

# **ICT Indicators**

## Mapping Resources and Issues



May 1, 2003

---

### **Introduction**

How can we judge whether Information and Communication Technology (ICT) benefits society? What do we need to measure to determine whether a patient is more or less empowered through the availability of personal health records? How can we identify progress towards the Millennium Development Goals? Has innovation increased or decreased as a result of recent ICT policy interventions?

Answering all of the above questions requires the use, in some form or another, of indicators. Broadly defined, indicators are representations of a trend or a measurable change in some social, economic, environmental or other system over time. Here, we provide a mapping of indicators relevant to ICT. We examine first what indicators are, then their purposes, and finally some of the pitfalls associated with their use.

### **What are indicators?**

We use indicators on a daily basis to monitor what we care about, need to control or make decisions about. Parents are alert to the activity level of their children, the brightness of their eyes, the way they breathe in their sleep. The performance of every school child is expressed as test scores and grades. Doctors take your temperature, look at your tongue, do blood tests and CAT scans. Economists and policy makers use leading indicators, lagging indicators, cost-of-living indicators, employment indicators, consumer confidence indexes, the Nasdaq or Dow-Jones index, and--the most famous and most criticized of all indicators-- GDP. Some indicators are legends, such as the canary in the coalmine, the sea bird that hints of the yet-invisible land, and the puff of smoke from the Vatican chimney.

Obviously, not all indicators are alike<sup>1</sup>. Differences exist based in part on the complexity and the nature of systems being measured, and we use different words for different phenomena (e.g., signs, symptoms, omens, signals, clues, grades, ranks, data, pointers, warnings, and so on). Yet, what is common to most indicators is their purpose. The overriding role of indicators is to make complex systems understandable or perceptible. Indicators aim to characterize the nature of a system through its components-

---

<sup>1</sup> For the breadth and depth of the types of indicators see: *Statistical Resources on the Web* available at <http://www.lib.umich.edu/govdocs/stats.html>

-how they relate and how they change over time. This information can then be used to judge progress toward some goal or standard, against some past benchmark, or by comparison with data from some other institution or country. As such, indicators usually imply a *causal theory or model* of how some underlying process operates to generate a *particular value or set of values*.

## **Indicators and values**

Indicators (particularly of the statistical kind) are sometimes presented as neutral or scientific tools of measurement. In fact, though, they are inextricably linked with values--i.e., we measure what we care about. What would we like to know about the "Networked Society's contribution to society (and our lives)? How do we know if ICT can contribute to economic and human development? All these questions and subsequent answers involve value judgments, of which some are location- (e.g., access) or culture-specific (e.g. content), while others are more universal (e.g. human development). Some are quantitatively measurable, while others, which may be equally important, can only be gauged qualitatively.

Perhaps most important to recognize, however, is the point that not only do we measure what we value, but also that we come to value what we measure. The Dow Jones index arose from the information needs of stockholders, but now the general public sees it as an indicator of national economic health. As such, the presence, absence, or prominence of indicators affects behavior. This feedback process is common, inevitable, and useful--yet also the main source of certain pitfalls.

## ***Pitfalls of Indicators***

If indicators are poorly chosen, they can lead to serious misinterpretations, which in turn can lead to harmful policies. If policy makers manage a national economy to maximize GDP, then the result is likely to be just that—a maximization of GDP, not necessarily justice or freedom or environmental quality. If we judge the state of the Networked Society by focusing solely on the Nasdaq (and the subsequent bust), we may come to different (policy) observations and conclusions than if we also considered Internet penetration (growth).

Indicators are both important and dangerous because they sit at the center of the decision-making process. Nearly every human decision is intended to bring some system (ICT literacy, SARS spread, national debt) to some desired state. Action is taken depending on the discrepancy between the desired state and the current state of the system, as indicators perceive it. The problem is that the current state may not be perceived (i.e., measured) accurately. The indicators used may measure not the actual system state, but some proxy or associated state. (It's impossible, for instance, to measure the exact use of the Internet, so we measure access to the network and assume the use). It may be "noisy," so its central tendency is hard to deduce. It may be deliberately or accidentally biased. If an indicator is poorly chosen, inaccurately measured, delayed, noisy, or biased, decisions based on it cannot be effective. Misleading indicators will

cause over- or under-reactions, changes that are too weak or too strong to bring the system exactly to the desired state.

Despite their pitfalls, difficulties and uncertainties, we can't manage without indicators. Indicators are leverage points. Without them we fly blind. The world is too complex to deal with all available information. We have to choose a set of indicators small and meaningful enough to comprehend. Rather than discourage us, the pitfalls and difficulties should give ideas about how to design better indicators, and motivation to do so. The search for indicators is a constant process of improvisation. A lot of planes crashed before people learned what instruments to put in the cockpit. Many patients died before doctors figured out how to take temperatures and blood tests. When a system is extremely complex, it often takes trial, error, and learning to produce a reliable set of indicators. This is especially the case in the field of new information and communications technologies, which are highly dynamic and complex in nature. We should therefore subject the models and resources described further below to an appropriate and relevant level of scrutiny.

### ***Lessons for the use of Indicators for policy and decision making***

As indicated above, the choice and use of indicators are processes subject to pitfalls. The most common include:

- *Over or under-aggregation.* If too many things are lumped together, their combined message may be indecipherable. GDP is the classic example, combining money flows caused by "positive" economic changes (more education, say, or better food) and "negative" changes (more hospitalizations from automobile accidents). The counter-point is also true, however: if just a single variable is used to describe a complex trend or system change, the conclusion may also be distorted. Again, the use of GDP to measure development (which involves far more than economic wealth) is the classic example<sup>2</sup>. This pitfall has obviously also major implications if indicators are used for benchmarking or performance review. Multiple indicators, properly calibrated, are necessary so that their relative importance is reflected in any assessment of performance;
- *Measuring what is measurable, rather than what is important.* E.g., measuring raw bandwidth instead of the diversity and quality of services and content distributed using the bandwidth. The amount of money people spent on e-commerce rather than the level of satisfaction of the transactions;
- *Dependence on a false model.* We may think the price of telecom transactions tells us a lot about the difference between direct costs between local versus long distance calls, when it primarily tells us about the user sensitivity to price change.
- *Deliberate falsification.* If an index carries bad news, policy or decision makers may be tempted to alter it, delay it, change terms or definitions, remove funding

---

<sup>2</sup> See for instance *If the GDP is Up, Why is America Down?*

This article that originally appeared in The Atlantic argues why we need new measures of progress, why we do not have them, and how they would change the social and political landscape.

<http://www.theatlantic.com/politics/ecbig/gdp.htm>

- for it, or otherwise suppress it. Some governments have been known to report agricultural yields based on projected five-year plans, rather than actual harvests.
- *Diverting attention from direct experience.* Indicators may mesmerize people with numbers and blind them to their own perceptions. Computer sales are going up, so the Networked Society must be in great shape, despite the fact that most of the world's populations has never used a keyboard.
  - *Overconfidence.* Indicators may bestow a false sense of confidence in policymakers regarding the success of their policies, when in fact faulty indicators may mask failure.

In sum, despite the critical importance and value of indicators for policy-making, one should always recognize their incompleteness. An indicator is not the real system, but a proxy for the system. It may miss many of the subtleties, beauties, wonders, warnings, diversities, possibilities, or perversities of the real system. For these reasons the literature on indicators appears to agree on **what indicators cannot do**:

- *Set public policy goals and priorities.* The public establishes public policy goals and priorities through its elected representatives and other democratic processes. The information generated by an indicator system can inform those objectives, but it is just one factor among many in shaping decisions about policy preferences and priorities.
- *Evaluate programs.* Indicators cannot substitute for well-designed, in-depth evaluations of public policy programs or projects. Indicators do not provide the level of rigor or detail necessary; yet they do provide however important benchmarks that can be used for corporate governance purposes.

On the other hand **indicators can** describe and state problems more clearly, signal new problems more quickly, obtain clues about promising programs, provide tools for enhanced corporate accountability and the like. The following statement illustrates the realistic tone taken by the so-called social indicator movement<sup>3</sup>:

*We will be able to describe the state of the society and its dynamics and thus improve immensely our ability to state problems in a productive fashion, obtain clues as to promising lines of endeavor, and ask good questions.*

*The fruit of these social indicator efforts will be more directly a contribution to policy-makers' cognition than to their decisions. Decisions emerge from a mosaic of inputs, including valuation and political, as well as technical components.*

Within a corporate governance context, this implies that indicators enable the Board and managerial staff to consider their operations in perspective and to bring problems and threats to light where variances are significant.

## **ICT Indicators**

In comparison with other areas of policy and decision-making such as the economy, environment and so on, the development of methodologically sound ICT indicators has largely been ignored. With ICT becoming mainstream in the developed world and with a growing global digital divide, there is a growing need for relevant, up-

---

<sup>3</sup> See Sheldon and Parke, 1975, Social indicators. *Science*, 188, 693-699.

to-date and comparable statistics to analyze the sector. This includes measurements for comparing universal service, network progress and performance as well as macro-economic measurements to gauge the impact of ICTs on social and economic development.

The National Research Council (NRC) study of *research needed on the economic and social effects of IT* already indicated in 1998 the need for the following types of indexes<sup>4</sup>:

- *Interconnectivity index*. This index would provide a measure of the facility of electronic communication and an evaluation of the development of this dimension of the information infrastructure.
- *Information quality of life index*. Similar to an index produced by OECD, this index would attempt to evaluate the qualitative levels of communication available to individuals.
- *Leading information indicators*. This index would attempt to measure the growth of the information infrastructure.
- *Home media index*. This index of the state of penetration of communications technologies in the home might qualify as a leading index of the potential for future consumption of information.
- *Marginalization index*. This index would measure the extent to which specific populations are excluded from participation in the information infrastructure.

At the global level, there is also an urgent need to gauge the impact and costs of liberalization, privatization, competition and globalization taking place in the ICT sector to inform policy makers and others about the effects of their decisions. Ironically, these trends are complicating the availability and comparability of the statistical data for ICT indicators. Other areas of concern and trends with regard to ICT indicators, some of them identified through the regularly held Telecommunication/ICT Indicators Meetings<sup>5</sup>, organized by the International Telecommunication Union (ITU):

- Convergence has blurred the boundaries of the telecommunications, broadcasting and computing industries, making it difficult to determine what exactly is to be measured;
- Need to strengthen telecom/ICT statistics collection in developing countries. In this regard, it was noted that loans and grants are available; that there are efforts to raise the visibility of indicators among high-level policy makers; and the assistance of international organization in providing guidelines (e.g., sample surveys, definitions, etc.) and in some assistance funding.
- Need for identification and definition of key telecom/ICT indicators to improve international comparability. It was noted that the relevance of indicators might vary depending on the state of a country's economic development. The effort of several international organizations in providing guidelines and definitions was noted. The meeting also updated the indicators in the ITU Telecommunication/ICT Indicator Handbook that can assist sector regulators in identifying the key indicators to collect.

---

<sup>4</sup> See <http://www.nsf.gov/sbe/srs/seind00/access/c9/indices>

<sup>5</sup> The background documents of the respective meetings are available at the following web site: <http://www.itu.int/ITU-D/ict/WICT02/index.html>

- The measurement of the information society and the digital divide, particularly through composite indexes, is difficult<sup>6</sup>. More attention needs to be paid to the construction of the indexes. It was noted that an expert group could provide input into the construction of such indexes by the ITU.

### ***Mapping of Selected Indicators Sources***

---

<sup>6</sup> See for instance also :*Comparison of E-Readiness Assessment Models*  
<http://www.bridges.org/ereadiness/report.html>

<i>Source</i>	<i>Description</i>	<i>Accessibility</i>	<i>Geographic Range</i>	<i>Sectoral Range</i>
The World Bank <a href="http://www.worldbank.org/data/">http://www.worldbank.org/data/</a>	A comprehensive and wide-ranging resource for a variety of development-related indicators, including ICT	<ul style="list-style-type: none"> <li>• Much of it free, some pay</li> <li>• Sophisticated interactive data retrieval tool</li> <li>• Data sets generally available for download</li> </ul>	Global, but particularly strong on developing countries	Covers a number of sectors in depth, not just ICTs
UN Statistics Division <a href="http://unstats.un.org/unsd/">http://unstats.un.org/unsd/</a>	Range of data available, with focus on MDC indicators and social development indicators	<ul style="list-style-type: none"> <li>• MDC and social indicators free, rest pay</li> <li>• Retrieval limited to tabular form</li> <li>• Some data sets available for download</li> </ul>	Global, with emphasis on developing nations	Limited ICTs, mostly social and economic development
OECD <a href="http://www.oecd.org/EN/statistics/0,,EN-statistics-0-nodirectorate-no-no-0,00.html">http://www.oecd.org/EN/statistics/0,,EN-statistics-0-nodirectorate-no-no-0,00.html</a>	Wide range of data. Greater emphasis on commerce/business and less on development than above two sources.	<ul style="list-style-type: none"> <li>• A lot free, some for pay</li> <li>• Retrieval in graph and tabular format</li> <li>• Data sets available for download</li> </ul>	Global, but emphasis on OECD countries	<ul style="list-style-type: none"> <li>• Extensive, including ICTs.</li> <li>• Focus on business and commerce (e.g., intellectual property and e-commerce)</li> </ul>
World Economic Forum <a href="http://shorl.com/gudrupyrastibra">http://shorl.com/gudrupyrastibra</a>	<ul style="list-style-type: none"> <li>• Data taken from annual Global Information Technology Report: Readiness for the Networked World.</li> <li>• Includes Readiness rankings, and some data on variables (e.g., competitiveness, human capacity, infrastructure, etc.) that make up the Readiness index.</li> </ul>	<ul style="list-style-type: none"> <li>• Full rankings available, but only limited availability of underlying data</li> <li>• Available in tabular form (PDF) and some graphs</li> </ul>	<ul style="list-style-type: none"> <li>• Global, with emphasis on developing countries</li> <li>• Some country case studies available</li> </ul>	Mostly ICT, but includes some “supporting” data (e.g., social capacity) for ICTs.

		sets		
CIA Factbook <a href="http://www.cia.gov/cia/publications/factbook/">http://www.cia.gov/cia/publications/factbook/</a>	<ul style="list-style-type: none"> <li>• Social, political, economic and cultural data on every country</li> <li>• Includes both quantitative and qualitative data (encyclopaedia format)</li> </ul>	<ul style="list-style-type: none"> <li>• Free</li> <li>• Some interactivity</li> <li>• No downloads of data sets, but publication can be downloaded</li> </ul>	Global	Limited ICTs, but wide range of other indicators.
ITU <a href="http://www.itu.int/ITU-D/ict/links/">http://www.itu.int/ITU-D/ict/links/</a>	Most extensive data on ICTs available on web. Includes telecommunications, Internet, mobile, and other ICT sectors.	<ul style="list-style-type: none"> <li>• Limited free availability, mostly pay (expensive)</li> <li>• Mostly available in tabular format</li> <li>• Some data sets available</li> </ul>	Global	Focused on ICT data. Very in-depth for ICTs, but limited in other areas.
CyberAtlas <a href="http://cyberatlas.internet.com/">http://cyberatlas.internet.com/</a>	Range of Internet-related marketing and commercial data.	<ul style="list-style-type: none"> <li>• Free</li> <li>• Some tables, some embedded in written reports</li> <li>• Interactive statistical application/retrieval tool</li> </ul>	Mostly on West, and particularly USA	Focused on Internet and marketing information
Pew Internet and American Life <a href="http://www.pewinternet.org/">http://www.pewinternet.org/</a>	<ul style="list-style-type: none"> <li>• Data and reports on Internet usage in USA. Distinctive emphasis on cultural/social attitudes to Internet.</li> </ul>	<ul style="list-style-type: none"> <li>• Free</li> <li>• Reports available immediately, underlying data sets available 6 months after report</li> </ul>	Focussed on USA	Limited to Internet, although some associated ICT sectors (e.g., broadband)
UCLA Center for Communications Policy	<ul style="list-style-type: none"> <li>• Data from regularly issued UCLA Internet Report</li> </ul>	<ul style="list-style-type: none"> <li>• Report available for download</li> </ul>	Focussed on USA	Limited to Internet

<a href="http://ccp.ucla.edu/pages/internet-report.asp">http://ccp.ucla.edu/pages/internet-report.asp</a>	<ul style="list-style-type: none"> <li>• Extensive data on Internet usage, demographics, commerce, politics, etc</li> </ul>	<ul style="list-style-type: none"> <li>• Data sets available to academic researchers and non-profit organizations upon request</li> <li>• No interactive facilities</li> </ul>		
<p>United Nations Conference on Trade and Development (UNCTAD) ICT Development Indices</p> <a href="http://www.unctad.org/en/docs//it_eipc20031_en.pdf">http://www.unctad.org/en/docs//it_eipc20031_en.pdf</a>	<ul style="list-style-type: none"> <li>• Constructs indices for ICT development based on a wide range of access, connectivity and policy variables</li> <li>• In addition to its own indices, contains an interesting discussion of other sources and of methodological considerations</li> </ul>	<ul style="list-style-type: none"> <li>• Report available free</li> <li>• Data in tabular format</li> <li>• No interactivity</li> </ul>	Global	Range of media, although focussed on Internet and generally excludes standard telecommunication s indicators
<p>Commercial Research Sites</p> <p>Forrester: <a href="http://www.forrester.com">www.forrester.com</a></p> <p>Gartner: <a href="http://www.gartner.com">www.gartner.com</a></p> <p>Jupiter: <a href="http://www.jup.com">www.jup.com</a></p> <p>Pyramid: <a href="http://www.pyramidresearch.com">www.pyramidresearch.com</a></p>	<ul style="list-style-type: none"> <li>• Extensive market research data on Internet and other ICTs.</li> <li>• Industry focussed research.</li> </ul>	<ul style="list-style-type: none"> <li>• Very limited free information</li> <li>• Expensive—targeted at corporate users.</li> <li>• Data appears to be mostly embedded in reports</li> </ul>	Mostly focussed on USA, but other nations may be available, too.	<ul style="list-style-type: none"> <li>• Focussed on ICTs, with emphasis on commercial aspects.</li> <li>• Limited social data.</li> </ul>

? 1. For further links to a wide range of data sources, see <http://www.developmentgateway.org/node/244175/> and <http://www.princeton.edu/~ina/internet/sources.html>

? 2. In addition you may want to consult the book *Finding Statistics Online: How to Locate the Elusive Numbers You Need* by Paula Berinstein, Susanne Björner, Susanne Björner (Editor) – see <http://shorl.com/bobrifryrosona>