on Gender Issues*. Geneva: ITU.

Museumland. (2003). The World Wide Portal to Museums and Cultural Heritage. http://www.museumland.com/

Musée. (2003). http://www.musee-online.org/home.asp

Noman, H. (2002). An Overview of The Demographics and Usage Patterns of Internet Users in Developing Countries: Yemeni Internet Population as a Case Study: UNDP. http://www.undp.org.ye/ict.htm

Noronha, F. (2003). Community Radio – Singing New Tones in South Asia. *Economic and Politically Weekly*, xxxviii (22): 2168-2172.

OECD. (2002a). Measuring the Information Economy. Paris: OECD.

OECD. (2002b). Proposed Standard Practice for Surveys on Research and Experimental Development – Frascati Manual. Paris: OECD.

OECD. (2001). Science, Technology and Industry Scoreboard: Towards a Knowledge-Based Economy. Paris: OECD.

OECD. (1994). Using Patent Data as Science and Technology Indicators – Patent Manual. *The Measurement ofScientific and Technological Activities Series*. Paris: OECD.

OECD. (1990). Proposed Standard Method of Compiling and Interpreting Technology Balance of Payments Data: TBP Manual. *The Measurement of Scientific and Technological Activities Series.* Paris: OECD.

OECD/Eurostat. (1997). Proposed Guidelines for Collecting and Interpreting Technological Innovation Data – Oslo Manual. *The Measurement of Scientific and Technical Activities Series*. Paris: OECD.

OECD/Eurostat. (1995). The Measurement of Human Resources Devoted to Science and Technology – Canberra Manual. *The Measurement of Scientific and Technological Activities Series*. Paris: OECD.

OECD/UNESCO Institute for Statistics. (2003). Literacy Skills for the World of Tomorrow – Further Results from PISA 2000. Paris: OECD/UNESCO.

Pimienta, D. (1999). Measuring Languages on the Internet: A Methodology Based on Counting Word Occurrences With Search Engines. *Funredes Research and Projects*. http://www.funredes.org/LC/

Pringle, I. & David, M.J.R. (2002). Rural Community ICT Applications: The Kothmale Project. *The Electronic Journal on Information Systems in Developing Countries, 4:* 1-14.
http://www.is.cityu.edu.hk/research/ejisdc/vol8/v8r4.pdf

Proenza, F.J., Bastidas-Buch, R. & Montero, G. (2001). Telecenters for Socioeconomic and Rural Development in Latin America (FAO, ITU, IADB): Washington D.C.

Rajagopal, I. & Bojin, N. A. (2003). Gendered World: Students and Instructional Technologies. *FirstMonday*. *8(1)*. http://www.firstmonday.dk/issues/issue8_1/rajagopal/

Richardson, D., Ramirez, R. & Haq, M. (2000). Grameen Telecom's Village Phone Programme: A Multimedia Case Study. *Report to the Canadian International Development Agency*. http://www.telecommons.com/villagephone/index.html

SACMEQ. (2003). National Policy Research Reports. http://www.unesco.org/iiep/eng/publications/recent/rec11.htm

Schaaper, M. (2003). The Collection of ICT Statistics in non-OECD Countries Using OECD Methodology (OECD). *Presented at the Ibero-American Network for Science and Technology Indicators Second Workshop on Information Society Indicators*: Lisbon.

Sciadas, G. (2002). Monitoring the Digital Divide. *Orbicom-Cida Project.*

UN. (2003). The Inter-Agency Committee for the Coordination of Statistical Activities. http://unstats.un.org/unsd/accsub/index.asp

UN. (1992). Fundamental Principles of Official Statistics in the Region of the Economic Commission for Europe. *Report*. Geneva: United Nations.

UNCTAD. (2002). Indicators of Technology Development. *UN Commission on Science and Technology for Development.* Geneva: UNCTAD.

UNDP. (2001). The Technology Achievement Index. http://hdr.undp.org/reports/global/2001/en/pdf/techindex.pdf

UNESCO. (2003). Developing and Using ICT Indicators in Education. *Asia and Pacific Regional Bureau for Education & Southeast Asian Ministers of Education Organization Regional Center for Educational Innovation and Technology*. Bangkok: UNESCO.

UNESCO. (1978). UNESCO's Recommendation Concerning the International Standardization of Statistics on Science and Technology. Paris: UNESCO.

UNPAN. (2001). Benchmarking E-Government: A Global Perspective – Assessing the Progress of UN Member States: New York: UNPAN.

UNECE. (2000). Guidelines for Statistical Metadata on the Internet. *Conference of European Statisticians Statistical Standards and Studies (52).* Geneva: UNECE.

Wilson, M.I. and Li, H. (1999). Measuring Internet Access and Use: Conceptual and Methodological Issues. *International Conference on the Measurement of Electronic Commerce 1999*: Singapore.

World Bank. (2003b). Millennium Development Goals. www.developmentgoals.org/About_the_goals.htm

Wortley, D. (n.d.). Community Learning by Radio and Internet Potential Application of Community Radio and Virtual Classroom Technologies. Lubenham: Mass Mitec.

Statistical Sources

ITU. (2003). World Telecommunication Indicators Database. Geneva: ITU. http://www.itu.int/ITU-D/ict/statistics/

OECD. (2003a). ANBERD Database. Paris: OECD. http://www.oecd.org/statsportal/0,2639,en_2825_293564_1_1_1_1_1,00.html

OECD. (2003b). PISA Database. Paris: OECD. http://www.pisa.oecd.org/

UNESCO Institute for Statistics. (2003). Education / Culture & Communication Database. Montreal: UIS. http://132.204.2.104/unesco/eng/ReportFolders/Rfview/Explorerp.asp?CS_referer=

Mogee Research and Analysis Associates. (2001). International Analysis of Internet-Related Business Methods. *Cited in L.M. Rausch. International Patenting of Internet-Related Business Methods. National Science Foundation Division of Science Resource Statistics.* http://www.nsf.gov/sbe/srs/infbrief/nsf03314/nsf03314.pdf

UNPD (2001) World Population Prospects: The 2000 Revision. [CD-ROM]. United Nations Population Division, Department of Economic and Social Affairs.

World Bank (2003a) World Bank Online Database. http://devdata.worldbank.org/data-query/

Acronyms

- CCSA: Committee for the Coordination of Statistical Activities
- CIDA: Canadian International Development Agency
- DFID: Department for International Development
- EDI: Electronic Data Interchange
- EFA: Education for All
- EUROSTAT : Statistical Office of the European Community
- FAO: Food and Agriculture Organization
- GDP: Gross Domestic Product
- GNI: Gross National Income
- IADB: Inter-American Development Bank
- ICT: Information and Communication Technologies
- IDRC: International Development Research Center
- IEA: International Association for the Evaluation of Educational Achievement
- IFLA: International Federation of Library Associations
- ILO: International Labour Organization
- IRI: Interactive Radio Instruction
- ISC: International Study Center
- ISCED: International Standard Classification of Education
- ISCO: International Standard Classification of Occupations
- ISIC: International Standard Industrial Classification
- ISO: International Standards Organization
- ISP: Internet Service Provider
- ITU: International Telecommunication Union
- LAMP: Literacy Assessment and Monitoring Programme
- MDGs: Millennium Development Goals
- NCERT: National Council of Educational Research and Training

- NEC: Nippon Electric Company
- NECTEC: National Electronic and Computer Technology Centre
- NESTI: National Experts on Science and Technology Indicators
- NGO: Non-Governmental Organization
- NSO: National Statistical Office
- OECD: Organization for Economic Cooperation and Development
- PISA: Programme for International Student Assessment
- PPP: Purchasing Power Parity
- R&D: Reasearch and Development
- RETTP: Radio Education Teacher Training Project
- S&T: Science and Technology
- SACMEQ: Southern Africa Consortium for Monitoring Educational Quality
- SCB: Statistical Capacity Building
- SOC: Standard Occupational Classification
- UIS: UNESCO Institute for Statistics
- UNCSTD: United Nations Commission on Science and Technology for Development
- UNCTAD: United Nations Commission on Trade and Development
- UNDP: United Nations Development Program
- UNECE: United Nations Economic Commission for Europe
- UNESCO: United Nations Educational Scientific and Cultural Organization
- UNPAN: United Nations Online Network in Public Administration and Finance
- UNPD: United Nation Population Division
- WEI: World Education Indicators
- WPIIS: Working Party on Indicators for the Information Society
- WSIS: World Summit on the Information Society

Annex

Countries	*Internet hosts per 10,000 inhabitants	*Internet users per 10,000 inhabitants	***Annual dial-up Internet tariff as a % of GDP per capita (peak tariffs)	*Teledensity	*Ratio of cellular subscribers to main telephone lines CAGR (%)	**Television receivers per 1,000 inhabitants	**Radio receivers per 1,000 inhabitants	**Computing graduates as % of total graduates
	2001	2001	2001	2001	1998-2001	1997	1997	2000
Afghanistan	–	…	…	0,13	–	13	135	…
Albania	0,59	32	28,88	6,28	153,58	129	258	0,76
Algeria	0,22	65	26,80	6,10	44,54	108	247	…
American Samoa	119,04	…	…	21,03	…	221	930	…
Andorra	356,65	…	…	39,01	…	362	210	…
Angola	0,01	15	52,55 *a*	0,59	63,62	12	52	…
Antigua & Barbuda	120,82	1 076	8,48	57,28	97,47	480	561	…
Argentina	124,14	974	24,30	21,63	25,62	223	681	…
Armenia	6,23	185	236,95 *a*	14,03	35,90	218	224	…
Aruba	88,67	2 306	…	35,67	74,64	217	552	…
Australia	1 183,44	3 723	1,49 *b*	54,22	19,80	548	1 377	4,54
Austria	403,73	3 901	2,51 *b*	47,18	32,07	525	752	1,68
Azerbaijan	1,62	31	300,91	11,54	69,09	22	22	…
Bahamas	0,91	549	…	40,00	59,31	229	736	…
Bahrain	26,36	2 030	7,62	26,67	31,06	457	562	…
Bangladesh	–	13	205,42	0,40	50,03	6	48	…
Barbados	4,84	559	…	48,04	40,34	287	896	…
Belarus	3,24	416	33,27	28,21	77,38	245	293	…
Belgium	342,92	3 118	4,34 *b*	50,00	44,15	463	792	3,35
Belize	14,42	779	…	15,25	78,76	194	625	…
Benin	0,78	39	613,22	0,92	89,38	10	107	…
Bermuda	814,53	4 735	…	88,62	0,37	1 064	1 323	3,03
Bhutan	5,30	23	269,59	0,82	–	6	19	…
Bolivia	1,79	211	…	6,16	29,49	116	675	1,76
Bosnia & Herzegovina	7,99	111	35,82	11,07	63,96	–	267	…
Botswana	8,19	322	11,00 *a*	9,18	96,41	21	160	…
Brazil	95,30	464	…	21,69	20,14	223	433	…
Brunei Darussalam	260,11	1 046	…	26,42	25,13	250	302	3,34
Bulgaria	34,23	769	7,50	37,04	84,36	402	548	1,30
Burkina Faso	0,59	16	497,36	0,49	110,55	9	34	…
Burundi	–	9	…	0,31	157,80	4	71	…
Cambodia	0,46	7	613,89	0,25	27,45	8	111	…
Cameroon	0,26	30	243,42	0,67	175,25	32	163	…
Canada	931,89	4 514	1,33 *b*	65,38	17,81	718	1 079	…
Cape Verde	0,78	275	27,58	14,28	110,97	4	183	…
Cayman Islands	134,56	…	…	96,12	24,40	202	1 031	…
Central African Rep. [1]	0,02	8	1 198,83	0,24	63,94	5	81	…
Chad	–	5	…	0,14	–	1	233	…
Chile	79,68	2 014	…	23,25	46,86	215	354	…
China	0,70	262	24,27	14,04	30,96	322	336	…
Hong Kong, China [2]	556,95	3 737	1,51 *a*	55,99	14,87	284	687	…
Macao, China [3]	4,21	2 251	2,37	39,33	23,60	114	373	2,06
Colombia	13,41	270	12,00	17,22	11,88	115	525	…
Comoros	0,15	34	736,86	1,22	–	2	139	…
Congo	0,14	3	…	0,71	157,91	12	123	…
Costa Rica	20,79	934	9,87 *a*	22,98	22,46	140	261	3,72
Côte d'Ivoire	1,92	43	412,68	1,80	46,65	60	150	…
Croatia	47,23	1 113	23,81	38,26	70,30	262	325	…
Cuba	0,78	107	…	5,11	9,30	239	352	…

Countries	*Internet hosts per 10,000 inhabitants	*Internet users per 10,000 inhabitants	***Annual dial-up Internet tariff as a % of GDP per capita (peak tariffs)	*Teledensity	*Ratio of cellular subscribers to main telephone lines CAGR (%)	**Television receivers per 1,000 inhabitants	**Radio receivers per 1,000 inhabitants	**Computing graduates as % of total graduates
	2001	2001	2001	2001	1998-2001	1997	1997	2000
Cyprus	26,44	1 898	…	55,03	25,90	325	406	…
Czech Republic	210,06	1 462	10,03 *b*	37,63	62,50	530	802	6,83
DPR of Korea [4]	…	–	…	2,23	–	55	154	…
Dem. Rep. Congo [5]	0,02	1	…	0,04	96,80	137	381	…
Denmark	1 052,10	4 313	1,36 *b*	72,48	16,70	592	1 143	3,02
Djibouti	0,20	51	411,26	1,54	81,66	48	90	11,49
Dominica	31,63	1 277	30,43	32,98	78,88	78	647	…
Dominican Rep. [6]	49,09	219	24,47 *a*	11,23	48,81	97	181	…
Ecuador	2,63	259	…	10,37	27,28	130	348	…
Egypt	0,26	87	15,46	9,68	106,75	120	319	…
El Salvador	0,80	234	41,97	10,16	38,90	677	465	…
Equatorial Guinea	0,13	19	…	1,47	152,80	10	427	…
Eritrea	0,67	16	249,23	0,82	–	–	104	…
Estonia	370,73	3 121	…	36,78	26,94	419	699	2,75
Ethiopia	0,01	4	1 359,82	0,44	–	5	201	…
Fiji	8,12	182	63,06	11,21	70,44	27	636	…
Finland	1 712,75	4 317	1,52 *b*	54,94	10,02	622	1 498	3,58
France	132,69	2 633	1,68 *b*	57,24	33,86	594	944	…
French Guiana	7,05	188	…	29,94	103,37	202	701	…
French Polynesia	72,79	844	…	22,20	57,40	180	576	…
Gabon	0,55	135	43,55 *a*	2,95	129,35	55	183	…
Gambia	0,90	135	748,86	2,62	68,06	4	164	…
Georgia	3,97	89	56,05	16,56	38,12	484	568	0,04
Germany	295,85	3 756	1,29 *b*	63,75	37,73	567	949	2,13
Ghana	0,12	21	263,64 *a*	1,23	26,46	96	243	…
Gibraltar	477,28	2 326	…	92,26	35,10	375	1 373	…
Greece	134,83	1 318	3,75 *b*	52,79	39,98	241	476	…
Greenland	458,69	3 552	…	46,55	15,71	385	483	…
Grenada	1,28	555	12,35	34,93	39,78	353	615	…
Guadeloupe	10,68	464	…	48,67	109,59	283	271	…
Guam	9,36	3 034	…	50,57	24,24	711	1 490	…
Guatemala	5,67	171	…	6,47	62,42	61	79	…
Guinea	0,30	18	374,50	0,31	11,41	11	46	…
Guinea-Bissau	0,16	33	…	0,98	–	–	44	…
Guyana	0,26	1 245	8,34	10,47	149,64	61	560	…
Haiti	–	36	…	0,97	65,12	5	53	…
Honduras	0,49	137	65,99	4,71	53,04	96	412	…
Hungary	168,99	1 492	14,16 *b*	37,74	43,55	437	692	1,12
Iceland	1 942,83	6 113	2,05 *b*	67,72	22,18	360	955	…
India	0,81	68	67,67	3,76	31,77	66	121	…
Indonesia	2,13	186	48,56	3,36	47,41	68	155	…
Iran [7]	0,35	141	…	15,27	37,87	69	254	1,91
Iraq	–	…	…	2,86	–	83	229	…
Ireland	333,45	2 330	2,54 *b*	48,42	28,85	399	693	…
Israel	232,78	2 916	2,74	49,14	26,28	299	544	…
Italy	118,33	2 713	2,54 *b*	47,57	24,16	527	879	0,80
Jamaica	5,53	385	…	20,48	62,80	183	483	…
Japan	559,03	3 840	2,15 *b*	58,56	9,38	686	955	…
Jordan	4,33	463	37,08	13,23	68,36	110	365	…

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	2001	2001	2001	2001	1998-2001	1997	1997	2000
Kazakhstan	6,80		4,24	12,05	105,80	236	394	…
Kenya	0,86	160	361,10	1,04	164,95	25	107	…
Kiribati	2,74	238	561,02	4,32	104,48	15	213	…
Kuwait	17,44	1 015	2,86	23,97	33,50	512	687	…
Kyrgyzstan	9,14	302	113,61	7,79	108,73	45	111	0,04
Lao PDR [8]	0,31	19	228,10	0,97	25,45	11	148	…
Latvia	103,93	707	43,64	30,00	41,72	494	713	2,67
Lebanon	19,97	731	29,89	17,61	8,23	356	859	3,80
Lesotho	0,29	24	83,51 *a*	1,07	53,38	28	54	…
Liberia	0,03	3	…	0,22	–	30	342	…
Libya [9]	0,13	37	…	11,28	19,65	147	272	…
Liechtenstein	1 080,52	2 423	…	60,89	19,39	365	661	…
Lithuania	95,29	678	39,78	31,22	38,46	459	513	2,15
Luxembourg	315,80	3 618	1,75 *b*	78,42	27,58	387	677	…
Madagascar	0,14	21	538,10	0,36	74,74	22	209	…
Malawi	0,02	17	…	0,47	38,37	–	249	…
Malaysia	32,70	2 872	7,63	20,81	33,37	172	435	…
Maldives	–	333	197,98	9,08	71,56	28	128	…
Mali	0,07	26	613,56	0,43	53,15	4	55	…
Malta	222,92	2 527	…	53,03	76,92	730	665	1,30
Marshall Islands	0,58	174	102,92	8,08	6,11	…	…	…
Martinique	8,90	1 037	…	44,61	51,07	175	218	…
Mauritania	0,41	25	266,57	0,92	–	26	149	…
Mauritius	26,70	1 350	14,98	26,20	37,79	227	370	…
Mexico	91,49	362	6,00 *b*	13,72	47,09	272	329	7,41
Micronesia Fed. St [10]	51,89	397	33,74	8,01	–	…	…	…
Mongolia	0,59	156	182,17	4,86	105,83	48	146	0,89
Morocco	0,81	131	82,82	3,91	163,00	110	235	…
Mozambique	0,01	16	…	0,48	109,09	5	42	…
Myanmar	–	2	…	0,61	5,88	6	92	…
Namibia	25,91	252	…	6,57	46,65	36	140	…
Nepal	0,64	25	133,88 *a*	1,26	–	6	39	…
Netherlands	1 652,36	4 959	2,55 *b*	62,80	36,19	518	978	1,78
Netherlands Antilles	5,48	…	…	37,30	…	329	1 034	…
New Caledonia	214,42	1 133	…	23,08	49,98	257	527	…
New Zealand	1 072,18	4 627	2,37 *b*	47,87	30,20	523	1 018	2,07
Nicaragua	4,21	144	…	2,95	66,90	68	265	…
Niger	0,16	11	1 334,61	0,19	7,15	13	70	6,09
Nigeria	0,06	10	267,79	0,46	96,99	66	224	…
North. Mariana Isl. [11]	1,71	…	…	…	…	…	…	…
Norway	679,85	4 679	1,55 *b*	73,85	11,59	461	915	6,02
Occ. Palestinian Ter.[12]	…	181	…	…	…	…	…	…
Oman	17,84	458	…	8,97	30,99	695	608	0,27
Pakistan	0,78	34	116,86	2,33	33,74	24	104	…
Panama	26,99	414	…	12,99	57,52	187	299	…
Papua New Guinea	0,89	102	526,13	1,26	15,31	9	91	…
Paraguay	4,80	106	…	5,12	45,52	101	182	…
Peru	5,18	767	…	7,75	12,46	126	273	…
Philippines	4,00	259	48,83	4,30	50,07	52	161	…

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	2001	2001	2001	2001	1998-2001	1997	1997	2000
Poland	126,99	985	7,65 *b*	29,55	41,52	338	523	0,88
Portugal	245,72	2 890	4,50 *b*	43,63	24,98	333	303	…
Puerto Rico	4,01	1 518	…	33,64	18,65	269	711	…
Qatar	2,21	696	…	29,13	25,03	431	480	4,24
Rep. Korea [13]	147,49	5 180	1,81 *b*	48,28	16,33	348	1 039	3,55
Republic of Moldova	4,10	140	152,68	14,92	139,79	292	745	…
Réunion	–	2 049	…	40,99	61,32	185	252	…
Romania	20,67	447	60,78	18,39	51,22	233	319	…
Russian Federation	24,49	297	14,06	24,68	70,74	411	417	…
Rwanda	1,43	25	343,56 *a*	0,27	59,95	–	105	…
Saint Kitts & Nevis	0,79	942	6,14	58,91	40,50	264	701	…
Saint Lucia	1,14	870	…	33,46	3,50	220	773	…
St. Vincent & Gren. [14]	0,26	482	35,87	22,88	68,50	164	693	…
Samoa	336,67	189	31,20	6,08	17,12	66	1 125	…
San Marino	618,76	5 163	…	76,42	31,62	360	610	…
Sao Tome & Principe	66,13	642	…	3,88	–	172	288	…
Saudi Arabia	5,43	143	8,01	15,37	28,21	280	343	…
Senegal	0,76	104	201,26 *a*	2,45	59,43	41	142	…
Serbia & Montenegro	14,86	569	…	23,19	67,65	260	298	1,43
Seychelles	32,17	1 105	21,18	26,25	65,23	141	543	…
Sierra Leone	0,61	15	…	0,50	–	13	271	…
Singapore	481,90	4 138	1,12	47,41	25,68	360	690	…
Slovakia	134,29	1 247	24,28 *a*	28,80	45,56	487	579	4,12
Slovenia	148,88	3 022	7,81	40,39	69,24	356	403	1,25
Solomon Islands	8,43	43	302,94	1,60	10,19	6	141	…
Somalia	–	1	…	0,38	…	17	60	…
South Africa	54,45	660	33,40 *a*	11,25	35,11	125	332	…
Spain	134,93	1 851	3,47 *b*	43,91	43,84	407	329	4,99
Sri Lanka	1,20	79	50,14	4,34	24,72	83	209	…
Sudan	–	18	63,21	1,42	44,20	82	259	…
Suriname	1,41	347	…	18,46	88,41	153	728	…
Swaziland	12,18	149	37,28	3,41	80,46	24	178	…
Sweden	832,30	5 208	2,83 *b*	74,55	13,56	519	931	4,78
Switzerland	735,87	3 102	2,17 *b*	73,92	30,07	462	991	6,71
Syrian Arab Republic	0,01	36	…	10,30	–	70	277	…
Tajikistan	0,49	5	…	3,63	40,09	3	144	…
Thailand	11,32	556	38,98	9,50	33,58	252	231	…
TFYR Macedonia [15]	12,69	343	14,12 *a*	26,35	56,85	256	206	3,27
Togo	0,47	322	311,06 *a*	1,04	79,53	18	229	…
Tonga	2 071,19	282	179,22	10,87	9,33	21	617	…
Trinidad & Tobago	52,85	923	10,81	23,98	69,45	333	533	…
Tunisia	0,23	418	27,93	11,05	63,30	100	225	…
Turkey	15,76	591	6,88 *b*	27,95	49,60	329	178	1,99
Turkmenistan	3,35	17	…	8,02	25,60	185	277	…
Uganda	0,12	25	600,24	0,23	74,76	15	122	…
Ukraine	11,86	122	32,86	21,73	104,55	355	885	0,94
United Arab Emirates	288,47	3 678	…	39,68	35,43	126	333	…
United Kingdom [16]	374,69	3 325	1,77 *b*	59,27	30,43	517	1 433	6,28
UR Tanzania [17]	0,41	28	554,73 *a*	0,41	74,30	3	270	…

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	2001	2001	2001	2001	1998-2001	1997	1997	2000
USA [18]	3 714,02	4 995	0,75 *b*	66,45	15,11	797	2 094	3,91
U.S. Virgin Islands [19]	201,85	1 390	…	56,76	11,26	577	910	…
Uruguay	210,93	1 190	…	28,29	31,34	239	603	…
Uzbekistan	0,08	59	496,69	6,58	21,26	271	457	…
Vanuatu	17,73	272	145,83	3,35	5,02	13	341	…
Venezuela	9,18	468	…	10,93	32,78	180	472	…
Viet Nam	0,06	128	132,86	3,85	33,87	48	109	…
Yemen	0,04	9	139,17	2,21	53,49	29	65	…
Zambia	1,03	23	201,05	0,80	91,00	29	106	…
Zimbabwe	2,72	78	135,94	1,97	100,39	31	95	…

…	Data not available
–	Not applicable or magnitude nil
a	Unlimited Internet access
b	Data from OECD
CAGR	Compound Annual Growth Rate is computed by the formula: [(Pv / P0) (1 / n)] - 1 where Pv = Present value P0 = Beginning value n = Number of periods
1	Central African Republic
2	Hong Kong Special Administrative Region of China
3	Macao Special Administrative Region of China
4	Democratic People's Republic of Korea
5	Democratic Republic of the Congo
6	Dominican Republic
7	Iran (Islamic Republic of)
8	Lao People's Democratic Republic
9	Libyan Arab Jamahiriya
10	Micronesia (Federated States of)
11	Northern Mariana Islands
12	Occupied Palestinian Territory
13	Republic of Korea
14	Saint Vincent and the Grenadines
15	The former Yugoslav Republic of Macedonia
16	United Kingdom of Great Britain and Northern Ireland
17	United Republic of Tanzania
18	United States of America
19	United States Virgin Islands
Sources:	* ITU (ICT data) and UNPD (population data)
	** UIS (ICT data) and UNPD (population data)
	*** ITU (ICT data), UNPD (population data) and World Bank (GDP - current U.S. dollars)

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