

Sustainable Development and ICT Indicators

DRAFT FOR DISCUSSION

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Sustainable Development & ICT Indicators

A holistic picture needs to be considered for measuring the access, usage and impact of ICTs on sustainable development (SD). The purpose of this paper is to provide a brief overview of the current state of ICT indicators and their relationship to SD indicators and to suggest ways in which they can be made more reflective.

About indicators in general

Indicators aggregate, quantify and simplify information. They help us to measure the status quo or progress towards some objective and to evaluate vast amounts of information by looking at few simple figures. Indicators can be used to benchmark one country against another or one income or demographic group against others. Indicators can provide guidance, goals and objectives. When developing, measuring and analysing indicators several things need to be borne in mind:

Measure the right thing

There are no bad or good indicators, there are merely useful and less useful ones, with the use being determined by the link between the indicator and the phenomena to be described. Indicators chosen for a global benchmarking might be more or less useful for national policy making in individual countries. A useful indicator for water supply for rural Namibia, for example, could be households with access to drinking water in walking distance (ie 5 -10km). An equivalent water supply indicator for the UK could be less than two hosepipe bans a year.

Keep it simple

Albert Einstein coined the phrase: Everything should be made as simple as possible, but not simpler. This is in particular true for indicators. Aggregating information too far might result in us not seeing the link between the indicator and the phenomena it is supposed to inform about. When Deep Thought¹ gave 42 as an answer to the ultimate question of life, the universe, and everything, after several million years of computation, it might have been the right answer to the wrong question or the answer was simply too aggregated for anyone to make sense of it. The further condensed an indicator is, the more information has been lost on the way.

Make it practical

- Data availability: How easy is it to collect the information needed to compile an indicator? Do institutions already collect the data or would primary data collection be required?
- Data frequency: How frequently is the data available—monthly, annually, occasionally?
- Data reliability: How reliable is the data collected? How representative is the data? Is it hard data or perceptions?
- Link between an indicator and the phenomena to be observed: Does a change in the indicator reflect a change in the observed phenomena? Could a change in the observed phenomena take place without the indicator changing value?

¹ See Douglas Adam's Hitchhiker's Guide to the Galaxy

About ICT indicators

An important distinction to keep in mind when considering ICT indicators is the one between access, usage and impact. Access indicators measure what people or businesses have in terms of ICTs or how many exist in a country. Usage indicators measure how and for what ICTs are being used by households, individuals, businesses or governments etc. Impact indicators capture the impact of access and usage on economic growth, employment creation, improvement in public service delivery on a macro level; and company performance, household poverty levels and social inclusion on a micro level, to give just a few examples. Impact indicators are usually derived from analysis of primary or secondary data. This is the level at which ICT indicators link to sustainable development. This does not mean, however, that access or usage indicators are not useful to measure sustainable development. All that needs to be demonstrated is the link between access and usage indicators and the impact. This link is likely to be a different one across countries.

Another distinction can be made between demand and supply side indicators. Demand-side indicators are based on information collected from users of ICTs and supply-side indicators on information from service providers. Mobile subscribers per 100 inhabitants can, for example, be computed using data from household surveys (demand side) or by adding subscribers of all operators of a county and dividing the sum by the total population of that country (supply side).

One can similarly talk about macro and micro indicators. Macro indicators could be ratios of macro economic variables like total factor productivity, GDP and Investment. ICT investment divided by total investment in a country could be such a macro indicator. An equivalent micro indicator would be the average ratio of ICT investments to total investment at firm level. One could even talk here of a meso indicator for the same ratio at industry level.

A further distinction could be by users of ICTs: household indicators, individual indicators, business indicators, school indicators, health indicators, government indicators, trade indicators, ICT sector indicators, gender indicators etc. Adding to this complexity would be any combination of these distinctions, resulting in many permutations. The figure below demonstrates the indicator space for just three distinctions:

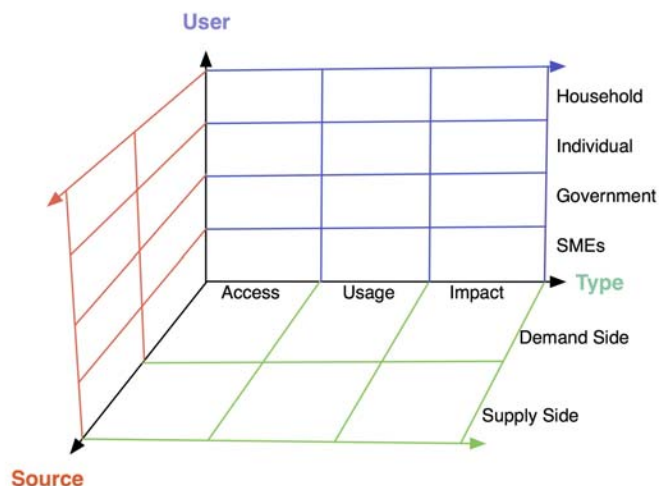


Table 1: Example of Household indicators

	Indicator	Demand side	Supply Side
Access Indicator	Mobile Penetration	Mobile subscribers per 100 inhabitants—as determined by household surveys?	Mobile subscribers per 100 inhabitants: Sum of all subscribers of all operators divided by population
Usage Indicator	Mobile Phone Usage	Average money spend on mobile phone usage proportional to disposable income	Total call minutes billed by operators
Impact Indicator	ICT investment and economic growth	Magnitude and significance of coefficient for ICT investment and ICT expenditure on profit, sales and labour productivity using firm-level data	Strength and lead and lag of link between ICT investment and GDP using Granger causality ²

ICT indicators in practice

While these distinctions may seem simple and obvious, combining them into useful indexes or models that reflect the overall state of ICT development and its contribution to sustainable development is a challenging task. A good example for this is the way the International Telecommunications Union (ITU) is measuring the information society. Its ICT Opportunity Index (ITU, 2007) is based on ten indicators and uses the conceptual framework of George Sciadas's (2005) Infostate Model. It distinguishes between Infodensity and Info-Use. In the initial model Infodensity is the sum of all ICT stocks (capital and labour); Info-use the consumption flows of ICTs for a certain period and the Info-state, the aggregation of Infodensity and Info-Use. The ITU splits the Infodensity indicators into network and skills indicators and the Info-Use indicators into Uptake and Intensity indicators (see table below).

Table 2: ITU - ICT Opportunity Index

Info density	Networks	Main telephone lines per 100 inhabitants
		Mobile subscribers per 100 inhabitants
		International Internet bandwidth
	Skills	Adult Literacy rates
		Gross enrolment rates (primary, secondary, tertiary)
Info Use	Uptake	Internet Users per 100 inhabitants
		Proportion of households with a TV
		Computers per 100 inhabitants
	Intensity	Total broadband Internet subscribers
		International outgoing telephone traffic per capita

² See Granger (1969)

The indicators chosen for the sub-indices are somewhat unfortunate. Main telephones and mobile phone subscribers per 100 inhabitants say little about the network. These could better be described as access indicators and would better be placed under Uptake indicators. Equally, the broadband Internet subscribers could better be categorized as an Uptake rather than an Intensity indicator.

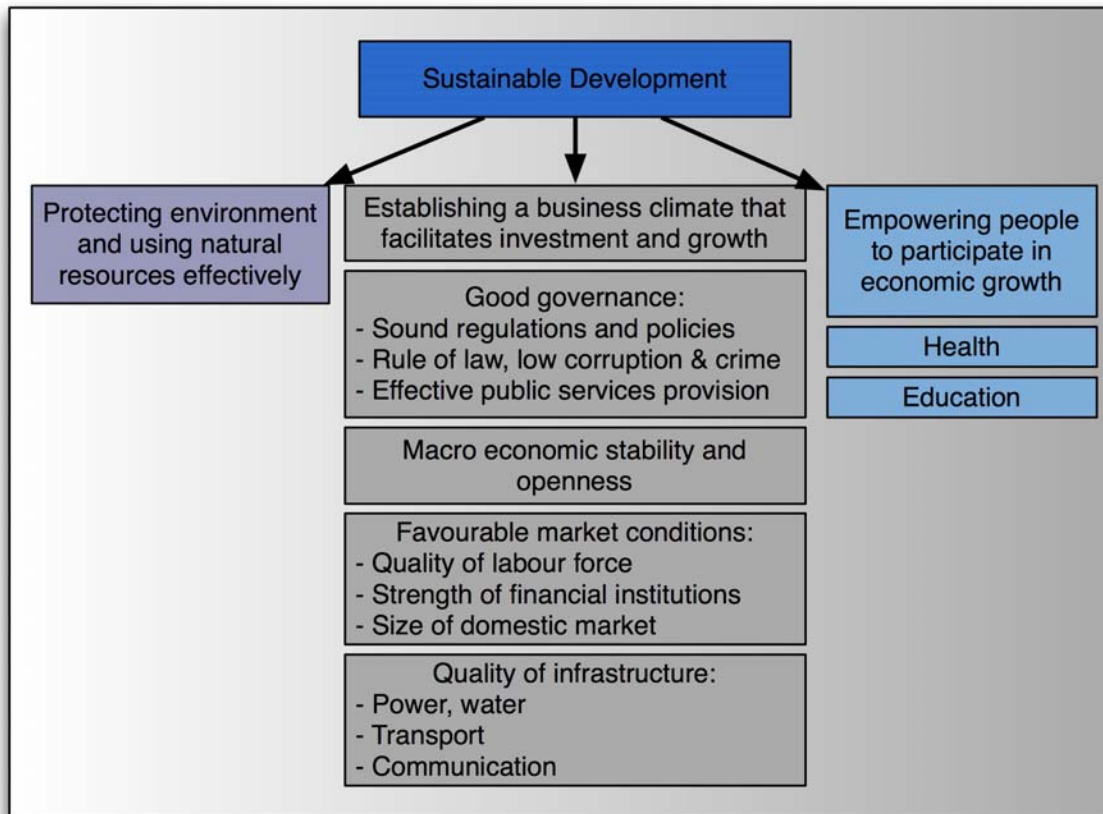
Stork & Esselaar (2006) provide an alternative model that defines intensity by usage divided by access. On a micro level that can be an index of activities for which ICTs are being used by a household divided by what a household has in terms of ICTs. On a macro level an example for an intensity indicator could be call volume divided by subscriber lines.

Measuring only the one side

Measuring ICTs only from one side might bear the risk that progress is being observed without it actually taking place. The number of mobile phone users stated by operators often seems questionable, for example. Using household data help to check on these figures, aligning the supply side and demand side indicators. A holistic approaches to ICT indicators that reflect all dimensions is hence of importance.

Link between sustainable development (SD) and ICTs

Sustainable development can only be private sector driven. Private sector driven sustainable development depends in turn on human capital, good governance, an effective use of natural resources and the protection of the environment for future generations (see Stern 2002). ICTs can contribute to improve all these factors.



Several sources collect indicators useful for the analysis of sustainable development. The World Bank collects various types of indicators for business climate in its Doing Business Survey (World Bank 2005). The Global Competitiveness Report from the World Economic Forum (Lopes-Claros et al. 2007) benchmarks countries based on indicators mainly derived from perceptions of business leaders. Index of Economic Freedom from the Heritage Foundation (Miles et al. 2006) focus also on the private sector aspect of sustainable development using secondary data from the World Bank’s Doing Business Survey, and many other sources.

The Human Development Report (HDR) and human development index (HDI) of the United Nations is an indicator set for the human development pillar of sustainable development as depicted in the graphic above.³

ICT indicators are often included in development indicator frameworks. Millennium Development Goals contain three ICT indicators as part of goal 8, “Develop a global partnership for development”. The UN Commission on Sustainable Development equally uses ICT indicators for the sustainable development indicators, and so does the HDI. The table below lists some of the SD indicator frameworks and the ICT indicators used for them including classifications.

³ <http://hdr.undp.org/hdr2006/statistics/>

Table 3: ICT indicators used in the sustainable development context and their classification

	ICT Indicators	Classification	Source
Global Competitiveness Report (WEF)	Technological readiness Firm-level technology absorption Laws relating to ICT Government Prioritization of ICT Government success in ICT promotion Quality of competition in the ISP sector Extent of business Internet use	Demand side Impact Indicators	Survey: Perception of business leaders
	Cellular mobile telephone subscribers per 100 inhabitants Internet Users per 10,000 inhabitants PCs per 100 inhabitants Internet hosts per 100,000 inhabitants	Supply side Access indicator	ITU
	Internet access in schools	Access indicator	
MDG	Goal 8 - Develop a global partnership: Fixed line and mobile phone subscribers per 1,000 people Internet users per 1,000 people Personal computers per 1,000 people	Supply side Access indicator	ITU
UN Commission on SD	Internet users per 1,000 people Main telephone lines per 1,000 people	Supply side Access indicator	ITU
UNDP: HDI	Internet users (per 1,000 people) Telephone mainlines (per 1,000 people) Cellular subscribers (per 1,000 people)	Supply side Access indicator	ITU

The UN Statistical Commission has just (14 Mar 2007) endorsed a core list of indicators on information and communication technologies (ICT), which were developed by the UNCTAD Partnership on Measuring ICT for Development.⁴ These indicators are grouped into four categories:

- Technology infrastructure and access
- Access and use of information and communication technology by households and individuals
- Access and use of information and communication technology by businesses
- Information and communication technology sector and trade in information and communication technology goods

⁴ http://new.unctad.org/templates/Page_____847.aspx

Table 4: UN Core Indicators - Technology Infrastructure and Access

ICT Indicators	Classification	Source
Radio, TVs, fixed telephone lines, mobile cellular subscribers, computers, Internet subscribers and broadband Internet subscribers per 100 inhabitants International Internet bandwidth per inhabitant	Supply side Access indicator	ITU
Percentage of population covered by mobile cellular telephony Internet access tariffs (20 hours per month), in US\$, and as a percentage of per capita income Mobile cellular tariffs (100 minutes of use per month), in US\$, and as a percentage of per capita income Percentage of localities with public Internet access centres (PIACs) by number of inhabitants (rural/urban)	Supply side Access indicator	Operators

Table 5: UN Core Indicators - access & use of ICTs by Households and Individuals

ICT Indicators	Classification	Source
Proportion of households with a radio, TV, electricity, fixed line telephone, mobile cellular telephone, computer and Internet access Proportion of individuals who used a computer (from any location) in the last 12 months Proportion of individuals who used the Internet (from any location) in the last 12 months Proportion of individuals with use of a mobile telephone	Demand side Access indicator	Household survey
Location of individual use of the Internet in the last 12 months (at home, at work, place of education, at another person's home, community Internet access facility, commercial Internet access facility)	Demand side Access indicator	Household survey Operators School survey
Internet activities undertaken by individuals in the last 12 months like getting information, communicating, purchasing or ordering goods or services, Internet banking, formal education or training activities, dealing with government organizations/public authorities and leisure activities. Frequency of individual access to the Internet in the last 12 months (from any location)	Demand side Usage indicator	Household survey

Table 6: UN Core Indicators - access & use of ICTs by Businesses

ICT Indicators	Classification	Source
Proportion of businesses using computers and the Internet Proportion of employees using computers and the Internet Proportion of businesses with a Web presence, an intranet Proportion of businesses receiving orders over the Internet or placing orders over the Internet Proportion of businesses using the Internet by type of access	Demand side Access indicator	Business survey

Proportion of businesses with a local area network (LAN)		
Proportion of businesses with an extranet		
Proportion of businesses using the Internet by type of activity	Demand side Usage indicator	Business survey

Table 7: UN Core Indicators – ICT sector and trade in information and communication technology goods

ICT Indicators	Classification	Source
Proportion of total business sector workforce involved in the ICT sector	Macro-economic data	Labour force surveys
Value added in the ICT sector (as a percentage of total business sector value added)	Macro-economic data Impact indicator	National accounts
ICT goods imports as a percentage of total imports ICT goods exports as a percentage of total exports	Macro-economic data	Trade statistics

The ICT core indicators, developed by the UNCTAD partnership and approved by the UN Statistical Commission are useful for international benchmarking. The access and usage indicators classified as core indicators are undoubtedly useful indicators of development. However, the information required to compute many of these indicators is not available for most developing countries. Household income and expenditure surveys do not collect the required information on ICTs in most cases and the lack of business registers means that representative sampling of businesses is impossible for most countries.

Consultations with national statistical offices to include key ICT indicators in national statistical frameworks such as income expenditure surveys and censuses are ongoing to address some of the issues. In other cases one might have to look for alternative indicators. Complete business registers cannot be expected anytime soon for many developing countries, for example, in particular not ones that also include the informal sector. Business related micro indicators might hence be not suitable and could be replaced by macro indicators, in particular impact indicators (effect of ICTs on total factor productivity, for example).

ICT indicators for sustainable development

Ample evidence from around the world for the positive impact of ICTs on economic growth and development exists. The ICT sector is an input sector for any economy such as the transport sector or water and electricity. The fixed-line network belongs to infrastructure as roads do.

A common problem that developing countries face is that of trade-offs and development priorities. Should more international bandwidth be bought or inhabitants in a shanty-town be supplied with clean drinking water? However, in many developing countries considerable potential for improvement exists due to imperfect regulatory and policy environments. An efficient regulatory and policy environment would not require diverting resources from other important development projects—since it would lead to private sector investment and development, thereby freeing up scarce public resources and development assistance funds for investment in public goods and areas of market failure. The experience of the past two decades has conclusively demonstrated that ICTs are an area in which appropriate policies and regulations will lead to development through private investment and competitive market forces, while protecting essential public goals and values.

Looking at this from another perspective, one needs to ask what really needs to be measured. Access and usage of ICTs in a country is a function of many variables and past developments. What would be of most interest for sustainable development is how progress can be achieved with the fewest resources given the status quo.

Hence what should be measured as ICT indicators for sustainable development are the competitiveness of the ICT sector and the effectiveness of the regulatory environment. Nominal and relative prices are important indicators for that. Prices can generally be seen as impact indicators since they are the result of the access, usage and regulatory environment. Prices also work the other way round: Lower prices will lead to more access and usage. In a competitive environment prices should be lower than in a non-competitive environment.

Focussing on prices is a very effective way of “keeping it simple” and thereby meeting one of the key tests of effective indicators set out in the introduction. However, this is by no means a simple task.

Price indicators are always relative and the only way of making them comparable across countries is by defining user baskets and pricing them for each country. The OECD devised benchmarking tools for mobile and fixed telephone usage based on such user baskets.

**Cost of cheapest prepaid available in a country for the OECD User
Baskets in US\$, converted using nominal end of year 2006 exchange**

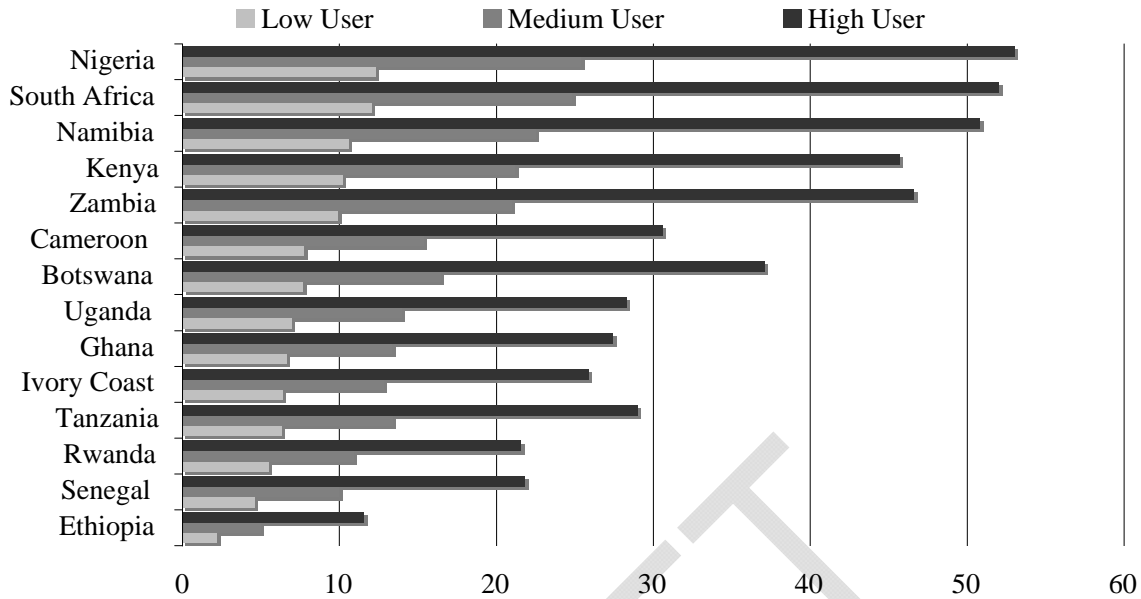


Figure 1: Mobile price comparison for 2006 using OECD basket methodology and nominal exchange rates

The OECD defined three users, a Low User, a Medium User and a High User and based its assumptions on usage (minutes and SMS), time-period of calls and call destinations on information submitted by member countries. The OECD mobile price-benchmarking basket was last revised in February 2006.

What is clear from figures 1 and 2 is that one needs to use nominal as well as ppp⁵ price indicators in parallel. Uganda, Ghana and Rwanda moved to the top of the most expensive countries for prepaid mobile usage when pricing the OECD user baskets in US\$ using implied ppp conversion rates.

⁵ ppp = purchasing power parity

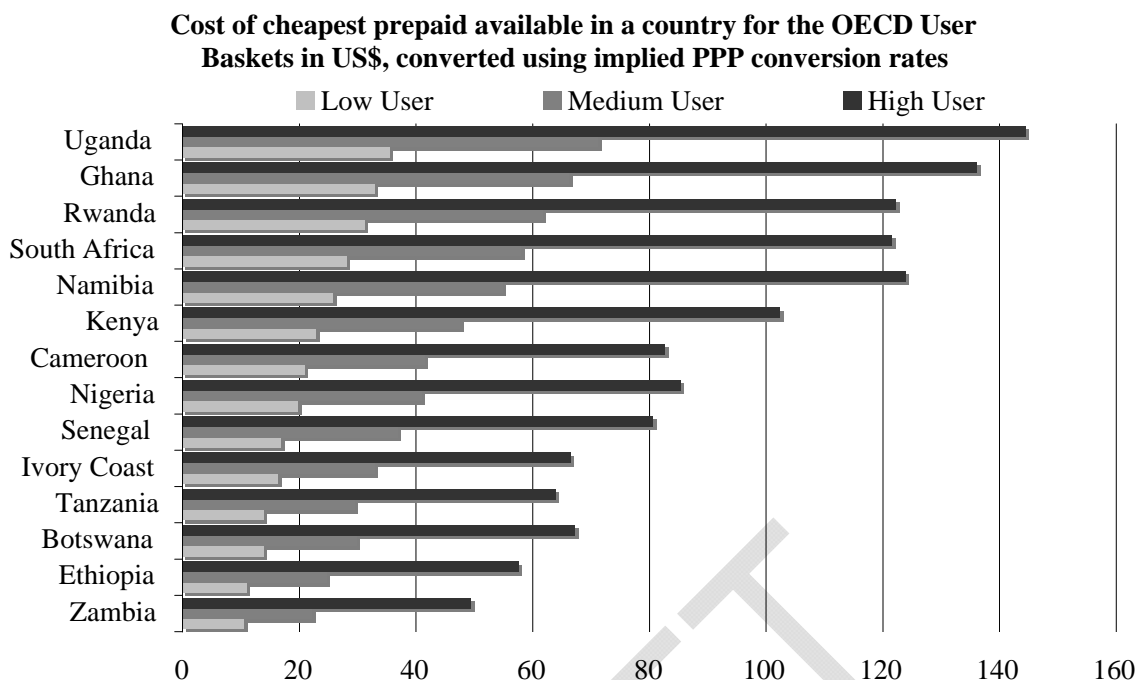


Figure 2: Mobile price comparison for 2006 using OECD basket methodology and implied ppp conversion rates

Price indicators, however, would not be enough for measuring sustainable development and to assess the competitiveness of the sector since they themselves do not indicate whether or not there is effective competition, the basic driver of ICT sector development and the source of much of ICT's contribution to SD.

The number of operators in a country is not necessarily positively correlated to increase in competition, for example. On the one hand, effective regulation could translate into lower prices. High prices on the other hand do not necessarily mean that the regulatory environment is ineffective since many other factors are in play (e.g., import duties). Price indicators need therefore be complemented by other indicators that help indicate the extent to which there is effective competition in a country's ICT sector, such as concentration measures and accounting indicators for operators (the return on equity, profit margin, asset turnover, financial leverage and many others).

Conclusion

ICT indicators are commonly used in sustainable development frameworks. The most frequent indicators found are supply side access indicators collected by the ITU. These indicators are usually the most easily obtainable, which explains their preponderance in ICT measurement literature. A holistic picture needs to be provided for measuring the access, usage and impact of ICTs, rather than just a focus on supply side indicators. This means that different measurement tools need to be used, such as household surveys. In addition, a new set of indicators is proposed that would provide information about the effectiveness of the regulatory environment and the competitiveness of the ICT sector. This integrated approach

would go some way towards providing useful indicators for measuring ICT progress across countries.

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