The Development Dimension

ICTs for Development

IMPROVING POLICY COHERENCE

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Foreword

Information and communication technologies (ICTs) are crucial in improving access to health and education services and creating new sources of income and employment for the poor. Being able to access and use ICTs has become a major factor in driving competitiveness, economic growth and social development. In particular, mobile phones are opening up new channels for connectivity and contributing to the free flow of ideas and opinions.

This publication draws on discussion papers prepared for the workshop Policy Coherence in the Application of Information and Communication Technologies for Development, jointly organised by the OECD and *info*Dev/World Bank and held on 11-12 September 2009 in Paris. The work was launched and co-ordinated by Raili Lahnalampi, Sam Paltridge and Karine Perset from the OECD and Tim Kelly from *info*Dev/World Bank.

The workshop examined some of the main challenges in closing the discrepancies in access to ICTs and use of ICTs between countries. It also suggested best practices for more coherent and collaborative approaches in support of poverty reduction and meeting the Millennium Development Goals.

Contributions are gratefully acknowledged from Tim Kelly, Lead ICT Policy Specialist, *info*Dev/World Bank; Richard Heeks, Director, Centre for Development Informatics, University of Manchester; Rohan Samarajiva, Chair & CEO, LIRNE*asia*; Victor Mulas, Consultant, Siddhartha Raja, Consultant, Christine Zhen-Wei Qiang, Senior Economist and Mark Williams, Senior Economist, all from the Global Information and Communication Technology Department, World Bank; Paul Makin, Principal Consultant, Consult Hyperion; John Houghton, Professorial Fellow, Centre for Strategic Economic Studies, Victoria University; Mitakshara Kumari, Associate Director and Nilaya Varma, Director, PriceWaterhouseCoopers India. The publication was compiled and edited by Amelia Smith.

The organisers also wish to thank all speakers and commentators for their valuable contributions to the workshop.

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Acronyms and Abbreviations

ADSL	asymmetric digital subscriber line
BOP	bottom of the pyramid
BTS	base transceiver station
CAGR	compound annual growth rate
DSL	digital subscriber line
EPIC	erosion productivity impact calculator
EDUSAT	Indian satellite built to serve the educational sector
EMIS	education management information system
FDI	foreign direct investment
GATS	General Agreement on Trade in Services
GDP	gross domestic product
GERs	general education requirements
GHG	greenhouse gases
GIS	geographic information system
GPT	general purpose technology
GSM	global system for mobile communications
HSDPA	high-speed downlink packet access
HSM	hardware security modules
HSPA	high-speed downlink packet access
ICT4D	information and communication technologies for development
ICT4E	information and communication technologies for education
IP	Internet protocol
IPv4	Internet protocol version 4
IPR	intellectual property rights
IRI	internationalised resource identifiers
IS	information systems
IT	information technology
IVR	interactive voice response
IXP	Internet Exchange Point
KYC/AML	know your customer/anti-money laundering regulations
LAN	local area network
LCD	liquid crystal display
MDG	Millennium Development Goals
NREN	national research and education network

ODL	open and distance learning
OER	open educational resource
OLPC	one laptop per child
QoSE	quality of service experience
SEC	socio-economic classification
SEMIS	school education management information system
SIM	subscriber identity module
SMP	significant market power
SMS	short message service
TRE	telecom regulatory environments
VSAT	very small aperture terminal
WAP	wireless access protocol
WiFi	wireless fidelity
WiMAX	worldwide interoperability for microwave access
USSD	unstructured supplementary services data
USO	universal service obligation

Executive Summary

The Organisation for Economic Co-operation and Development (OECD) and the World Bank's Information for Development (*info*Dev) programme joined forces to organise a workshop on Policy Coherence in the Application of Information and Communication Technologies for Development (ICT4D), held 10-11 September 2009 in Paris. There were a number of initiatives that led to this meeting, including:

- The OECD's Policy Coherence for Development initiative (*www.oecd.org/development/policycoherence*);
- The OECD Summit on the Future of the Internet Economy, held in Seoul in May 2008 (*www.oecd.org/futureinternet*);
- The 2009 edition of the World Bank's *Information and Communication for Development* report, which looks at extending reach and increasing impact;
- The OECD/World Bank workshop on Innovation and Sustainable Growth in a Globalised World, held in November 2008, which identified ICTs as a General Purpose Technology (GPT) but also highlighted the need for a co-ordinated and coherent approach to maximise the effectiveness of ICTs as a tool for development.

The workshop identified key areas for action:

Access to ICTs and the Internet: Lack of access and capacity are still major constraints in promoting the use of ICTs for development. There is a need to improve the coherence of different sectoral policies, such as taxation and competition, to promote wider access.

Broadband policy development: Governments need to develop clear broadband strategies, as broadband's importance as an economic stimulus and the social benefits it brings are widely accepted. Strategies should provide balance between government intervention and private sector investment and ensure a strong regulatory environment to allow competition to flourish.

Strategies should recognise the importance of rolling out fibre in its own right but also in its role as a backbone network to support wireless. In many developing countries broadband access will be via mobiles, so governments should make adequate spectrum available at reasonable prices. Governments themselves should take full advantage of broadband by making their services available online, increasing awareness and improving access.

Mobile payments: True banking transactions (m-banking) should be distinguished from basic money transfers (m-payments). There is a need to reconcile the need to regulate international money transactions (*e.g.* to prevent money laundering or terrorism financing) with promoting the use of mobiles for affordable access to money for the poor. Collecting existing best practices would be a useful way to share knowledge and address current challenges.

Security considerations: Key challenges include a co-ordinated national approach, lack of implementation of existing best practices and lack of cross-border co-operation. Awareness needs to be raised and an appropriate balance struck between security and privacy concerns. Capacity-building in particular is needed to provide a flow of newly educated security professionals in developing countries who can help co-ordinate international action.

ICTs for the environment: Opportunities for ICTs lie not only in reducing their own share of greenhouse gas emissions, but also in using them to reduce emissions in other sectors and to address systemic change and rebound effects. Intellectual property rights, technology transfer and local capacity-building warrant particular attention. There is scope for improving ICT performance throughout the whole life cycle, from purchase to disposal, with potential for governments to lead by example.

ICTs for education: A main focus should be on improving learning and education and improving ICT skills/resources available for teachers as much as for students. There is a need for better information about what is happening at the national level as well as a better understanding of technological and pedagogical trends, reflecting the overall need for better empirical evidence as to the benefits of investment in ICTs for education (ICT4E) and their broader impact on society.

The workshop proceedings, including the agenda, presentations and background documents, are available at: www.oecd.org/ict/4d.

Chapter 1

Why ICTS Matter for Development

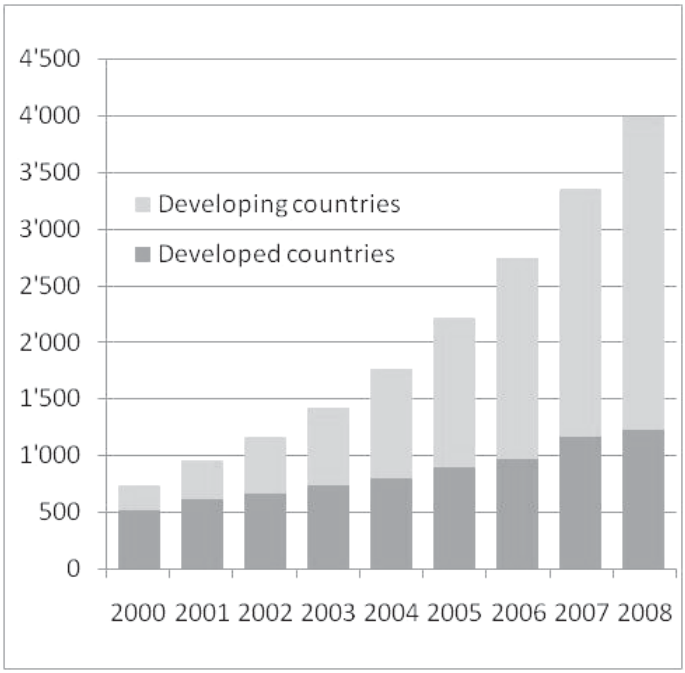
*Realising the full benefit of Information and Communication Technologies (ICTs) for development requires that they be seen as a development innovation rather than just another development tool. This chapter gives a general overview of the six ICT-enabled applications discussed at the OECD/info*Dev *workshop, outlining how each may contribute to development while presenting some of the challenges faced by countries currently implementing them.*

The six substantive sessions of the Policy Coherence in the Application of ICTs for Development workshop looked at different facets of the issue of policy coherence in Information and Communication Technologies for Development (ICT4D) and the need to accelerate progress on poverty reduction, reducing inequalities including the digital divide, and achieving the Millennium Development Goals. Each of the sessions included presentation of a background report, some of which are presented here as succeeding chapters. **Chapter 2**, in particular, raises key questions and charts the evolution of ICT4D to date.

Access to ICTs and the Internet

The number of mobile subscriptions around the world now exceeds 4 billion, with developing countries accounting for two-thirds of that number.

Figure 1.1: Mobile phones worldwide, 2000-08



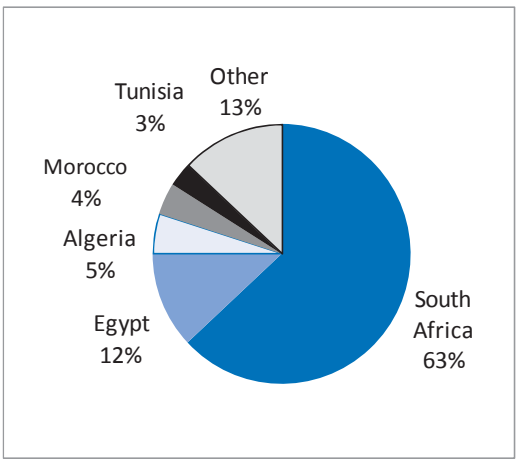
Source: Mohsen Khalil, Head of the World Bank/IFC Global ICT Department (GICT).

Indeed, many developing economies are now leapfrogging their OECD counterparts in terms of SIM card ownership, with the UAE being the first economy to exceed two SIM cards per citizen. In the broadband world, however, the traditional digital divide still holds true. This is reinforced by differences in the unit cost of broadband between developing and developed countries, with the latter being up to ten times more expensive.

Mobile telephones becoming increasingly affordable and accessible has assisted in the creation of new sources of income and employment as well as encouraging innovation aimed at meeting local requirements. On the other hand, key infrastructures may not exist or are underutilised. More than half the world's countries do not have an Internet Exchange Point (IXP) where local traffic can be exchanged and, as one consequence, face relatively high charges for transiting this traffic through the developed world.

Internet Protocol (IP) addresses are critical to the development of the Internet, as all connected devices – including routers, computers, or IP phones – must have an IP address. Africa's growing Internet usage is driving demand for IP addresses: the current ratio is only 0.36 Internet addresses per Internet user, with only 3% of global IP addresses (compared with 10% of the world's population). Within Africa the disparities are even more marked, with almost two-thirds of IPv4 addresses having been allocated to South Africa due to its important role in the early development of the Internet.

Figure 1.2: IPv4 address distribution in Africa



Source: workshop presentation by Adiel Akplogan, CEO, AfricNic and Chair, Number Resource Organization.

IPv4 address exhaustion is likely to occur as early as 2011 globally, and 2013-2014 in Africa, which will affect new users connecting to the Internet as well as businesses requiring IP addresses for their growth. To date, deployment of the newer version of the Internet protocol, IPv6, has been much slower than expected.

Most African countries still rely on satellite connectivity and typically pay between USD 2 000-5 000 per Mb per month for international bandwidth. The continent was traditionally served by two undersea cables (SAT3 and SAFE), but they also charged high prices. Recently, two new cables serving the East African region have come online (SEACOM and TEAMS) and are soon to be joined by a third (EASSy). These will certainly have a beneficial effect on pricing, but other challenges – such as the lack of interconnection, high operating costs and legal and regulatory barriers – are also factors.

There are two basic models for exchange of Internet traffic: peering and transit. The former is much more beneficial for Internet service providers. The optimal solution, therefore, is to develop local Internet Exchange Points (IXPs). All that is required is a switch, and infrastructure costs are relatively low. This keeps a higher percentage of traffic local and facilitates the provision of value-added services. For instance, if Google traffic is peered locally, backhaul Internet traffic costs are typically cut by around 40%. This also reduces average transmission delays from 1.2 seconds to less than 100 milliseconds. The ripple effect of this improved performance also benefits other developmental applications.

One solution for meeting the challenge of connecting the developing world is the "budget network telecom model" presented in **Chapter 3**. Akin to low-cost airlines such as EasyJet or RyanAir, this model has already been successful in driving the mobile success story and can now be applied to broadband. A key feature is reliance on pre-paid billing. In South Asia, the total cost of ownership of a mobile is typically below USD 5 per month, compared with an average for developing economies of over USD 13. The budget telecom network model does not appear to have negatively impacted the profitability of local operators.

Broadband policy development

The number of broadband subscribers around the globe, on either fixed or mobile connections, is likely to exceed 1 billion for the first time during 2009. This means that the vast majority of Internet users now enjoy speeds at least four times faster than ordinary dial-up connections, making many new applications possible. But what are the implications for developing

countries? Why should governments go further than simply creating enabling regulatory environments and including broadband within their national economic stimulus packages? Answers to these questions may be found in **Chapter 4**.

Although broadband cannot really be considered a public good, it is nevertheless the primary means of access to information, which has the characteristics of non-excludability and non-rivalry. Information, therefore, may be considered a public good.

Recognising this, governments around the world are including broadband as part of national stimulus packages. OECD countries have committed almost USD 50 billion to future public sector investments, with the Australian government, having committed AUD 43 billion to a national broadband network, being the standout case.

A useful tool for comparing broadband connectivity is the Nokia Siemens Networks' Connectivity Scorecard and Broadband Impact Study. The Study measures "useful connectivity" between "innovation-driven economies" (mainly developed) and "resource and efficiency-driven economies" (mainly developing).

Figure 1.3: Connectivity Scorecard scores for developed and developing economies

Innovation-driven economies	Connectivity score
United States	7.71
Sweden	7.47
Denmark	7.18
Netherlands	6.75
Norway	6.51
United Kingdom	6.44
Canada	6.15
Australia	6.14
Singapore	5.99
Japan	5.87
Finland	5.82
Ireland	5.70
Germany	5.37
Hong Kong SAR	5.33
France	5.22
New Zealand	4.85
Belgium	4.65
Korea	4.17
Italy	3.99
Czech Republic	3.71
Spain	3.49
Portugal	3.02
Hungary	2.72
Greece	2.62
Poland	2.49

Resource and efficiency-driven economies	Connectivity score
Malaysia	7.07
Turkey	6.71
Chile	6.59
South Africa	5.76
Mexico	5.39
Russia	5.37
Argentina	5.14
Brazil	5.12
Colombia	4.08
Botswana	3.98
Thailand	3.75
Iran	3.62
Ukraine	3.60
Tunisia	3.50
China	3.19
Philippines	3.17
Egypt	3.02
Sri Lanka	2.87
Vietnam	2.75
India	1.88
Indonesia	1.87
Kenya	1.75
Bangladesh	1.60
Pakistan	1.54
Nigeria	1.30

Source: workshop presentation by Ilkka Lakaniemi, Director, Global Policy Initiatives, Nokia Siemens Networks.

One of the surprising elements of the 2009 results is that certain countries, such as Korea, score lower than expected, mainly because of the lack of development of broadband in the business sector. By contrast, the US ranks at the top, thanks in part to its well-developed services sector. The Scandinavian countries all do well. The UK has been one of the biggest risers since the previous survey in 2007. Within Europe, there is a north-south digital divide in broadband.

Amongst developing economies, Malaysia is the top performer, with Chile the lead country in South America and South Africa leading in Africa.

The analysis permits a comparison with each country's performance in GDP per capita. It shows, for instance, that Sweden and Ireland are doing much better than their GDP would suggest, while Greece and Spain are doing less well.

Egypt's relative success can be attributed to a public/private partnership between the policy-maker (MCIT), the regulator (NTRA), the incumbent (Telecom Egypt) and the private sector. The main elements of the policy include an attempt to widen access to, and awareness of, ADSL services; rolling out Wi-Fi; a programme to extend the use of PCs in households and small businesses, building on the success of the "free Internet" model (usage bundled into the price of dial-up minutes); and other initiatives such as PC clubs and the Egypt PC2010 project. Such initiatives have succeeded in reducing the price of broadband to the point where the average cost per Mb per month is now around USD 24.

Government investment in broadband as a part of stimulus packages should be balanced with policy objectives. Initiatives could include unbundling the local loop, making sufficient spectrum available and ensuring all investments supported by government funds are accessible to competitors via open access. For example, Mexico's government announced in May 2009 that it will open up the national electric company's network to competitive telecom service providers.

Fixed-line fibre networks have a huge theoretical capacity (*i.e.* for instance, a single fibre strand could allow every single person in the world to hold a simultaneous phone conversation). But such networks are lacking in developing countries and therefore the focus there is more likely to be on the provision of mobile broadband.

Mobile payments

Several billion people in the developing world have very limited or no access to any form of financial services. Increasingly, mobile phones are being used as a channel for money transfers or to buy and sell products and services. This is providing affordable financial services for the first time to many people with extremely limited means, while offering them greater security and efficiency than traditional alternatives.

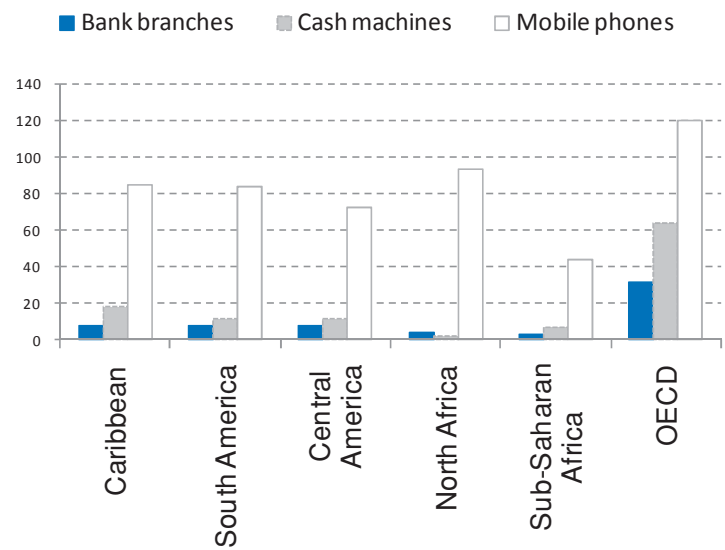
The pace of mobile payment development is uneven across different countries, perhaps reflecting the fact that the disruption which attends innovation is not always welcomed by all stakeholders and that lessons can be learned from countries with the most successful roll-out of services. At the same time, the convergence of communications and financial services

has brought into play separate regulatory authorities whose practices may need to be examined for overall coherence in meeting policy objectives.

The development of the money transfer service M-PESA, initially deployed in Kenya, is described in **Chapter 5**. Though originally intended for remittances, the service has evolved to include new financial services such as micro-finance, micro-insurance, and school fees payment. The logical next step is to integrate public sector services into the system; however, regulatory positions are too often inconsistent or incoherent with no best practice.

The difference in mobile phone coverage between OECD and developing countries is relatively small, but the gap in number of bank branches and especially cash machines is much wider. This provides the strongest case for m-banking. Generally speaking, where there are multiple money transfer operators (as in the US, Spain and UK) the average transaction cost (USD 6.6 per USD 200) is much lower than in countries where there are relatively few (such as Japan, France, Canada and the Netherlands), where the average transaction cost is USD 15.5 per USD 200. Mobile payment operators like M-PESA can reduce these transaction costs substantially.

Figure 1.4: Network coverage in selected regions (% of population)



Source: Presentation by Laura Recuero Virto, Economist, Development Centre, OECD.

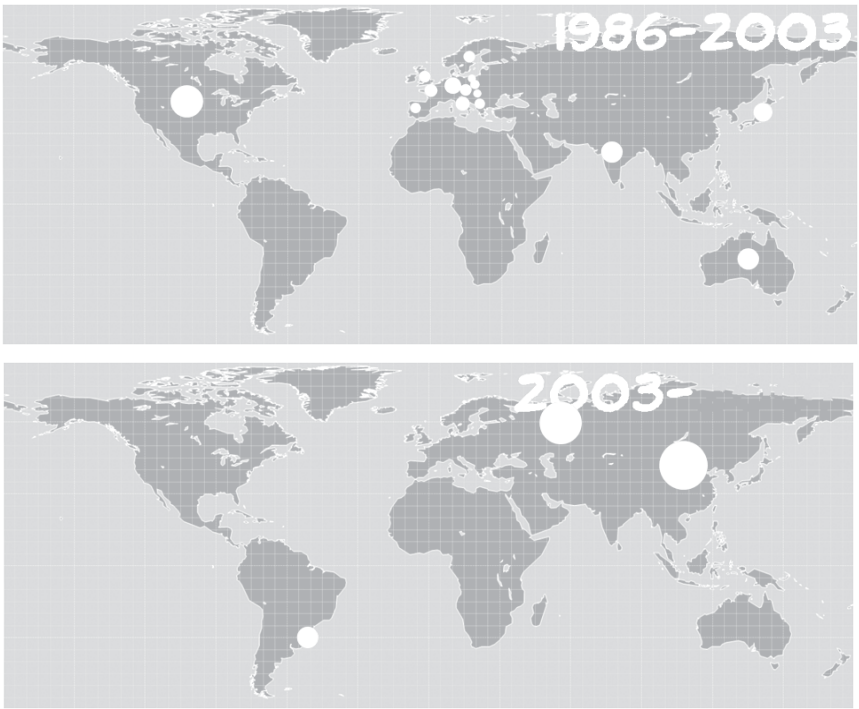
In some developing countries the volume of remittances greatly exceeds the value of formal donor aid. Innovations such as M-PESA, which improve efficiency and reduce the margins of remittances, may have a marked beneficial effect. However, while m-banking opens up many new opportunities for development, it also creates scope for fraud. Thus there is a pressing need for policy coherence amongst ministries, regulators, donors and service providers.

Security considerations in ICTs for development

The globally interrelated nature of the Internet means that policies and practices adopted in one country have the ability to affect the security and stability of network use in others. In this context, the development of a culture of security which benefits all users around the world, and the funding of expenditure necessary to sustain that environment, will be particularly challenging for the next several billion Internet users.

Before 2003 the majority of viruses came from developed countries, with the main motivation being a distorted sense of fun and fame. Today hobbyist virus writers are largely a thing of the past. Now the biggest hotspots worldwide are Russia, China and Brazil, and the most common motivation is credit card scams, especially using keystroke loggers which are almost invisible to the user. Another common form of hacking is to capture computers around the world to act as botnets to launch denial of service attacks, which are then used to force ransom payments from online shopping sites. In terms of securing developing countries, it is likely that the initiative will need to come from international co-operation. Ironically, one of the main forms of protection developing countries currently have is their slow connection speeds, which make their systems less attractive to hackers.

Figure 1.5: Changes in the locus of virus creation hotspots, before and after 2003



Source: workshop presentation by Mikko Hyppönen, Chief Research Officer, F-Secure Corporation.

A corpus of best practice literature from international organisations already exists, such as the Council of Europe's Convention on Cybercrime, the International Telecommunication Union's Anti-Spam Toolkit and the 2002 OECD Guidelines for the Security of Information Systems and Networks. There is a need to translate these recommendations into action through schemes such as the Australian Internet Security Initiative. Initiatives should be multi-stakeholder in nature and action-oriented.

Addressing ICT security should avoid leading to a two-sided situation whereby a trusted and secure cyberspace for the developed world is distinct from a non-trusted and non-secure cyberspace for others. Anti-piracy initiatives and co-operation, the need to support free/libre and open source software and its community, and the possibility of applying the "polluter pays" principle to the ICT world are all important. There is also a need for

balance between security and privacy concerns, especially in areas such as online shopping, smart grids and online searches.

Security concerns are the same in both developed and developing countries. A number of tools are available to address them, but the problem lies in a lack of implementation and cross-border co-operation. The lack of awareness and interest amongst young people to follow ICT security as a possible career path is a particular lacuna, especially in developing countries.

There is a role for capacity-building, as well as for striking an appropriate balance between security and privacy. The sequence of priorities should be prevention, followed by mitigation and then prosecution.

ICTs and the environment

One of the key tasks facing all stakeholders is how to harness ICTs to improve environmental performance and mitigate climate change across all sectors of the economy. This challenge is discussed in detail in **Chapter 6**.

It has been estimated that ICTs account for between 2-2.5% of global greenhouse gas emissions, with a forecast that these emissions will rise in future. On the other hand, ICTs have the potential to mitigate greenhouse gas emissions in other sectors by around five times their direct polluting impact. There is also the question of "rebound effects" from energy efficiency improvements (*e.g.* cheaper and more widespread energy causing usage to go up). This phenomenon is not well studied in developing country environments at present.

A broader issue is whether today's developing countries will follow a long-term development model similar to that of developed countries, from agriculture to manufacturing to services. Is it possible for developing countries to leapfrog directly to ICT-enabled services? Issues to consider include:

- access to data;
- understanding life-cycle impacts;
- managing possible rebound effects;
- technology transfer.

An example of the impact of ICTs on the environment can be found in Hong Kong and the Pearl River Delta. The burgeoning growth of data centres in the region, each of which can consume the equivalent energy of a small town, has sparked green initiatives covering four main areas: energy

conservation, water treatment and conservation, green building materials and ensuring quality of life.

Efforts at greening data centres include improving processing power while reducing power consumption, better server consolidation and a more eco-friendly approach. According to the US Environmental Protection Agency, it should be possible to improve power efficiency compared with the current technology curve by up to ten times in the next five years.

In terms of developing new strategies, an appropriate approach is to reuse existing strategies and adapt them, for instance by using the Data Centre Code of Conduct. Many organisations have long-term contracts for ICT supply which may constrain opportunities for green innovation. Flexibility is required, as well as setting definite targets to be achieved. Product design is an important area to address, especially for reducing power requirements for cooling. Emphasis should be put on "pop-out" and "upgrade" technology. "Dirty ICT" products are becoming increasingly hard to process for waste disposal.

"Green ICTs" have been defined as the intersection between environmental and efficiency goals within an enterprise. In other words, not so much about greening the ICT sector alone, but using green initiatives to improve sector-wide processes. Typical applications for green ICTs are in power and logistics management. Although PCs may be switched off, LANs rarely are and their weekend power consumption is typically 95% of that on weekdays. Computer centre managers need to be educated to identify opportunities for power- and cost-saving.

There is a tendency to overlook the very urgent need to address the ICT sector's own greenhouse gas emissions in the enthusiasm to promote their potential to reduce emissions in other industries and improve environmental performance through applications across economies.

ICTs for education

Greater use of ICTs in schools can help achieve development goals related to universal primary education and the elimination of gender inequality in education. However, doubts remain as to the priority ICTs should be afforded relative to other educational needs.

There has been a tendency to oversell the benefits of ICTs for education; in reality, the evidence base is still sparse. The knowledge maps of ICT for education published by *info*Dev in 2005 were rather alarming in exposing how little is still known to date and provable about direct benefits.

The results of regional studies commissioned by *info*Dev on ICTs for education in Africa (2008) and the Caribbean (2009) show their increasing use in different places at different speeds.

In Africa, Ghana, Rwanda and Senegal might be considered as leading the wave, while countries in post-conflict situations, such as Liberia or Sudan, are lagging. As many as 48 of the 53 African countries had policies in place, but in general civil society and the private sector are setting the pace. There is a lack of implementation capacity as well as infrastructure for both power supply and ICTs. Gender equity is also generally lacking. Macro trends include public/private partnership, digital content development, open source software, regional initiatives, national research and educations networks, international connectivity and wireless networks.

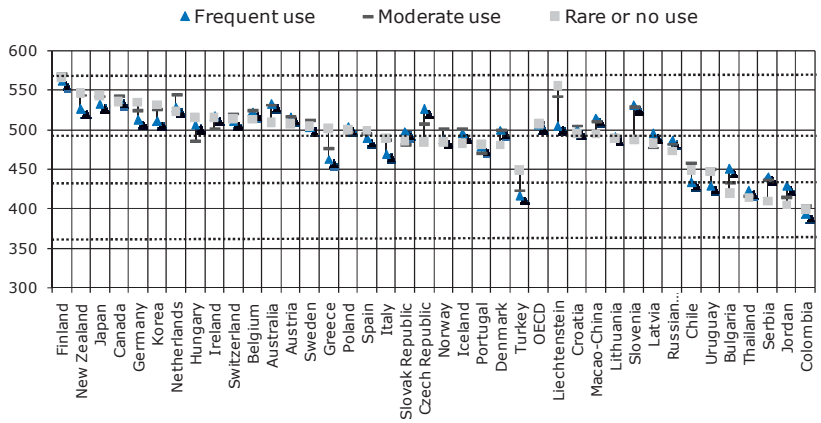
By contrast, the Caribbean forms a more cohesive region in terms of understanding trends. ICTs are perceived as a way of effecting change. The focus is on ICT skills development. There is a regional ICT exam and broadband is typically rolled out to schools without additional costs.

The preliminary outcomes of the newest regional survey commissioned by *info*Dev covering India and South Asia are presented in **Chapter 7**. The eight countries of the region are at quite different stages of development, but it is nevertheless possible to generalise an ICTs for education (ICT4E) ecosystem and identify aspects that need to be defined as part of a "policy plus" approach.

The OECD's Programme for International Student Assessment (PISA) finds a link between frequency of use of computers at home and improved student performance (Figure 1.6). It is more difficult, however, to show the same relationship between computer use in schools and improved student performance. Indeed, when the influence of socio-economic status of students is taken out of the equation, any relationship begins to disappear. The evidence seems to be that use of ICTs further benefits those who already have good performance, and does not harm those who do not.

There is a gap between the lives of students at home and in school. The average 15 year-old in OECD countries spends about two hours per day at home in front of a computer and less than one hour per week on a computer in school. The question arises: is it worth investing more in ICTs for education? Will there be a pay-off, financially and in terms of equity?

Figure 1.6: Relationship between technology use and educational attainment in science (2006 PISA survey)



Source: workshop presentation by Francesc Pedro and William Thorn, OECD.

The real challenge is to develop better measurement. Students in OECD countries are already exposed to an information-rich environment and therefore improvements coming from use of ICTs in schools are likely to be marginal. One might expect a bigger impact in developing countries. A particular challenge is to understand how computers are used in school. For the most part, they seem to be aimed at developing ICT skills rather than using ICTs as a medium for improving learning in other subjects.

There are a huge number of initiatives in the field of ICT4E. They do not necessarily come from donors, but from NGOs and national governments. The education donor community has been quite conservative in their education development policies. However, the demand for support for ICT4E in developing countries is growing quickly.

Access from developed countries to Internet knowledge resources such as Wikipedia or information search has greatly facilitated learning. The lack of access in developing countries means a growing knowledge gap is inevitable. Seventy per cent or more of the population in OECD countries have access to the Internet, while in close to 100 developing countries the figure is less than 10%. In developing countries, the primary platform for access is the mobile phone, with mobiles increasingly used for e-learning and video instruction. Mobile computing platforms such as the iPhone coming down in cost and becoming widely available in developing countries will have a huge impact on access.

The rapid growth of open source learning management systems and availability of open education resources driven by initiatives like the Massachusetts Institute of Technology's OpenCourseWare are changing how people think about the value of educational content – that it is in the delivery rather than the IPR of the course content itself. Trends in technology – *e.g.* rapid improvement in the capacity of memory storage compared with relatively slow improvement in connectivity – suggest that more educational content could be stored locally rather than accessed over expensive networks.

A variation on Solow's paradox might say, "We see the computer age everywhere in schools, except in educational improvement". This suggests that we need to rethink how we use technology in schools. The new digital divide is not about access but about differences in the type and quality of use.

Chapter 2

Where Next for ICTs and International Development?

By Richard Heeks[1]

There are problems with the coherence of Information and Communication for Development (ICT4D) policies today. This chapter identifies some of those problems and proposes, if not solutions, at least a shape or framework for moving forward. It then charts the logic and chronology of applying ICTs to developing countries.

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Overall policy coherence challenges

The constant novelty and innovation of digital technology brings a constant stream of policy challenges. For example, Manchester's Centre for Development Informatics has been studying barriers to diffusion of "m-finance": *i.e.* the use of mobile phones to help bring financial transactions and services into the poorest communities (Duncombe 2009).

An immediate policy barrier arises due to sectoral convergence. When mobile phones become mobile wallets, information and communication technology (ICT) policy crashes into financial policy. Some countries lack a helicopter view of multiple policies – the kind necessary to see the bigger picture of their impact on development. For instance, financial regulations may allow only banks to undertake formal financial transactions, yet banks are currently among the least-trusted of financial institutions. Furthermore, such regulations restrict competition – keeping mobile operators and third-party innovators out of the market, restricting the spread of m-finance, and thus damaging development.

Some countries, by contrast, lack a grassroots view of policy – they do not understand the roadblocks that individuals within poor communities face when trying to make use of ICTs. Taking the example of m-finance, three key barriers prevent the poor from making use of services even when available: affordability, lack of financial literacy, and lack of trusted intermediaries. To address these would, again, require coherence across a set of policy areas including taxation, telecommunications policy, education, and financial regulation.

The OECD/*info*Dev Policy Coherence in the Application of Information and Communication Technologies for Development workshop focused on the need for coherence around particular applications of ICTs, such as the m-banking example. But there are more generic Information and Technology for Development (ICT4D) policy coherence challenges, which can be grouped into four questions.

Question 1: Is there coherence in ICT4D policy between the global North and the global South?

Of course, some commentators would argue that there is complete coherence: rich nations' policies benefit rich nations, and policies forced onto poor nations also benefit rich nations. The current struggles in World Trade Organization negotiations suggest that things are not quite so simple these days, as some of the nations in the global South become ever more

economically and politically powerful. Nonetheless, the question of who benefits from ICT4D policies – the global North, the global South, particular stakeholders? – is still worth asking.

Question 2: Is there coherence – and balance – in policy amongst the various parts of the ICT-for-development value chain?

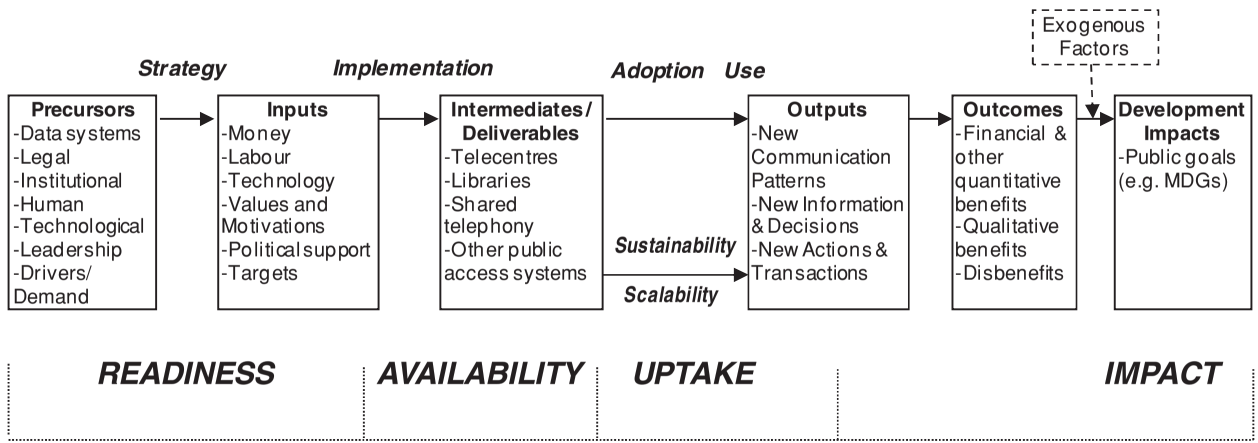
In very simple terms, the ICT4D value chain traces the transformation of technological inputs into development outputs (Figure 2.1). In more detail, it is divided into four focal areas:

- *Readiness*: countries require a set of precursor systems such as legal foundations and human and technological infrastructures. Through strategic actions – including policy – these become specific programme and project inputs such as money and technology, and softer inputs such as motivation and political support.
- *Availability*: inputs implemented into a set of programme-specific deliverables; intermediate items such as a telecentre or mobile phone system.
- *Uptake*: the actual adoption and usage of digital technology, including questions of the sustainability and scalability of particular ICT4D programmes.
- *Impact*: the familiar threesome of outputs, outcomes and development impacts; outputs being the immediate behavioural changes that an ICT4D project causes; outcomes being the individual and community benefits that ensue; and development impacts being the extent to which ICTs help wider development goals to be achieved.

How has the focus of ICT4D policy changed over time along the value chain? For many years – and in some agencies, and for some policies, still today – attention has been given to the foundations. Only recently have policies begun to extend themselves fully to look at whether and how people use those foundations and, most important, what contribution the technology is making to development.

ICT for development policies might lack coherence if they only focus on the early parts of the value chain. So when we analyse policy, we can ask – what is it covering? Is it only looking at the foundations – at issues of readiness and availability – or does it have the whole soup-to-nuts coherence that includes not just laying down the railway tracks and buying the trains but also ensuring that someone uses the them, and that the railway helps national development?

Figure 2.1: The ICT4D value chain



Source: Richard Heeks.

Question 3: Is there coherence between ICT policy and development goals?

Just as we have seen the focus of policy changing over time between different parts of the value chain, so we can also see changes over time in the relation between typical ICT policies and development (Heeks 2009).

Twenty-five years ago, ICTs were pretty much off the policy agenda; largely ignored by development agencies and all but a very few developing country governments. With the advent of the microcomputer ICTs became too much of a phenomenon to ignore, but the vast bulk of strategists and policy-makers were unfamiliar with the new technology. So ICTs were somewhat ostracised; they might occasionally be mentioned but were kept isolated from the development policy mainstream, dealt with by a very small and separate team of specialists.

When the Internet fully arrived on the scene in the late 1990s, this worldview flip-flopped and ICTs were placed centre stage and even idolised as a saviour that could deliver all development goals. Recently, a more level-headed approach has seen agencies and governments integrating ICTs into their network of policy tools.

We can therefore chart out a "4Is" chronology. In the days before ICT4D was called ICT4D, ICT was often *ignored* and then *isolated*, with only a limited perceived contribution to development. Then when ICT4D began in the late 1990s, it was first *idolised* by some, and then *integrated* into the mainstream of development policy.

This "mainstreaming" approach has come to be seen as the appropriate relation between ICTs and development policy. However, one could ask whether an "*innovate*" view – adding a fifth "I" – would be better; one that sees ICTs not as just one tool among many, but as a unique technology with a transformative potential for development.

- Mainstreaming traps ICTs in individual development goal silos; an "innovate" view sees them as a cross-cutting, linking technology for development.
- Mainstreaming loses the sense of excitement, motivation and hope that ICTs can bring; an "innovate" view captures and channels these sentiments.
- Mainstreaming accepts the current rules of the game; an "innovate" view recognises that ICTs can transform development.

On this last point, we can find increasing ways in which ICTs are transformative of the way we do development; ushering in new development models and offering the possibility of "Development 2.0".

This is recognised in the OECD's Shaping Policies for the Future of the Internet Economy document, which underlines the catalyst role that ICTs can play, especially around promoting creativity and innovation (OECD 2008). We can see this in "micro-giving" models such as Kiva. Such models *distintermediate* by cutting out the institutions that traditionally sit between those in the global North who want to help, and those in the global South who want investments. They *reintermediate* by allowing entry to new types of development actors such as Kiva itself and the microfinance partners through whom it works.

The policy coherence problem arises when we need a worldview for today and tomorrow, but have development policies for yesterday. Most obvious would be policies that ignore or isolate ICTs so they cannot effectively contribute to development. But what about policies that have mainstreamed and integrated ICTs? Do we instead need to be taking a more "Development 2.0" policy view that recognises the cross-cutting, innovative and transformative nature of digital technology?

Question 4: Do we have the necessary content, structure and process to deliver coherent, effective policy?

Effective policy requires paying attention to three things: the content of policy; the formal and informal institutional structures through which policy is made and implemented; and the processes by which policy is made and implemented.

To date there has been too much focus on policy content, somewhat to the exclusion of the other two components: structure and process. A more balanced view is needed. For example, recent research on e-government policy in Sri Lanka finds the initial content of policy matters relatively little in the overall equation. Instead, it is the nature of the stakeholders involved, their interests and the way in which they form a policy network that more determines the outcome and impact of policy (Stanforth 2009).

From ICT4D 0.0 to ICT4D 1.0 to ICT4D 2.0

The first digital computer put to use in a developing country was installed in Kolkata in 1956 at the Indian Institute of Statistics for numerical calculation work. From that early start until the 1990s, there were two application emphases in the use of computing for development. Initially,

government was the key actor, and IT (as it was then referred to, rather than ICT) was applied mainly to internal administrative functions of the public sector in developing countries. During the 1980s, multinationals and other firms came to the fore, and IT – epitomised by the advent of the microcomputer and its associated software – was seen as a tool for delivery of economic growth in the private sector. We might christen this "ICT4D 0.0" period IT4G – information technology for government, then overtaken by information technology for growth.

Two things happened in the 1990s that gave birth to what might recognisably be called ICT4D 1.0. The first was general availability of the Internet. The second was the Millennium Development Goals (MDGs).

The Internet sparked an upsurge of interest in ICTs, including a reinvigorated interest in how they might be applied in developing countries. At the same time, international development began to move back up the political agenda. This move was given impetus by the search for concrete targets, emerging first as the International Development Goals in 1996 and then formalised as the MDGs in the September 2000 Millennium Declaration, which sought particularly to reduce poverty and improve health and education and gender equality.

The digital technologies of the 1990s, then, were new tools in search of a purpose. Development goals were new targets in search of a delivery mechanism. That these two should find each other was not unexpected. Together they produced "ICT4D", born in a flurry of publications, bodies, events, programmes and project funding: the 1998 World Development Report from the World Bank, highlighting the role of information, knowledge and ICTs in development; the creation by the G8 countries of the Digital Opportunities Task Force in 2000, setting an agenda for action on ICT4D; and the World Summits on the Information Society held in Geneva in 2003 and Tunis in 2005, acting as key learning and policy formation points along the ICT4D path.

The key actors became international development organisations and NGOs, and the priority application of ICTs was to the MDGs. Centrally, the MDGs are about improving the lives of what Prahalad has called the "bottom of the pyramid": the 3 billion on the planet who live on an average of less than USD 2 per day.

Box 2.1. Addressing the needs of the poor

There are three ways in which development actions can address needs of the poor:

- Inclusive: improving opportunities and services that cover all people, including the poor;
- Enabling: supporting the policies or context that will improve the lives of the poor;
- Focused: specifically targeting the rights, interests and needs of the poor.

The initial phase of ICT4D incorporated all of these. For example, there were inclusive e-government initiatives aiming to increase delivery of public services via the Internet. There were enabling actions on ICT governance, seeking to ensure that poor countries' interests were included in the global regimes that control the Internet and telecommunications traffic and tariffs. But most energies were reserved for focused projects: those that took ICTs into poor communities and sought to deliver information and services that might address poverty, health, education and gender equality – the four areas that form the bulk of the MDGs. It is likely that this combined approach – inclusive, enabling, and focused – will remain under ICT4D 2.0. We may, though, see some rebalancing, with more recognition being given to the importance of governance in shaping the outcomes of ICT4D.

What happened during ICT4D 1.0?

With timescales short and pressure to show tangible delivery, the development actors involved with ICT4D did what everyone does in such circumstances. They looked around for a quick, off-the-shelf solution that could be replicated in poor communities in developing countries.

Given that most poverty is located in rural areas, the model that fell into everyone's lap was the rural telecottage or telecentre which had been rolled out in the European and North American periphery during the 1980s and early 1990s. Seen to mean a room or building with one or more Internet-connected PCs, this could be installed fairly quickly, provide tangible evidence of achievement and deliver information, communication and services to poor communities (and could provide sales for the ICT companies who were partners in most ICT4D forums). Thus a host of colourfully-named projects began rolling out, from InforCauca in Colombia to CLICs in Mali to Gyandoot in India.

Naturally, ICT4D 1.0 was not solely restricted to telecentre projects. But the telecentre was the archetype for this period, stretching from the mid/late-1990s to the mid/late-2000s.

What has been the outcome? Painting with a broad brush, we can sum up with three words: failure, restriction, and anecdote. Each of these has led to specific lessons and new watchwords:

- *Sustainability*: given the failure of many ICT4D projects to deliver and/or survive, there is a new emphasis on ensuring the longevity of such projects.
- *Scalability*: given the limited reach of individual telecentre projects, there is a new search for scalable ICT4D solutions.
- *Evaluation*: given that ICT4D 1.0 was often held aloft by hype and uncorroborated, self-interested stories, there is a new concern with objective evaluation of impacts.

More generally, these outcomes of the first decade of ICT4D have led to a rolling re-appraisal of priorities, processes, and purposes. There is no sharp divide to mark out the first from the second phase of ICT4D – the latter began as the first lessons were being learned back in the 20th century. And there is no consensus on what ICT4D 2.0 looks like – the discussion is ongoing.

Nonetheless, we can sketch out some of its component parts – a task that will be taken up in the rest of this chapter.

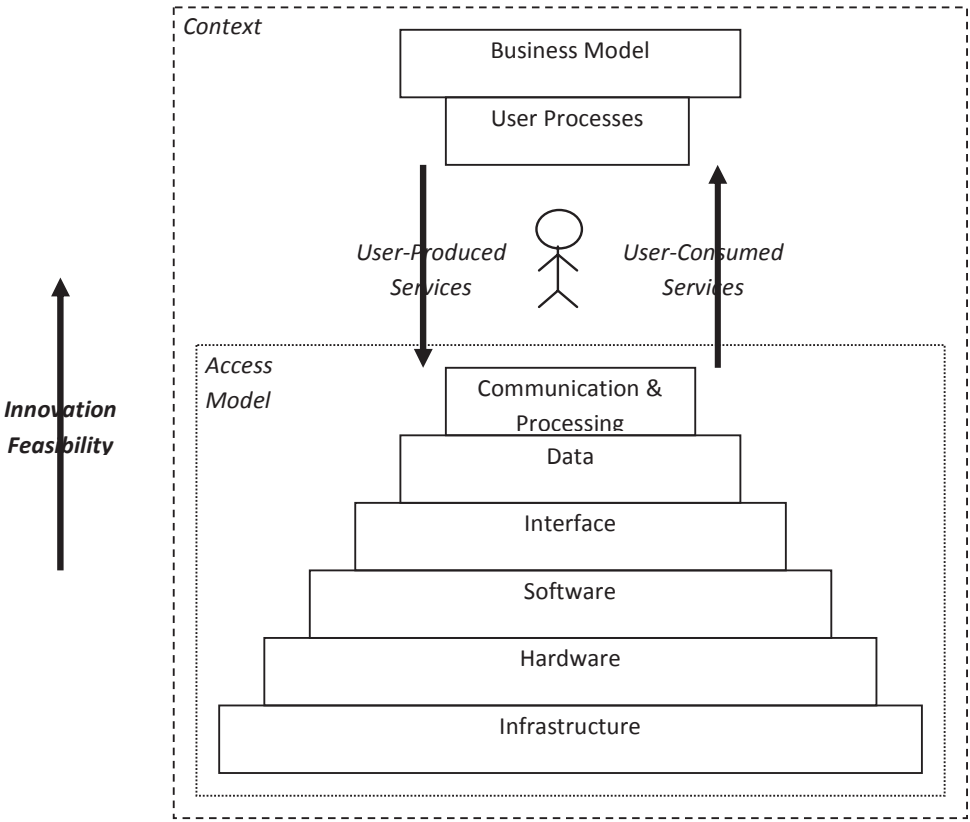
ICT4D 2.0's new technological priorities

Figure 2.2 provides an overview of the technology and processes of ICT4D. Before plunging into how some of these are likely to change in the coming years, though, we will take a step back.

In his book *The Shock of the Old*, David Edgerton argues that we have been too obsessed with technology-as-invention, and too little focused on technology-in-use. Yet it is the latter that has made much more of a difference to people's lives.

The ICT4D field has certainly been prone to this. It has sought to surf each new wave of "technovelty". ICT4D 1.0 initially took an invention-down approach – bringing new technologies into development contexts – much more than it took a use-up approach of understanding how existing technologies were being applied within poor communities.

Figure 2.2: The technologies and processes of ICT4D



Source: Richard Heeks.

If ICT4D 2.0 does shift the invention-use balance, it would mean:

- Less emphasis on what might be used (the Internet and PCs) and more on what is actually used (mobiles, radio, television).
- Less emphasis on fundamental technical innovation and more on application and business model innovation.
- Less emphasis on piloting and sustaining new applications and more on assessing and scaling existing applications.

Box 2.2. ICT4D impact assessment and evaluation

Impact assessment and evaluation have always been the neglected children of the development family. We fear looking back at the current project lest, like Lot's wife, we should be turned into pillars of salt. Instead, we hasten on to the next project. Part of the problem is motivation, which is hard to alter, but part of the problem in ICT4D has been lack of guidance. Initiatives such as the Compendium on Impact Assessment of ICT-for-Development Projects, and the Global Impact Study will help provide such guidance for ICT4D 2.0.

New hardware

As we stand on the threshold of ICT4D 2.0, a key technical question to be answered is: how will we deliver the Internet to the remaining 5 billion?

Back in the 1990s, the initial model was that serving the global North: a PC connected via a landline. But attempted roll-out faced major hurdles as the South's bottom of the pyramid proved far harder to reach. The model was too costly to be sustainable or scalable, and/or the necessary power and telecommunications foundations were often absent. Pushing forward, the Internet-connected PC will therefore require hardware innovations in:

- *Terminals*: there are ongoing efforts to develop the type of low-spec, low-cost, robust terminal devices that could work in large numbers of poor communities. The most high-profile of these is the One Laptop per Child (OLPC) project's XO. Not coincidentally, a slew of relatively similar devices is spewing forth. Some – like the PixelQi and the Intel Classmate – have a similar intention to target developing country needs. Others – Linutop, InkMedia, Elonex ONE, Asus Eee and many more – are more generalised commercial products. Despite twenty years of overpromising and underdelivering – from the "People's PC" to the Simputer – it appears that low-cost terminals will be a central part of ICT4D 2.0.

- *Telecommunications*: wireless has become the delivery mode of choice to provide connectivity into poor communities in the global South. Interest in satellite-based forms such as VSAT during the 1980s and 1990s has given way to a focus on land-based transmission systems. In the same way, attention is turning from WiFi-based systems and innovation to WiMAX. The overriding innovation issue remains the relatively low traffic demand and population density of areas of rural poverty, requiring solutions that can deliver broader reach at lower cost than current technology.

- *Power*: with only 15% of rural households in sub-Saharan Africa having access to electricity, three areas of innovation continue to be required: new, low-cost devices for local electricity generation; better ways to store, carry and transmit electricity; and lower power consumption by ICT devices.

But, in some ways, we stand at a fork in the Internet access road. Do we continue heading down the PC-based route when less than 0.5% of African villages have so far got a link this way? Or do we jump ship to mobile telephony, which already reaches out to more than two-thirds of the African population? Here the requirement for hardware innovations appears to be relatively limited, but offerings from multinational firms appear to be diffusing fairly readily. Half the world's population are mobile phone users; a greater number have access to a mobile; and growth rates are currently fastest in the poorest regions.

Current growth rates will likely carry usage to well over 90% of the world's population, leaving the questions of reaching the last half-billion, and the spread of Internet-enabled phones, given that most phones in poor communities are currently calls-and-SMS-only. For both, the need for hardware innovation may re-emerge. There are also likely to be innovations as iPhone-and-apps-type developments on mobiles converge with netbook-type attempts to produce lower-cost PC-like terminal devices, ending with something like a "Blackberry-for-Development".

Box 2.3. Broadband: new hope/new divide

Broadband is already an integral part of ICT usage in the global North. In the US (one of the poorer performers), for example, by 2008 there were 25 broadband subscriptions per 100 citizens, and 55% of households had broadband, representing around 90% of all Internet connections. By contrast, the subscription rates for most African countries, including Ethiopia, Ghana, Kenya, and Uganda, were well under 0.1% of the population. Tiny Andorra had roughly as many broadband subscriptions as Africa's most populous country, Nigeria.

So as we start seeing digital divides closing around Internet access and mobile phone ownership, a new broadband divide is growing. This does and will continuingly require a strategic response which, if not led, must at the least be coordinated by government. As and where this happens, the development results will be impressive. Broadband uptake is associated at the macro level with growth in indicators such as employment and GDP, and at the micro level there are many new employment- and productivity-enhancing opportunities.

Most likely, in dealing with the "remaining 5 billion" issue, ICT4D 2.0 will simultaneously push along both the PC and the mobile route. But some have asked whether the Internet should be the focus, or whether we should we look at where the poor have "voted with their wallets" and explore whether the simpler, cheaper technologies already in use can deliver sufficient ICT functionality? Rather than wait for handset and bandwidth upgrades to allow mobile Internet access, what can be achieved for development through calls and SMS? And what about older technologies? Access (as opposed to ownership or geographical coverage) figures are hard to come by, but we can estimate that something like 80% of the population in developing countries has access to a radio, and 50% to a television. Hence, early in ICT4D's history, the reinterpretation of ICTs to incorporate radio and television.

Hence, too, the role that convergence will play in ICT4D 2.0. In practice, this means looking at the technologies that already penetrate – mobiles, radios, televisions – and seeking ways to add computing and Internet functionality. Pilot projects are already underway. Community radio stations seek answers to listener questions via e-mail and the Web and broadcast the response, as seen in Kothmale in Sri Lanka. Telecentre databases add an SMS gateway that allows farmer searches in the field via mobile phone, as seen in Warana in India. Many other such hub-and-spoke innovations are likely to find a valuable application in future.

Box 2.4. ICT4D 2.0 and the rise of the individual

There has been a central difference between the application of ICTs in industrialised and developing countries. In the global North the dominant ICT ownership and use model of the past two decades has been first the household and then the individual. In the global South, by contrast, the ownership and use model has been the community or the community group.

This model has inhered both conceptually and practically within almost every ICT4D 1.0 project. It has helped ensure far greater reach-per-device than simple extrapolations of Northern models suggest. The digital divide in the South has thus been overestimated, because shared access to ICTs multiplies many times the basic technology ownership figures. This model has also been the source of broader benefits of some projects, which have helped to form or strengthen community groups. Such groups – often facilitated by an "infomediary" trained from within the local community –consider the implications of information received (*e.g.* about child health or agricultural improvements) or, latterly, participate in creating their own digital content.

Box 2.4. ICT4D 2.0 and the rise of the individual (continued)

This will continue into ICT4D 2.0 but is challenged by a rise in household and even individual ownership, particularly of mobile phones. Early phone projects took a one-phone-per-community model, but this is being overtaken as mobiles diffuse further. Mobiles are thus starting to substitute for some uses of community-owned ICTs and, as they slowly become portable radios, televisions, Web devices, etc., this substitution will increase.

With substitution comes disintermediation pressures and less need for groups and infomediaries. This may spark a new release of entrepreneurial uses of ICTs for development. But it may also have negative consequences. These include loss of community cohesion and greater expression of intra-community and intra-household inequalities. We have already seen signs of the latter with the uptick in domestic violence associated with growing use of mobiles. So ICT4D 2.0 will bring new challenges as well as new opportunities.

It will also bring greater pressures to stop homogenising "the poor" (as this paper does). Instead, there will be a greater need to differentiate groups with different needs and different vulnerabilities. The most obvious – partly recognised within ICT4D 1.0 – will be differentiation of men and women. Other differentiations –location, income, age, and so on – may follow. The destination – taking seriously Amartya Sen's notion of "development as freedom" – may be to treat "the poor" as individuals.

New applications

Moving upwards from the hardware core of ICT4D, we meet an issue that has been alive since at least the 1960s – that of interface design for development. It is a common mistake to equate the poor in developing countries with illiteracy. Adult literacy even in the very poorest countries of the world is still greater than 50%, and two-thirds of 15-24 year-olds are literate. Effectively, every community will have at least some literate members who can act as "infomediaries", thus massively multiplying the accessibility of written materials, online or otherwise. And literacy rates amongst the poor are steadily rising.

Nonetheless, interface innovation is still needed to drive access to ICT-based information, services and jobs. First, in the field of audio-visual interfaces. Second, though now covered for all the world's major languages, there is still some work to be done to create interfaces for all local languages.

Box 2.5. Free and open source software during ICT4D 2.0

Linking hardware and application is, of course, software. During ICT4D 1.0, free and open source software (FOSS) emerged as a potentially important instrument in delivering development-appropriate solutions. It brings the promise of systems that are lower-cost, more-robust, and more locally-customisable than some proprietary solutions. It also brings the promise of helping poorer countries develop local ICT enterprises based on such FOSS customisation.

This promise has been threatened by the resemblance of parts of the FOSS community to a religious cult. Some have adopted a "with us or against us" mentality bordering on paranoia that has produced a welter of self-justification, but very little independent analysis. These FOSSers seem to feel users only have to hear the word of Stallman and they will be converted. Niceties like robust business models, rigorous total cost of ownership calculations or user-friendliness can be forgotten. These perspectives might work behind the walls of Waco, but in the real-world such FOSS developers need to professionalise their act or be eaten for breakfast by more market-savvy players.

There are indications that some professionalisation is happening. The more rational, socialised fraction of FOSS is growing, challenging the inward-looking, technology-focused approach often adopted during ICT4D 1.0. One outcome is the increasing use of FOSS in ICT4D systems, and the growth of FOSS-based ICT4D programmes such as the Health Information Systems Programme, HISP. (Another is the growing fight-back from proprietary solution providers, a bellwether of which was the 2008 addition of a Windows version of the OLPC.)

Even if past and future innovations can provide access to ICTs for the majority of the world, the hardware-plus-interface combination remains an empty husk. When filled with applications software, that husk can have four main development roles: data content handler, interactive communicator, service deliverer and productive tool. These form a chronology of sorts as ICT4D moves slowly to close the gap between supply (what is easy to provide) and demand (what the bottom of the pyramid actually want).

Content. It was rapidly recognised during ICT4D 1.0 that plugging a peasant farmer or slum-dweller into Google was of limited value. Much of the information they required would not emerge because it was not present in digital format. Hence, a series of projects, such as Open Knowledge Network, sought to create relevant local data content focused on livelihood-appropriate issues such as health, education, agriculture, and rights. Hence, too, a recognition once media technologies such as radio and television were incorporated into ICT4D that their non-interactive and broad-scale nature presented a problem of lack of specific data relevance. For these technologies, the phase change to ICT4D 2.0 is therefore associated with

community radio and, to a lesser extent, community television – very localised broadcasting that allows community input. There is growth of participatory video – the creation of video content by the local community and its presentation at individual screenings for community groups. We are also likely to see more content creation with an external purpose. This means use of locally-created data to raise awareness, action or funds from external groups as organisations like Kiva and Treatment Action Campaign currently do.

Box 2.6. Falling barriers to data conversion

One of the informational barriers faced by developing countries is that useful data content is in the wrong format for effective use. New technologies are reducing – and through innovation during ICT4D 2.0 will increasingly reduce – those barriers. Examples include:

- Audio/digital conversion through spoken dialogue and interactive voice response systems to offer development information, or speech recognition systems for literacy training.
- Text/digital conversion either directly via scanning to improve data entry speed and accuracy or enabling conversion to digital speech or Braille output.
- Conversion of mental representations to digital maps to capture local knowledge.
- Conversion of physical measurement data to digital format on low-cost sensor devices such as for blood tests, heart monitoring and agricultural management.

Interaction. There was quite a fuss made in this domain about dealing with "ICTs not IT" – *i.e.* technology "now with added C". Despite this, use of technology for communication – at least, for interactive communication – has been a late arrival. This may be because, faced with the telecentre model, interaction meant e-mail, and the poor had no one to message. Their social networks were seen as small, local and informal. In fact, as take-up of mobile phones proved, these networks have been extended by rural-to-urban and international migration. And they might be extended further by the new technology, thus adding to the social capital of the marginalised majority. How this can be done, and how the interactive communications capabilities of digital media can best be exploited, remains a growing task for ICT4D 2.0.

Services. Just as Web models move from informational to interactional to transactional stages, so ICT4D has recently moved to look at delivery of service transactions for the poor. To date, this has targeted e-government: enabling bill payments via telecentres or helping to order important certificates. After some years of problematic pilot projects, this now seems to be delivering measurable benefits. However, the limited reach of the telecentre model constrains the impact of such innovations, and ICT4D 2.0 seems likely to take forward "m-development": finding ways to hang relevant services onto the growing mobile base. For the moment, this means exploiting existing functionality such as use of SMS for tasks ranging from reminding people living with AIDS to take their anti-retrovirals to monitoring elections. From here forward it means adding further functionality such as "banking the unbanked": using mobiles to deliver financial and banking services to those currently excluded from the mainstream.

Box 2.7. Beyond the MDGs to ICTs for resilient development

Three major issues that have worked their way up the development agenda in the years since the MDGs and the start of ICT4D 1.0 are:

- Security, including terrorism.
- Economic growth, including its variability and fragility as demonstrated by the post-credit-crunch recession and slow recovery.
- Environmental sustainability, particularly climate change.

In the medium term of ICT4D 2.0, climate change may well form the single largest item on the development agenda. But all three issues can be grouped together into the notion of "resilient development", and they drive some key questions for the next phase of ICT4D 2.0:

- How can ICTs ensure development that is resilient in the face of threats such as insecurity, economic fluctuation, and climate change?
- How can ICTs provide development that is sustainable?

That ICTs will form a key part of this development agenda seems beyond doubt. For example, ICTs have been central to both the organisation of terrorism and counter-terrorism; ICT-based enterprise and use of ICTs in enterprise is now a keystone for economic growth and recovery; and ICTs are an integral part of "greener" technologies (though also of the growing issue of e-waste), of mapping climate change, and in assisting communities adapting to climate change.

Production. ICTs seem well understood as tools for delivering information and services to the world's poor. Where they have so far been little understood is as tools the poor can use to create new incomes and jobs. This new productive view is partly encompassed when the poor act as authors of data content, as seen in community radio and participatory video projects. As well as delivering relevant content, these also empower by making those involved into participative creators able to take control of these means of production for the 21st century. Can this now spread further to encompass all of Web 2.0? Can bloggers, mashers and wiki-writers be drawn from the ranks of the world's most disadvantaged? And will this require new applications to achieve?

The sense of empowerment and inclusion that come from content creation are valuable. But the number one priority for the poor is typically income and employment. Here we are only just waking up to the possibilities. Mobiles are widespread. To date the poor have created incomes both around the technology (selling accessories and pre-pay cards) and via the technology (selling or taking calls). But are there novel ICT-enabled microenterprises that could be developed? This is already happening around some rural and urban telecentres with "social outsourcing": the outsourcing of ICT services to social enterprises based in poor communities. But a priority for ICT4D 2.0 will be conceiving new applications and business models that can use the growing ICT base – of mobiles, telecentres and so forth – to create employment.

Box 2.8. ICT4D and the creative industries

The "creative economy" – "a vast and heterogeneous field dealing with the interplay of various creative activities ranging from traditional arts and crafts, publishing, music, and visual and performing arts to more technology-intensive and services-oriented groups of activities such as film, television and radio broadcasting, new media and design" – is seen to provide a growing opportunity for developing countries. These countries are seen as already rich in traditional creative industries, and as providing a low-cost base for new creative industries.

During ICT4D 2.0, digital technology is likely to provide a foundation for growth of both parts of the sector. ICTs are already finding application in traditional sectors such as greater marketing of craft goods and recording and sales of music. ICTs are also fundamental to new media work, including the growth of outsourced jobs in animation, gaming, and the like.

ICT4D 2.0's new innovation models

Underlying the discussion in Box 2.7 are two different views about technology and development – or, at least, two extremes on a continuum. At one end we have the "passive diffusion" view. Taking the lead from mobile telephony's rapid spread, this says that if ICTs do have a developmental value for the poor, then a combination of private firms' search for profit plus the poor's search for value will make it happen. Any attempt to intervene from outside is foolish and wasteful: a force-feeding of the inappropriate that will only lead to messy regurgitation. Conversely, the "active innovation" perspective feels the market will not deliver – or will deliver too slowly – to the poor. Hence, intervention is required in the form of new innovations that will better help to meet development goals.

This chapter does not compare these views in any detail. Certainly active innovation took a knock during ICT4D 1.0. There is a sense that international donor agencies subsidised the unsustainable, and were footling around in the supply-driven telecentre pond, oblivious to the market-driven mobile tsunami around them. On the other hand, non-market interventions have been the root of many subsequently marketised technologies. From the first computers to the origins of the Internet to the competitors spawned by the OLPC XO, active innovation has often been the foundation for passive diffusion. Finally, the two perspectives converge when private firms take the bottom of the pyramid notion to heart and start designing products specifically with poor consumers in mind (often changing the terminology as they do so from "developing countries" to "emerging markets").

What we can conclude is that some element of active innovation is likely to remain in the ICT4D field. In that case, two key questions arise.

First, what to innovate. As the OLPC experience demonstrates, large-scale hardware and operating system innovations specifically targeted at the bottom of the pyramid are risky ventures, only for the very brave or the very foolish. In a moderated way this even applies to the large private sector players. Instead, most ICT4D 2.0 innovation looks likely to occur on a smaller scale either in adapting or in applying existing technologies. Put another way, innovation appears more feasible (though perhaps more localised) as one moves up the chain from new telecoms/power infrastructure to new hardware to new software to new data content to new business models and processes (Figure 2.2).

Second, how to innovate. In terms of the innovation process, we can educe three different modes, here labelled laboratory (pro-poor), collaborative (para-poor), and grassroots (per-poor).

"Laboratory" (pro-poor) innovation is that done outside of poor communities but on behalf of the poor. Telecentres began this way and the OLPC was largely designed this way. This can be an effective approach for engaging resources from the global North in developing country problems. However, it runs into the danger of "design-reality gaps": a mismatch between the assumptions and requirements built into the design and the on-the-ground realities of poor communities.

The jury is still out on whether the various low-cost terminal devices will fall into this gap trap, but initial telecentre models surely did, and when there is a large design-reality gap the outcome is almost certain failure. Hence, the widespread lack of success and sustainability reported for telecentre projects. Nonetheless, there will still be a space for pro-poor innovation in ICT4D 2.0. For example, innovative pro-poor pricing models have been successful. Pre-paid for mobiles has been an essential part of their uptake in the developing world, and no doubt Microsoft's USD 3 Student Innovation Suite software package for developing countries will also prove popular.

"Collaborative" (para-poor) innovation is that done working alongside poor communities. Its use has grown during ICT4D 1.0 and will be central to ICT4D 2.0. The need for participative, user-engaged design processes was a key learning point of the first phase. It is a lesson the informatics discipline generally learnt several decades ago, but there is always a need to reinvent such wheels when new application areas arise, filled as they are by a gold rush of new actors.

Being learnt more slowly – though recognised in development studies in the 1990s – is the lesson that community participation in project design is fraught with pitfalls. Who participates matters – often a very small, vocal, elite minority. How they participate matters – individual and group processes produce different results. Why they participate matters – participants often give the answers they think designers want to hear. And why they do not participate matters – low self-efficacy amongst some developing country groups may stymie effective design input. The very nature of ICT4D participation is also difficult because it requires multiple divides between designer and user to be bridged: techie vs. non-techie; rich vs. poor; often Western vs. non-Western mindset. And, for certain projects, urban vs. rural; men vs. women.

Box 2.9. ICT4D's new innovation intermediaries

A variety of organisational arrangements can exist between ICT system designers and would-be users in poor communities. Traditionally, these have been temporary – an informal grouping that lasts during the period of design and initial implementation, and then dissolves.

However, the growth of ICT4D and the growth of the poor as a market for ICT systems has led to emergence of some more permanent organisational forms: what we can call ICT4D's "new innovation intermediaries". Taking one of the world's ICT4D hubs – Bangalore – we can cite three archetypes that are likely to play a growing role during ICT4D 2.0:

- Direct private sector. Microsoft Research (India) has developed relations with a set of poor communities through which innovations can be piloted. Learning from such pilots can then be fed back to other parts of Microsoft.
- Indirect private sector. The Centre for Knowledge Societies is a contractor that works on behalf of large private firms. Using a mix of anthropological and technological study methods within poor communities, it can report back to its clients on key ICT design and use issues.
- NGO sector. IT for Change works intensively in a small number of rural communities. It can then partner with outside agencies – typically international development agencies – to offer guidance on design good practice.

A mention should also go to the work of the technology-focused NGO Practical Action. Starting with a UK-based model of pro-poor innovation, it moved during the 1980s and 1990s to a collaborative, para-poor model. It has now begun, for example through its PROLINNOVA programme, to capture and disseminate the inventions of local innovators. This is not yet done in the ICT field but it offers a model for the role intermediary organisations can play in grassroots, per-poor innovation.

"Grassroots" (per-poor) innovation is innovation by and within poor communities. In the 1990s, it was hardly a possibility – there was insufficient contact between poor users and the new technologies; old information technologies such as radio and TV provided no innovative

space. But this has changed in the last few years. As mobiles have arrived, and as PCs and the Web start to arrive, the poor have themselves become innovators. Not in the traditional laboratory/research and development sense of the term, but in the sense of adapting and applying the technology in new ways.

By and large we have only anecdotes to date about:

- *New processes*: *e.g.* beeping (or flashing) that allows a message to be communicated without the call being completed. Street vendors use this to receive free "I want to buy now" messages from known customers.
- *New business models*: *e.g.* use of airtime as currency has allowed mobile phones to metamorphose into mobile wallets. Those who own phones in poor communities have therefore been able to use them for payments or for receipt of remittances from distant relatives.
- *New products*: *e.g.* back-street rechipping of phones. Informal-sector enterprises are emerging that strip and resell the circuitry from high-end phones, replacing it with basic calls-and-SMS-only functionality. They then sell the resulting high-end-body-with-low-end-organs as a unique hybrid for those who want the latest look but lack the budget to match.

As the weight of such anecdotes grows there will be pressure within ICT4D 2.0 for more systematic means to "harvest" grassroots innovations. This is something well-practised within the appropriate technology movement. This movement has already been through its cascade from pro- to para- to per-poor innovation, and has evolved methods for capture, assessment and scaling of new ideas from poor communities. Such methods may arguably be enhanced during ICT4D 2.0 by adding features from open source and Web 2.0 innovation models.

Box 2.10. *Jugaad* – Poverty is the mother of invention

As well as asking what and how to innovate, we could also ask: "why innovate?" For those working in and with poor communities the answer is: because you have to. Technologies from the "outside world" fail to work at all, fail to work properly, and break. Hence, the North Indian concept of *jugaad* – the improvised quick-fix to get or keep technology working within an environment of relative poverty and resource constraints.

Although the terminology may be localised, we can see *jugaad* in poor communities worldwide: minor innovations conducted within an environment of constraints. And that can lead us one step further, taking up the observation that resource poverty may be more of a spur to innovation than resource abundance.

We thus arrive at the notion for ICT4D 2.0 of constraint-driven innovation – what Prahalad pictures as innovation within a sandbox of constraining walls; that delivers specialised solutions which match the available resources in a way that "mainstream" innovations fail to do. They are lower in price, lower in capital intensity, lower in skill intensity, make greater use of local materials and are more adaptable to sporadic availability. In sum, they close the "design-reality gaps" that other innovations suffer, and demonstrate that poverty can drive innovation.

ICT4D 2.0's new implementation models

The two previous sections have focused mainly on the technologies of ICT4D 2.0: the main platforms, main applications and the ways in which these will be innovated. We now we look at how these new technologies will be put into action, thus focusing on various aspects of the way in which ICT4D will be implemented.

Funding ICT4D 2.0

ICT4D 1.0 was driven by money from a relatively small number of international development agencies. ICT4D 2.0 looks set to be funded by a much more eclectic range of sources.

Private sector. Private firms are increasingly investing in ICT4D for reasons which appear to lie at the rather murky interface between CSR (corporate social responsibility) and BOP (seeing the poor as bottom of the pyramid consumers). The investments of multinationals like Cisco, Hewlett-Packard, Intel and Microsoft in shifting kit into poor communities are well known. A bit less recognised are the growing developmental investments of IT firms from the South like Datamation and Wipro. There are also

commercial operators setting up their own ICT facilities in poor communities like Drishtee and N-Logue.

Southern governments. Previously – and still somewhat – reliant on donor funding in this area, some governments in the South are starting to invest their own funds in ICT4D, drawn by the push of community demand and the pull of perceived benefits.

New donors. The 21st century is seeing a new wave of Southern aid donors emerging. Countries such as China, India and South Korea are now active in development aid and – given their own economies and expertise – have been particularly keen on funding ICT4D, arguably more so than some Northern donors.

Revived old donors. Funding for ICT4D from Northern and international (*i.e*. Northern-dominated) donors has followed a dot.com-like cycle. It ramped up massively from the late 1990s, fell away after the 2005 Tunis World Summit on the Information Society, and showed signs of reviving from 2008 with, for example, the UK's Department for International Development placing ICTs back onto its agenda and the World Bank doubling its funding for African ICT initiatives.

As new funders enter, there are signs that they are repeating the mistakes of the past. Thus a key task for ICT4D's second phase will be finding ways to incentivise and facilitate learning by new entrants.

This is vital in a broader sense because of the large sums being spent. Development agencies like the World Bank, the US Agency for International Development, Japan's International Cooperation Agency, etc. spend at least USD 2 billion per year on ICTs for developing countries. Private sector investments in ICTs and developing countries – not least the mobile infrastructure – are far larger; for example, USD 10 billion per year in Africa alone on mobile. And the overall figures are far higher still. In 2007, for example, low- and middle-income countries spent around 6% of GDP on ICTs, totalling more than USD 800 billion.

Implementing ICT4D 2.0

New Actors. ICT4D 1.0 was largely implemented by international or national NGOs. They will continue to play a key role in ICT4D 2.0, but seem likely to be joined by others:

Private firms. As ICT4D investment and infrastructure grow, more commercial implementers are entering the fray to stand alongside the typical donor-funded consultants. In addition to examples already mentioned would be firms like Fundamo in South Africa and Globe in the Philippines, which

act as foundations for "m-development" applications. At the grassroots level, too, there is likely to be a growing emphasis on micro-enterprise, so perhaps less talk of telecentres and more of cybercafés.

Partnerships. "Partnerships" have always been a development buzzword, but they have pushed up the ICT4D agenda. There are public/private partnerships. An example would be that between government and private sector implementers in Lebanon's e-education, e-government and e-enterprise initiatives. And there are multi-stakeholder partnerships, such as those created to implement the UN Economic and Social Commission for Western Asia's Smart Communities Project, which are drawn from national and local government, local NGOs and community representatives.

Virtual organisations. Somewhat at "left field", virtuality is allowing development activities to happen at a distance. Kiva allows anyone Internet-connected to loan money to developing country entrepreneurs. UN Online Volunteering allows similar virtual contributions to ICT4D projects.

As these new actors and their new organisational forms play a greater role in ICT4D, it will be important to recognise that they bring different interests and different relations with user communities.

New Approaches: from blueprint to process. Some of the key causes of ICT4D 1.0 project failure can be summarised. These include project designs that draw solely from the understanding of designers rather than users; very rigid project implementation that does not deviate from the initial top-down plans; an inability to build appropriate knowledge that could help the project; a narrow reliance on external resources; and poor project leadership. These are also the constituent criticisms of the "blueprint" approach to development projects suggesting, instead, that ICT4D 2.0 projects could benefit from taking more of a "process" approach.

A process approach to ICT4D projects would include:

- Participation of beneficiaries in the design and/or construction of the ICT4D project.
- Flexibility and improvisation in the implementation of the ICT4D project.
- Learning in order to improve implementation of the ICT4D project (embracing both learning from past experience and iterative learning-by-doing during the project).
- Utilising and building local capacities including those of local institutions.

- Competent leadership of the ICT4D project that is able to promote the other four elements.

Box 2.11. Needs vs. wants on ICT4D projects

During ICT4D 1.0, it seemed that project designers often focused ICT application on a top-down determination of needs, rather than a bottom-up statement of wants. Projects were designed around a standard information needs template that said communities needed better access to information on health, education, governance, etc. However, when community members can freely discuss what they want from ICTs, priority items are often a mix of help with new income and employment, and entertainment.

The Namma Dhwani project in South India exemplifies the contrast. Community radio loudspeakers were wired up around the village to broadcast "developmental" information. Villagers were not happy about this and, at one point, the wires were cut and speakers linked up to a mobile sound system to broadcast music as a statue of Lord Ganesha was paraded around the village for a local festival. The former use of ICTs was seen as one the community needed. The latter was what they wanted.

Where projects focus on needs, they can suffer from low usage (and hence low impact), subversion and a lack of sustainability. Where projects – as, for example, in the case of some N-Logue kiosks in India – allow ICT usage to focus on wants, the opposite tends to happen.

Of course there is a balance to be struck here, but a less paternalistic view of project beneficiaries will be valuable in ICT4D 2.0, as will an understanding that fulfilment of wants – as already noted, we can think of this in terms of Amartya Sen's "development as freedom" – can be at least partly developmental.

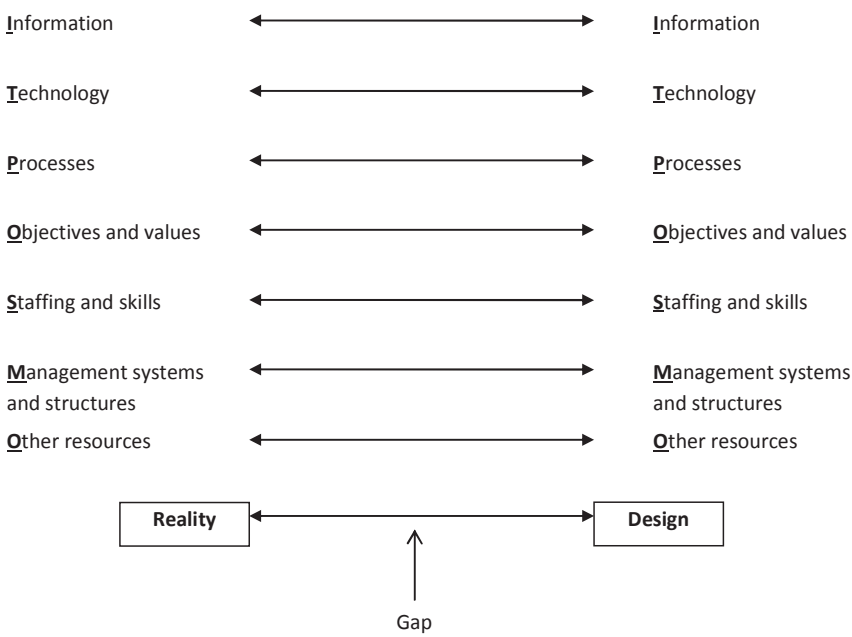
New Techniques: closing design-reality gaps. Analysis of ICT4D 1.0 project failures also shows that a single underlying model can be used to explain that failure: the design-reality gap model. This demonstrates that failures are associated with a large gap between design expectations and the actual realities of the project and its context. For problematic projects such large gaps are found on one or more of a set of dimensions, summarised by the ITPOSMO acronym and shown in Figure 2.3.

Drawing from the model, techniques to identify ICT4D project risks can be applied before, during and after the project. At all three times, the scores obtained can be used for risk identification. In the first two cases, they can also be used to predict likely project outcome, and to identify risk mitigation actions.

Such actions may be dimension-specific: to change the technology design, or to improve the reality of current skills. But these actions could also be more generic, thus acting as a more general guide to ICT4D 2.0 good practice. Examples would include:

- *Mapping project realities*: finding ways to expose the true situation within the project context and integrate it into implementation processes. One example would be the use of soft systems techniques such as "rich pictures", which have a good track record of mapping realities.
- *Using hybrids*: hybrid ICT4D professionals are those who combine an understanding of technology, systems and development (Figure 2.5), and thus help to recognise and reduce gaps.
- *Being incremental*: breaking the overall ICT4D project down into smaller steps and therefore reducing the extent of gap between design and reality that is undergone at any one time.

Figure 2.3: Design—reality gaps in ICT4D projects

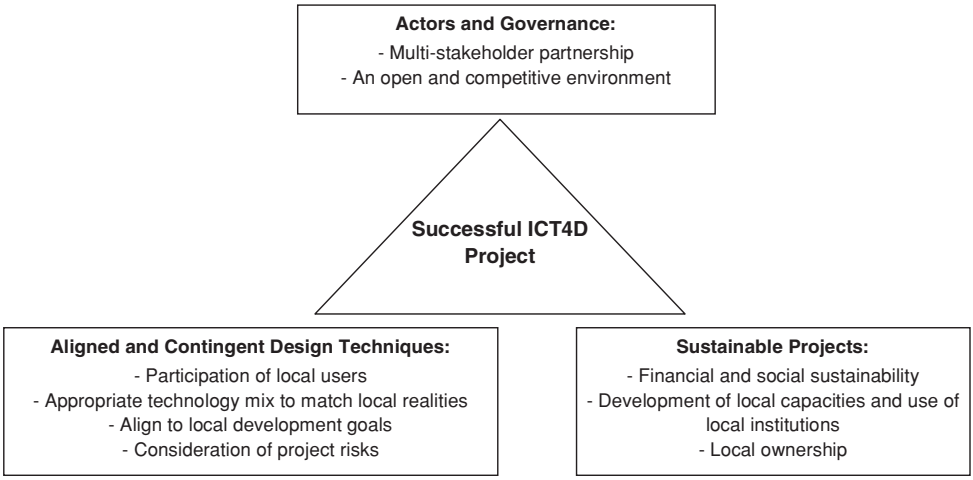


Source: Richard Heeks.

In addition, the process approach described in Figure 2.3 can demonstrably be shown to help close gaps because of the way it exposes project realities and enables flexible and iterative changes to both design and reality.

Putting this all together, we find something very like the guidance for ICT4D project strategy in Figure 2.4, which draws together lessons from ICT4D 1.0.[1]

Figure 2.4: Good practice for ICT4D 2.0 implementation



Source: Richard Heeks.

ICT4D 2.0's new worldviews for action

The key actors in the ICT4D field are drawn from particular disciplinary worldviews. What can we learn by looking at their backgrounds?

Many of those active in the field draw from a computer science background. Some from what we might call the "harder" end dealing with hardware and firmware, some from the somewhat "softer" ground of human-computer interaction. Such expertise is, of course, essential to ICT4D 2.0. It will be essential for delivering the new technological and application priorities detailed in Figure 2.4. It will be an essential part of laboratory/pro-poor and collaborative/para-poor innovation.

But alone, it is not enough. And, where it stands alone, problems arise. The root of a number of ICT4D failures is identified as their techno-centric

approach, dominated by an informatics worldview. Such projects are often analogous to the old medical joke, "The operation was a success but unfortunately the patient died". They deliver a system that works technically but which fails to make a developmental contribution.

To move from the failures of ICT4D 1.0, then, we need to have new, broader worldviews guiding ICT4D 2.0 projects. But where will those worldviews come from? There are two main disciplinary candidates.

The first is information systems. During the 1980s and early 1990s, information systems were the intellectual home of ICT4D before it was called ICT4D; particularly within the work of the International Federation for Information Processing's Working Group 9.4 on social implications of computers in developing countries. This has strengthened with the creation of IS discipline journals dealing solely with ICT4D, new editorial board members on key IS journals being appointed with a specific developing country remit, and, most recently, with the Association for Information Systems' creation of a special interest group on IS in developing countries.

An information systems perspective offers the means to understand many of the problems that beset ICT4D projects. Most notably, it offers models for understanding the human, political, contextual reasons behind why so many ICT4D projects fail. It also offers approaches for addressing these factors during project design and implementation. At its widest setting, information systems even permit us to step right back and answer questions about the political economy of ICT4D: whose interests it promotes, and what its opportunity costs are.

But the information systems perspective falls down in two ways. It has at least in part lost track of the artefact, becoming so much of a social science and so concerned with context that it fails to engage with the technology. It has made few connections with the context, stakeholders and process of development. Information systems tend neither to understand, nor use the ideas of, development studies.

One could argue for incorporation of a fourth worldview: communication studies. It has housed interests in development for decades and provides a key part of the ICT4D community. For simplicity, we will here view its key concepts as incorporated into information systems: a simplification more credible for communication models and telecommunications; less so in studying media.

It is to development studies that we then turn. Development studies have so far failed to adequately conceive or support ICT4D. In part, this has happened because development studies turned away from technology generally in the 1980s; a counter-reaction to the "big science" and

"technology transfer" ideas that characterised the by-then-discredited paradigms which had dominated development in earlier decades.

As a result, ICT4D 1.0 grew as something of a bubble. It was driven by actors external to the development field such as IT vendors, and by a few believers within that field. But it was isolated from the development mainstream, which remained sceptical about technology, especially new technology (despite the fact that in their own homes and workplaces they increasingly relied on it).

As the 2000s progress, though, things have changed in development studies. Science and technology are moving back up the development agenda, driven by human development champions such as Jeffrey Sachs who see technology as central to achieving the MDGs; by the central importance given to science and technology by the NICs (newly-industrialised countries like Korea and Taiwan) and BRICs (Brazil, Russia, India, China) that are emerging as economic powers and as new aid donors; and by new perspectives on technological innovation that show how it can be effective in addressing the problems of the poor.

There are thus greater opportunities within ICT4D 2.0 for engagement with development studies. This is an engagement that will help understand where digital technologies fit into development paradigms, processes and structures. Not only can this guide post-hoc activities such as ICT4D impact assessment, it can also guide pre-hoc activities that seek to understand ICT4D priorities, and ICT4D project design and implementation good practice. A development studies perspective thus provides guidance at both a macro and micro level, all ultimately increasing the likely contribution of ICTs to development.

Integrating perspectives

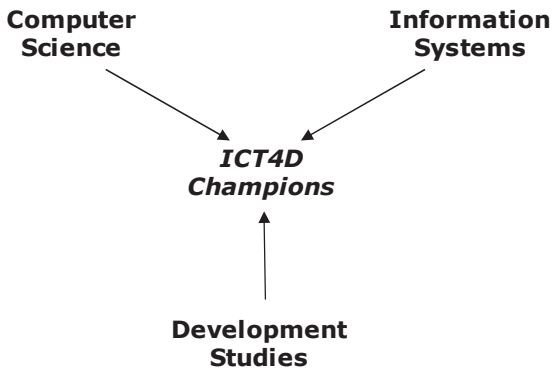
We may conclude that each one of the three intellectual domains – computer science, information systems and development studies – has something to offer the ICT4D field.

Conceptually, this means we need spaces that bring these three domains together. That has not yet been achieved, and it remains the key intellectual challenge during ICT4D 2.0. But there are some promising possibilities in groupings such as the ICTD conferences[2], which get a mix of informatics professionals to address development issues, and in the recently-formed IFIP special interest group on Interaction Design and International Development. Both groupings focus those at the computer science/information systems boundary on the particular needs and practices of system design in a development context. They draw on the broader burgeoning fields of design-

for-development in the academic sphere, and design-for-emerging-markets in the commercial sphere.

Practically, this means that ICT4D 2.0 projects need a combination of the three areas of expertise if they are to succeed. That could be interpreted as meaning multi-disciplinary teams, but just as important will be the issue of leadership. Here we can extend the general finding that successful ICT projects are led by hybrids that span the technical and the organisational.

Figure 2.5: Creating ICT4D 2.0 champions



Source: Richard Heeks.

As summarised in Figure 2.5, we therefore need to develop or find ICT4D champions who are "tribids" They must understand enough about the three domains of computer science, information systems, and development studies to draw key lessons and to interact with and manage domain professionals. How these tribrid ICT4D champions are created is another question. Vocational training will no doubt help; something that those creating Masters programmes in ICT4D are keenly aware of. The author also observes that tribrids tend to self-create during ICT4D projects as leaders from any individual domain rapidly find themselves facing problems that only insights from the other domains can solve.

Box 2.12. Teaching ICT4D 2.0

There is a small, but growing, number of formal training programmes dealing with ICT4D.

The one-year MSc in ICTs for Development at the University of Manchester explicitly uses the Figure 2.5 model as the basis for its training foundation. The experience has been that many participants already have a good foundation of computer science skills, so these are provided only as an option.

The focus of the core curriculum is therefore on three areas:

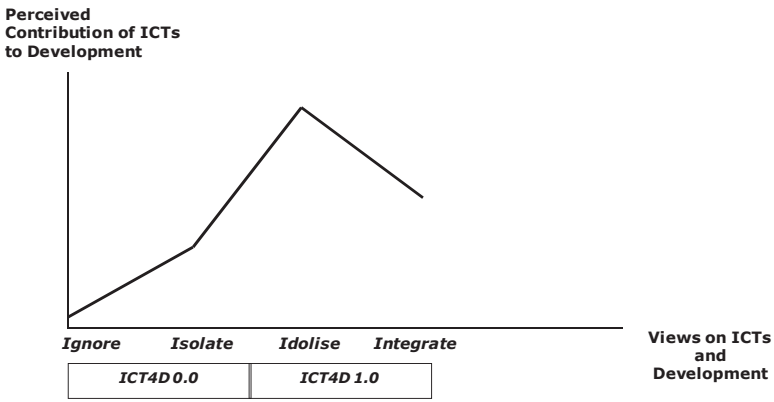
- Development concepts: foundational frameworks of knowledge for understanding development processes and structures.
- Development project practice: knowledge and skills related to managing projects in a development setting.
- Information systems: knowledge and skills for understanding information and information systems, and their construction and implementation within development settings.

The curriculum also links the different domains through a capstone element on ICTs and socio-economic development, and a set of field visits to ICT4D projects in a developing country. In teaching this element, this – and other ICT4D curricula – have often structured themselves around the ability to achieve MDG-like goals (with issues such as economic growth added). A question for ICT4D 2.0 remains whether this "integrated approach" (Figure 2.6) is most appropriate, or whether there is a place for a more transformational "Development 2.0" curriculum.

Strategically, it means that we also need to develop tribrids in ICT4D policy- and programme-making. We can chart this requirement by tracing a chronology of views about ICTs and development, as shown in Figure 2.6.

We can use this to reinterpret our earlier chronology of technology and development. Until the 1990s – what we labelled ICT4D 0.0 – most development programme- and policy-makers tended to either ignore IT (as it then was) completely, or to isolate it away from the mainstream of development into separate policies and ministries. Even if technology overall was seen positively within the development studies paradigms which dominated thinking, IT was relegated to a more marginal role, or even seen negatively (as, for example, in the "Jobs not Computers" graffiti appearing in India during the 1980s).

Figure 2.6: Changing strategic views on ICTs and development



Source: Richard Heeks.

As just indicated, this was a view that continued amongst at least some development officials during the 1990s as part of a more general sidelining of science and technology. But, at the same time, and driven from a technical and computer science-based paradigm that initially touched little on development studies, the ICT4D movement arose. This idolised digital technologies and placed them centre-stage in the development process. The world's main problem came to be seen as the digital divide: lack of access to ICTs.

ICT4D 1.0's failure to live up to its hype has already been charted. The latter part of this phase saw what might be called a reassertion of the supremacy of development studies, which has drawn also from information systems' views on what they see as the overly-narrow conceptions of computer science. ICT thus came to be "mainstreamed" within development, meaning it became subservient to the achievement of development goals, integrated into a long list of other tools and techniques that might prove useful. A typical formulation would start with a development goal, then seek to understand the role of information and communication in achieving that goal, then ask which new technologies – if any – could help deliver that role.

In many ways this integrated approach looks very sensible; it is one that many agencies – the World Bank, Canada's International Development Research Centre, the UK's Department for International Development – are following. It represents where we start with ICT4D 2.0 and lies behind

mantras such as "a means not an end" or "a tool not a goal" that one hears quoted in relation to ICT4D.

Box 2.13. ICT policy: beyond the menu

During ICT4D 1.0, a lot of research and advice about ICT policy seemed to focus much more on content rather than process and structure. To use a catering analogy, there has been an excess of attention to the policy menu; a lack of attention to the cooking and the restaurant. To continue the analogy, though, one can take a menu from a Michelin-starred restaurant and give it to the managers of a McDonalds – that does not mean they will be able to produce the required food. They lack the necessary institutional basis and capacities to do so.

In future, the menu will still be important, and it will change: for example in response to the convergence of digital technologies. However, we should also look more at two aspects during ICT4D 2.0. First, institutional capacities and their location. Experiences with various types of ICT policy suggest the value of autonomous and capable state agencies, combined with strong representative bodies for both the private sector and civil society and a mechanism for robust interaction between these three groups.

In addition to these structural considerations, the process of intervention over time is important. A foundation for some positive policy impact appears to be capacity for flexibility, learning and iteration within the institutions of ICT strategic intervention. Put another way, it may be that the starting content for ICT policy is of less importance than imagined. Instead, what matters more is the capacity to observe and react to the impacts of policy interventions and the contextual changes that beset the ICT domain.

But the integrated approach is also problematic for a number of reasons. By trapping ICT as a tool serving individual development goal silos, it misses out on ICTs' role as a cross-cutting, linking technology. This reduces the chance of diffusion of learning about ICTs, increasing the danger of reinventing wheels. ICTs can also now fall out of development programmes because they have no overarching champions. As many gender activists will tell you, when it comes to development policy, "mainstreamed" can be a synonym for "forgotten": "simply mainstreaming ICT4D … does not work".

As described earlier, putting the ICT artefact front-and-centre in development is highly problematic. But it also achieves things that are lost when ICTs become subsumed through integration. A sense of excitement, motivation and hope about development are lost. The ability to tap into additional development funding sources, such as those of ICT sector philanthropists, can also be lost.

An integrated approach typically means an information-centric approach to ICTs, conceiving them as tools for handling the information and communication that development requires. As a result, it seems harder to recognise and develop ICTs' productive role as the potential basis for thousands of new ICT microenterprises. Finally, the transformative potential of ICTs disappears in an integrated approach. There is no question of Development 2.0: of seeing how ICTs could "move the development goalposts" or of "thinking outside the MDG box".

For an example, we need look no further than the current state of mobiles in development. There are no cross-cutting initiatives to learn about this new mass technology, which is only adventitiously being incorporated into development projects, or to identify its transformative possibilities. Where is the necessary MOTForce – a Mobile Opportunities Task Force to match the earlier DOTForce – without which mobiles' contribution to development will be left to the market, left to chance, or just plain left behind?

Rectifying this during ICT4D 2.0 demands not just project-level tribrids, but policy- and programme-level tribrids. They can provide a more balanced approach to ICT4D strategy; an innovative approach that pulls its plan of action from an amalgam of the key questions each domain can answer:

- What is possible with digital technology? (from computer science)
- What is feasible with digital technology? (from information systems)
- What is desirable with digital technology? (from development studies)

Box 2.14. Research priorities for ICT4D 2.0

Much of the research agenda for ICT4D 2.0 flows from the phase change components outlined here:

- *New technologies*: *e.g.* more research on mobiles, FOSS, broadband, and integrating different ICTs.
- *New applications*: *e.g.* more research on content creation by poor communities and the potential for Web 2.0; and on using ICTs for productive purposes.
- *New innovation models*: more research to understand best practice in collaborative/para-poor innovation, and the realities of facilitating and scaling grassroots/per-poor innovation.

Box 2.14. Research priorities for ICT4D 2.0 (continued)

- *New implementation models*: more research on new ways to fund, organise and manage ICT4D.
- *New viewpoints*: more research that makes intellectual connections between development studies and the computer science/information systems boundary area; more research on ICT4D "beyond mainstreaming".

It will include specific elements drawn from other text boxes, such as:

- *Urban development*: researching use of ICTs in the developing world's cities.
- *Climate change*: researching how ICTs can record, publicise, reduce, and help deal with the consequences of climate change in developing countries.
- *Beyond the menu*: researching how ICT4D policy is made and implemented rather than simple reformulations of policy content.

Finally, we can identify some more generic research priorities:[3]

- *Defining development*: researching what vision of development ICTs can facilitate: just the MDGs or more than that? And researching how ICTs redefine development – is there an emerging "development 2.0"?
- *Standing back*: more research that "stands back" in various ways; in terms of time, taking a longitudinal approach; in terms of engagement, taking a more independent and less self-interested view on projects; in terms of focus, taking a more political economy and critical *studies* perspective that analyses who frames the ICT4D agenda and whose interests are being served.
- *Evaluation*: moving (per Figure 2.7) from researching ICT4D readiness and availability to researching uptake and – especially – impact. Rigorous impact assessment is the Macavity of ICT4D – much talked about but hardly ever seen.

Conclusion

There is no sharp dividing line to let us say, "ICT4D 1.0 stopped here; ICT4D 2.0 began here". On the ground there is a sense of evolution, not discontinuity. And yet … something messy, fuzzy but new is emerging. It makes sense to see what happens if we give this a label and a summary, as shown in Table 2.1.

Table 2.1: Summary of ICT4D phases

Issue / **Phase**	**ICT4D 0.0** (1960s – mid-1990s)	**ICT4D 1.0** (mid-1990s – mid-/late-2000s)	**ICT4D 2.0** (mid-/late-2000s onwards)
Iconic Technology	PC Database	Telecentre	Mobile Phone
Key Application	Data Processing	Content (& Interaction)	Services & Production
The Poor	Who?	Consumers	Innovators & Producers
Key Goal	Organisational Efficiency	MDGs	?Growth & Development?
Key Issue	Technology's Potential	Readiness & Availability	Uptake & Impact
Key Actor	Government	Donors & NGOs	All Sectors
Attitude	Ignore --> Isolate	Idolise --> Integrate	Integrate --> Innovate
Innovation Model	Northern	Pro-Poor --> Para-Poor	Para-Poor --> Per-Poor
Dominant Discipline	Information Systems	Informatics / Development Studies	Tribrid of CS, IS and DS
Development Paradigm	Modernisation	Human Development	?Development 2.0?

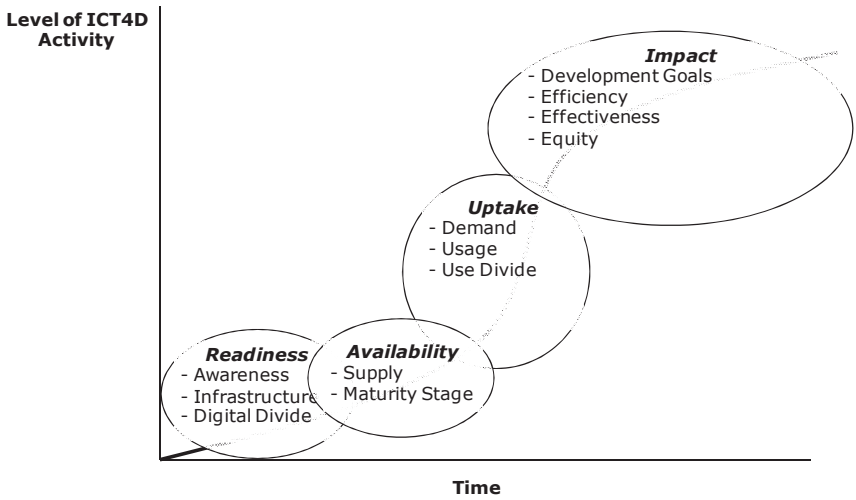
What, then, might we argue are the key differences between ICT4D 1.0 and 2.0? In answering this, we could draw parallels with the concept of Web 2.0. For example, ICT4D 2.0 is about the world's "long tail" – using digital technologies to draw on the capacities of the 80% who hold only 20% of the world's resources. Or, using Eric Schmidt's "don't fight the Internet" characterisation, we can see ICT4D 2.0's slogan as "don't fight the poor". Where 1.0 imposed pre-existing designs and expected the poor to adapt to them, 2.0 designs around the specific resources, capacities and demands of the poor. Or, we can transform "the network is the platform" to argue that while ICT4D 1.0 saw ICTs as a tool for development, the second phase sees ICTs as the platform for development.

Alternatively, we could break things down into a chronology of ICT4D issues, as represented in Figure 2.7:

- *Readiness*: do we have the policies and infrastructure to make ICT availability possible?

- *Availability*: how can we roll-out ICTs to the poor to help them become users?
- *Uptake*: in what ways can we implement and apply ICT to make it useful?
- *Impact*: how can we use ICTs to make the greatest developmental impact?

Figure 2.7: Changing ICT4D issues over time



Source: Richard Heeks.

Of course, readiness and availability and uptake issues will remain relevant for at least a generation; indeed forever as new waves of technology emerge. And they present ongoing needs for innovation in infrastructure, hardware and software. But mobiles are already a reality, and Internet-connected PCs are a growing possibility, particularly for the urban and peri-urban poor. So where ICT4D 1.0 was about getting the foundations in place, and proof of concept such as piloting largely supply-based uptake, ICT4D 2.0 can turn part of its attention elsewhere.

It can stop thinking solely about pilots, and can instead think more about sustainability, scalability and impact. It can stop thinking from a mono-disciplinary perspective, and can instead think more from a tri-disciplinary perspective that combines computer science, information systems and

development studies. And it can stop thinking solely about "needs" – often defined from outside poor communities in rather paternalistic terms. Instead, it can also think about "wants" – what is it that the poor themselves actually demand? How do and would poor communities use digital technologies if left to their own devices?

In conclusion and above all, we can see that ICT4D 2.0 is about reframing the poor. Where ICT4D 1.0 marginalised them, allowing a supply-driven focus, ICT4D 2.0 centralises them, creating a demand-driven focus. Where ICT4D 1.0 – fortified by the bottom of the pyramid concept – characterised them largely as passive consumers, ICT4D 2.0 sees the poor as active producers and active innovators.

Three overarching questions for this next phase therefore emerge. How can the poor be producers of digital content and services? How can they create new incomes and job through ICTs? And how can we recognise and scale the ICT-based innovations they produce?

Notes

1 Developed from SDC (2007) *SDC ICT4D Strategy*, Swiss Agency for Development and Cooperation, Berne.

2 For example, www.ictd2009.org; *www.scribd.com/doc/14234869/ICTD-2009-Proceedings*.

3 Some ideas drawn from: Walsham, G. & Sahay, S. *ibid*.

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Chapter 3

How the Developing World may Participate in the Global Internet Economy: Innovation Driven by Competition

By Rohan Samarajiva[1]

Full participation in the global Internet Economy requires electronic connectivity of increasing complexity. Today, due to a wave of liberalisation and technological and business innovation, much of the world is electronically connected, albeit not at levels that support full participation. This chapter examines the contributions made by competition and business innovation to achieving current levels of connectivity and the possibilities for extrapolation to ensure widespread participation in the global Internet Economy.

The biggest challenge facing the developing world in this area is connecting low-income groups. Solutions to this problem will make finding solutions to others easier. In addressing the challenge of connectivity, this chapter draws extensively from research conducted in South and Southeast Asia. In the concluding section, policy implications – including articulations with tax and other policies that must be aligned if access is to translate into wealth creation – are discussed.

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The OECD Seoul Declaration on the Future of the Internet Economy covers a full range of Internet-supported economic, social and cultural activities and related ICTs which will strengthen the capacity of countries to improve the quality of life of all their citizens by:

- Providing new opportunities for employment, productivity, education, health and public services as well as addressing environmental and demographic concerns.
- Acting as a key driver for the creation of enterprises and communities and stimulating closer global co-operation.
- Enabling new forms of civic engagement and participation that promote diversity of opinions and enhance transparency, accountability, privacy and trust.
- Empowering consumers and users in online transactions and exchanges.
- Reinforcing a culture of security which applies to information systems and networks, and their users.
- Developing an increasingly important platform for research, international science co-operation, creativity and innovation in many different sectors.
- Creating opportunities for new economic and social activities, applications and services through ubiquitous and seamless access to communication and information networks.
- Promoting a global information society based on fast, secure and ubiquitous networks which connect billions of people, machines and objects.

The fact that the OECD held a ministerial-level meeting on the Internet Economy and resolved to promote ubiquitous access to ICTs to advance its realisation indicates that the global Internet Economy has not yet been fully realised, even within OECD countries. It is even less of a reality for the billions living in developing countries, especially those who are poor. The Seoul Declaration takes this into account explicitly, declaring that it seeks to make the Internet Economy truly global through policies that:

- Support expanded access to the Internet and related ICTs, especially for people in developing countries.
- Recognise the potential of the Internet and related technologies to provide enhanced services to people with disabilities and special needs.

- Recognise the importance of a competitive environment for the successful growth of the Internet Economy and the opportunities this can bring for development, particularly for people and regions with the most limited economic means.
- Promote use of Internet and related ICT networks by all communities as well as the creation of local content and multi-language translations to improve economic and social inclusion of people with different capabilities, education, and skills, and to preserve cultural and linguistic diversity.
- Facilitate the introduction of internationalised domain names (IDNs) while ensuring the integrity and stability of the Internet.
- Increase cross-border co-operation of governments and enforcement authorities in the areas of improving cyber-security, combating spam, as well as protecting privacy, consumers and minors.
- Harness the potential of the Internet to tackle global challenges such as improving energy efficiency and addressing climate change.

Key for the purposes of this chapter is the third bullet point flagging the importance of a competitive environment for the flourishing of the Internet Economy, especially for people and regions with the most limited economic means. The massive progress achieved in the past few decades in bringing electronic connectivity to the developing world was indeed made possible by opening up the market for connectivity services, allowing varying degrees of competition. Success in expanding that connectivity to broadband networks will require equal adherence to the principle of competition and increased emphasis on its effective implementation.

What is the Internet?

A common mental image of the Internet features a desktop or laptop computer connected by wire or wirelessly to an access path with adequate capacity to allow non-stop downloads and uploads at certain speeds or to a broadband connection. However, awareness of the importance of the mobile as an alternative pathway is increasing, as acknowledged in the World Economic Forum's 2008-09 Global Information Technology Report, and Aspen India's 2008 "M-Powering India: Mobile Communications for Inclusive Growth". *The Economist* noted, in September 2008:

> [T]he number of mobile phones that can access the Internet is growing at a phenomenal rate, especially in the developing world. In China, for example, over 73m people, or 29% of all Internet users in the country, use mobile phones to get online. And the number of people doing so

> grew by 45% in the six months to June—far higher than the rate of access growth using laptops, according to the China Internet Network Information Centre. (*The Economist*, 2008)

Broadband has been defined by the Partnership for Measuring ICT for Development as an Internet service of at least 256 kbps in one or both directions. The US Federal Communications Commission also seeks to develop a definition of broadband. Separate definitions are given for fixed-line and mobile broadband – a distinction that probably would not have been made ten years ago. The incomplete nature of the definitions indicates that the phenomenon is inchoate.

There is value in thinking of the Internet, or the cluster of technologies enabling the Internet Economy, as a bundle of functions rather than as the composite, common-sense image just described. Functions currently provided include:

- communication in multiple forms (synchronous/asynchronous, one-to-one/one-to-many, etc.);
- information retrieval, including search;
- publication;
- transactions (including payments);
- remote computing.

This hierarchy moves from simple to complex. It is no surprise that a sophisticated user sitting at the end of a multi-megabyte pipe can use all the aforementioned functions easily, especially if they possess a credit/debit card. What is truly surprising is that many people who have never come in contact with a standard computer are already performing some of these functions electronically.

For example, when a poor person with a prepaid mobile connection types in a short code to check his or her account balance, they are engaging in one of the more complex current Internet functions: remote computing. Downloading a ringtone and paying for it from the "load" on a prepaid phone is a transaction that includes an electronic payment – again, something quite complex.

Mobile devices are now used for all forms of communication, including text-based (SMS) and context-based ("missed calls") communication. These functions can be performed with the simplest of today's second-generation mobile handsets even in countries that have yet to release the frequencies needed for third generation (3G) or sophisticated data-friendly services. In other words, billions of poor people in developing countries are also

participating in the Internet Economy, albeit in somewhat constrained and unfamiliar forms.

As countries introduce 3G mobile networks, the migration of high-end phones to low-income users will accelerate. As of October 2008, the modal value of new phones amongst socio-economic classification (SEC) groups D and E in Bangladesh was USD 43 (mean USD 58). The modal value of second-hand phones was USD 29 (mean USD 35). Qualitative research conducted as part of LIRNE*asia*'s Teleuse@BOP3 study showed that many of the second-hand phones were quite sophisticated. Both types were being used to transfer music from one phone to another using Bluetooth, to listen to music, watch video, play games, obtain news and employment information (sometimes as the sole source), and to keep records of transactions. The range and frequency of uses was much higher amongst the poor in Sri Lanka, the Philippines and Thailand, countries with relatively higher levels of disposable income, literacy and penetration.

It is becoming clear that agricultural information is better provided on the almost-ubiquitous mobile, where it is available whenever and wherever the user wants it rather than in kiosks with opening and closing hours or even in homes. Innovative companies such as CellBazaar in Bangladesh are introducing rudimentary e-commerce to bottom of the pyramid (BOP) users who might otherwise never get access to such services, using SMS and WAP (Wireless Access Protocol). Information on candidates in the 2009 Indian general election, such as their particular assets and liabilities, educational attainment and whether they had criminal records, was available through SMS. BuzzCity and Gupshup are creating social networking in the mobile space. Once the regulatory issues of m-payments are resolved, it is likely that mobile phones, not credit cards, will become the main mode of e-payment in the developing world, as is already the case in some parts of Africa.

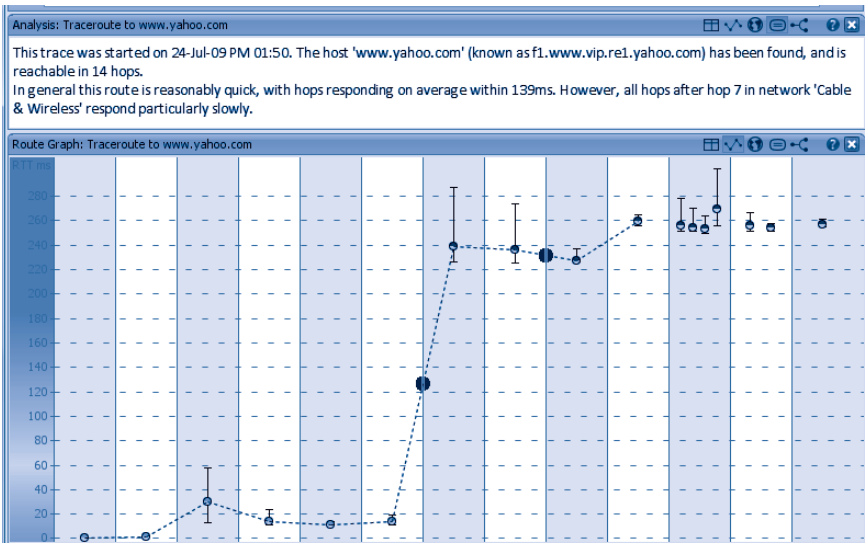
Preconditions for inclusion

Billions of poor people becoming electronically connected and capable of using some of the functions of the Internet is cause for celebration, but not for complacency. The present capabilities of 2G networks and handsets used by most poor people do not, for example, allow for the complex search and information retrieval activities taken for granted in conventional desktop/laptop-based Internet use. Publishing, in the sense of posting on websites and blogs, is quite cumbersome on a simple mobile handset, Twitter excepted. The qualitative research conducted as part of the LIRNE*asia* Teleuse@BOP study showed that heavy users tended to use both modes: downloading music at cybercafés, transferring it via Bluetooth and then listening on mobile handsets, for example.

There is little question then that access to broadband from both mobile handsets and computers must be improved if the emerging Internet Economy is to be inclusive. Governments the world over must give priority to and expedite spectrum refarming and transparently release frequencies to enable operators to offer 3G technologies and beyond. Looking at spectrum solely as a source of government revenue at point of release is not conducive to broad deployment or long-term government revenue generation.

The value of wireless in the access network or the "last mile" does not negate the fundamental importance of wireguides in the backhaul component. Behind each WiFi hotspot is a series of wireguides that connect users to the Internet cloud, in most cases in the continental United States. In the same way that the strength of a chain is determined by its weakest link, the overall performance of one's Internet connection is determined by the slowest component in the connection. LIRNE*asia*-IIT Madras research on broadband quality of service experience (QoSE) has shown that the real bottleneck for most users in developing countries is the international segment, where undersea cable and satellite capacity still appear to be under-provisioned by operators (Figure 3.1).

Figure 3.1: Return trip time (RTT) to www.yahoo.com, 24 July 2009 1350hrs



Note: Y-axis indicates the return trip time (RRT) to a server. Up to 6th hop IP addresses are within Sri Lanka (*www.whois.net*); the "leap" is from a local server to the first entry point to USA.

Source: LIRNE*asia* (2009). Broadband Quality of Service Experience. Test findings.

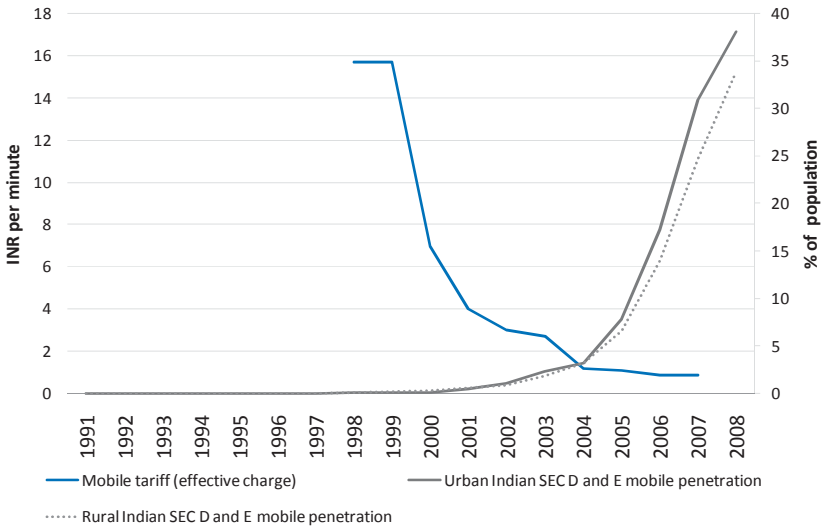
Clearly, much needs to be done to improve the supply of international and national backhaul capacity that is hindering both rich and poor in developing countries from participating in the Internet Economy. Unless these producer goods are plentiful and reasonably-priced, inclusion cannot be realised. The best way to achieve this is through policy actions conducive to participation by a greater number of suppliers in the backhaul market.

Decreased market barriers = increased connectivity

Connecting a majority of the world's population to electronic networks within just a few decades, either directly or through the connections of others, is an extraordinary public policy achievement. It is claimed that there are over 4 billion active SIMs worldwide, and a majority of the world's phones are now mobile. Getting from the gloomy-yet-effective prognostications of the Maitland Commission in 1984 to the current reality, in which the 87% of the poor in the Indo-Gangetic Plain[1] have made a phone call in the last three months and 41% own a mobile or fixed phone, has taken only 24 years. Understanding the causal factors is important, not only because the electronic foundation for the Internet Economy is not yet complete, but because there is value in adapting the lessons of the success of narrowband voice connectivity to ensure broadband connectivity for all. At a minimum, there is value in understanding what did not work in narrowband voice to avoid repeating failures.

The key to first generation connectivity for the poor is shown in Figure 3.2, adapted from a figure first developed by the Telecommunication Regulatory Authority of India (TRAI). Lower prices invariably lead to greater connectivity, which leads to even lower prices and even greater connectivity.

Figure 3.2: Mobile tariffs and the growth of Indian mobile in socio-economic classification D and E



Sources: Adapted from TRAI (2005), "Recommendations on Growth of Telecom Services in Rural Areas: The Way Forward", retrieved August 4, 2009 from http://ccaharyana.gov.in/recom3oct05.pdf; LIRNE*asia* (2009) Teleuse@BOP3. Survey findings.

Market entry

Across countries, the key to growth was significant market entry. This took the form of transparent entry in Pakistan, opaque licensing in Bangladesh and even "back door" entry by so-called fixed operators into the mobile space in Nepal. The common factor was a sufficiently significant number of suppliers with at least one willing to engage in disruptive competition.[2] Different operators assumed this role in different countries. In India, Reliance created a disruption and caused others to follow. In Thailand, the acquisition of a Thai-owned operator by a foreign operator served as the trigger. In Sri Lanka, late entry of the incumbent fixed operator into the mobile space through an acquisition set off the latest rapid growth phase.

Investment

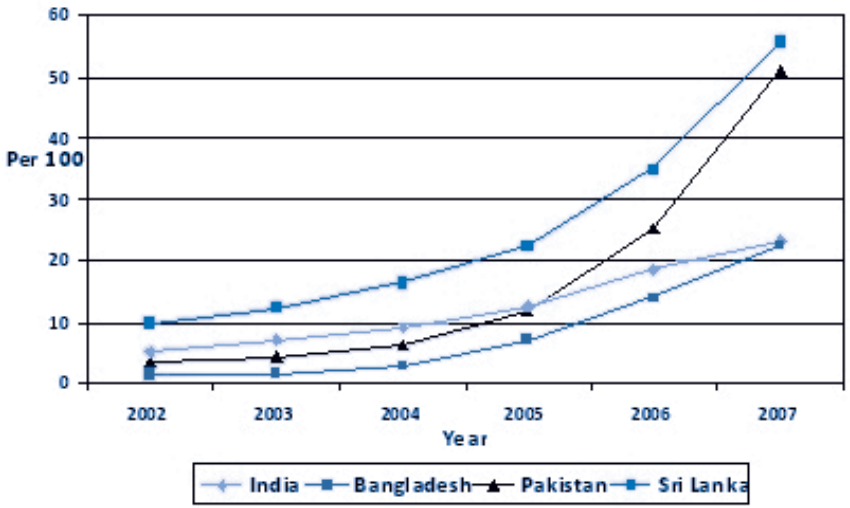
Growth in connectivity cannot occur without investment. The relaxation of government barriers to market entry resulted in increased investment,

supplied in most countries – with the notable exception of India – by external sources. But even in India the telecom sector attracted the second largest amount of foreign direct investment in absolute terms and the government raised the permitted FDI threshold to 74% in 2005.

Pakistan has seen the most dramatic improvement in connectivity in South Asia, and possibly the world, in the past decade, as shown in Figure 3.. Pakistan is a large country with a population of 162 million in 2007. With a population/sq. km of 204, it is the least densely populated amongst South Asia's non-micro states, compared to Sri Lanka (305) India (342) and Bangladesh (1 101).[3] Generally, low density poses additional difficulties in increasing connectivity.

Pakistan's per-capita GDP is considerably lower than that of Sri Lanka, suggesting that its connectivity should be significantly lower, based on the Jipp Curve. But this is not the case, with the exception of overall access paths (fixed plus mobile connections, as shown in Figure 3.), where Sri Lanka was at 55.58 at end 2007, compared to Pakistan's 51.12. This is a substantial narrowing of the gap since 2002, when Sri Lanka had 9.58 access paths/100, compared to Pakistan's 3.65.

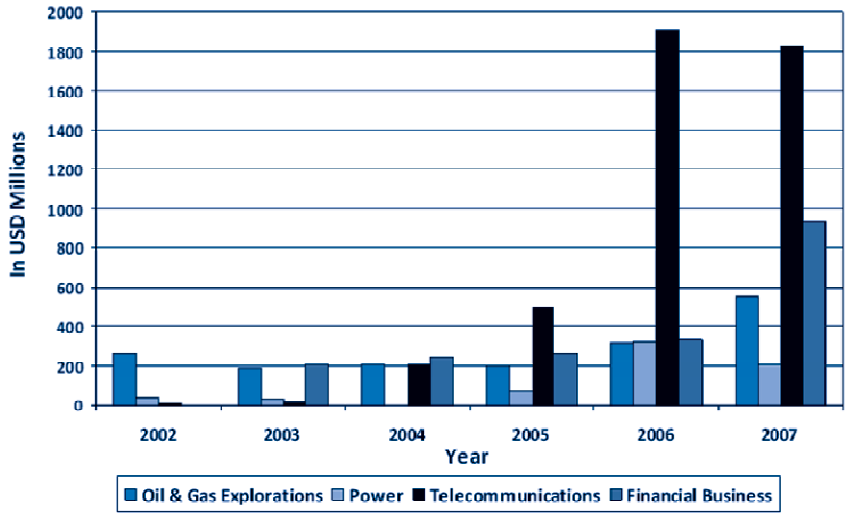
Figure 3.3: Access paths/100, 2002-07
Pakistan compared with South Asian peers



Source: ITU (2008), ICT statistics database, retrieved from www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx.

How was this good performance achieved? FDI into Pakistan's telecommunications sector increased massively in 2002-07, as shown in Figure 3.4. From a negligible USD 6.04 million in 2002 it increased to USD 1 905.06 million in 2006 (accounting for over 50% of total FDI) and USD 1 824.25 million in 2007 (close to 40%). Major reforms took effect in 2004, with the adoption of an exemplary licensing framework and the conduct of mobile license auctions. Mobile growth rocketed up from that point, as did FDI.

Figure 3.4: Foreign direct investment in the principal sectors in Pakistan, 2002-07



Note: FDI for the power sector in 2004 was USD -14.24 million.

Source: State Bank of Pakistan (2008) Economic Data. Retrieved from http://www.sbp.org.pk/ecodata/NIFP_Arch/index.asp

Lessons from the mobile success story for broadband

In India, home to a significant proportion of the world's poor, connectivity is not associated with low use of the network. In fact, India's average minutes of use are double that of OECD countries. The low prices and high use of India's network point to the core explanation for the success of connecting billions over the past decade: the discovery and application of the "budget telecom network model", an entirely new South Asian business

model akin to the budget airline model implemented by carriers such as Air Asia and RyanAir.

The budget telecom network model

The budget telecom network model first emerged in the South Asian markets of Bangladesh, India, Pakistan and Sri Lanka, evidenced by the fact that their total costs of ownership were the lowest at less than USD 5 in 2007, compared to an average of USD 13.15 across 77 emerging economies.[4] Operators in the South Asian region tend to be quite profitable in terms of earnings before interest, taxes, depreciation and amortisation (EBITDA), though there is considerable volatility.

Table 3.1: Operator revenues, EBITDA and EBITDA margins in selected South Asian markets (2005)

Country	Revenue (USD)	EBITDA (USD)	EBITDA Margins (%)
Sri Lanka	259 041 928	124 833 464	48
India	26 723 674 194 (2007)	9 938 340 523 (2007)	37 (2007)
Bangladesh*	655 900 000	344 500 000	54
Pakistan	978 802 178	n/a	n/a

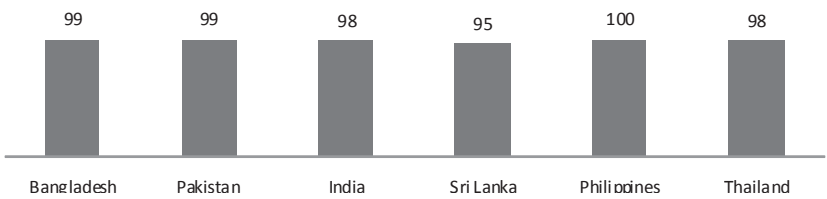
*Data are only for the three main mobile service providers: GrameenPhone, Aktel and Bangalink, whose total market share amounted to 93% in 2005.

Sources: Sri Lanka: Company annual reports, press releases by companies; Malik, P. (2008), *Telecom Regulatory and Policy Environment in India: Results and Analysis of the 2008 TRE Survey*; Bangladesh Telecommunications Regulatory Commission (2007) Annual Report. Revenue and EBITDA margin for Bangladesh (2005) as reported by Merrill Lynch are different. Pakistan Telecommunication Authority (2005), Annual Report.

Difficult policy and regulatory environments and low purchasing power of customers in the region appear to have compelled operators to innovate, both in terms of reducing operating expenditures to a minimum and serving the "long tail"[5] of customers using only a few calling minutes per month. The latter innovation rests on the reduction of transaction costs associated with prepaid customers, an overwhelming majority of the SEC D and E segment represented in the Teleuse@BOP study (Figure 3.5). The simple fact that prepaid avoids the more or less invariable costs of generating and

transmitting a monthly bill lowers overall transaction costs, a valuable reduction when revenue per customer is very low.

Figure 3.5: Prepaid mobile connections at the bottom of the pyramid (% of socio-economic classification D and E mobile phone owners)



Source: LIRNE*asia* (2009) Teleuse@BOP3. Survey findings.

Prepaid also allows customers to pay when they can or need to use the service. This suits the requirements of the poor, many of whom have irregular income patterns. The introduction of low-value recharge cards and especially electronic reloads that allow for the greatest payment flexibility was of special significance in making the model work.

In essence, the budget telecom network business model is an innovation driven by intense competition and in response to the strict regulatory environments and low purchasing power of South Asian countries. If not for competition, this innovation would not have taken place. The model was also borne out in Nepal, a country of 29 million people with many similarities to the South Asian countries where it is operational. Nepal had relatively high mobile prices in 2008, but in 2009 the prices of all mobile operators dropped sharply despite no new licences being granted. The cause was found to be entry – not the conventional type but a form of back-door entry where certain wireless-access operators licensed as "fixed" entered the mobile space.[6]

Lessons for Internet access

What lessons does the budget telecom network model hold for "expand[ing] access to the Internet and related ICTs, especially for people in developing countries"?

Expecting that conventional models of always-on, all-you-can-eat broadband will connect the billions of poor people now connected to voice, if at all, is as realistic as thinking that the conventional business model of

voice telephony would have succeeded in connecting the poor in the Indo-Gangetic Plain. As with voice telephony, it is imperative that operating expenses be lowered. This will include, most importantly, the key input cost of international backhaul. Radical reductions in domestic leased-line prices observed in emerging economies suggest that there is plenty of room for improvement in the levels of competition in leased lines, and in some regions, especially Africa and parts of the Indian Ocean, greater supply. India, a country that has paid sustained attention to domestic and international leased-line prices, has reduced both dramatically (Table 3.2 and 3.3).

Table 3.2: Trends in domestic leased line tariffs in India (for highest distance slab, i.e. > 500 km) for the incumbent, USD per annum, 1998-2005

Year	Capacity			
	64Kbps	2Mbps(E1)	DS-3	STM-1
1998	33 043	157 885	3 315 582	9 946 745
1999*	2 207	50 586	1 062 313	3 186 940
2000	2 053	47 059	988 235	2 964 706
2001	2 003	32 137	674 875	2 024 624
2002	1 994	31 990	671 791	2 015 372
2003	2 106	33 779	608 028	1 824 084
2004	2 183	20 009	420 191	1 260 573
2005	2 103	19 281	404 908	1 214 724
Nov 2005*	986	19 041	137 970	370 072

Source: Kathuria, R. (2009), Comparing the Impact of Decline in Leased line Prices in India and Indonesia: Lessons for Latin America. Unpublished paper.

*Regulatory price revision implemented

Table 3.3: IPLC (half circuit) tariff, India to US, 2000-2008 (USD per annum)

Year	Capacity		
	E1	DS3	STM1
1998	413 631.02	-	-
1999	404 690.73	-	-
2000	342 245.99	6 203 208.56	17 967 914.44
2001	333 889.82	6 203 208.56	17 529 215.36
2002	54 009.14	979 019.53	2 835 479.85
2003	67 558.68	1 033 779.34	2 994 077.65
2004	53 888.13	1 011 823.56	2 808 094.59
2005	44 390.89	790 753.72	2 191 717.79
Nov 2005	28 483.79	227 870.29	655 127.08
2006	26 209.68	209 677.42	602 598.57
2007	25 158.19	201 366.74	578 840.80

Source: Kathuria, R. (2009), ibid.

In addition to the reduction of input costs, extension of the budget telecom network model will be essential. Flat-rate pricing models are not appropriate for poor people with irregular incomes. They will purchase broadband access the same way they do voice telephony and shampoo: in small, prepaid increments as money becomes available and needs arise.

Broadband is currently offered in prepaid form in South Asia. Interestingly, these offers tend to come from mobile providers using HSPA/HSDPA rather than from fixed broadband (ADSL or WiMAX) operators. Questions related to "net neutrality" take on a different complexion in the mobile setting. Almost by definition, one cannot provide identical Internet experiences to those connecting through fixed, nomadic or mobile networks.[7] Unlike with wireline and fixed wireless networks, access to broadband via mobile networks is not fixed. Variation in the numbers of users using a base transceiver station (BTS) and the associated network resources results in variable quality of service experience. Fixed networks may be dimensioned to accommodate fixed numbers of users for components of the access network (through contention ratios), but users of broadband services offered by mobile operators tend to be subject to rationing rules that are automatically applied depending on demand,

including 3G geographical coverage areas that contract when demand from a specific BTS is heavy. In addition, the concept of "always on" has limited applicability to users of broadband services offered by mobile operators.

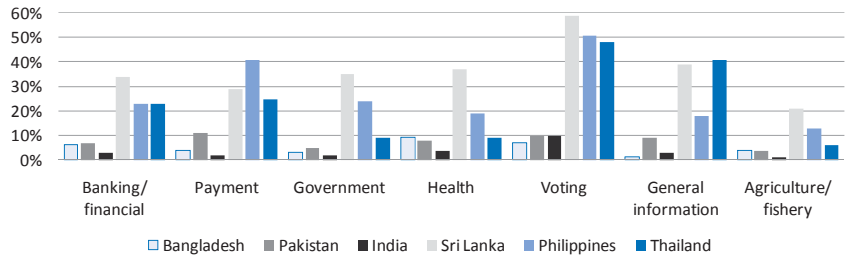
The budget telecom network model rests on aggregating small amounts of use in ways that will absorb a high proportion of the available capacity, rather than on the obsolete and misleading concept of average revenue per user (ARPU).[8] With individual users connecting from handsets, netbooks, laptops or desktops, the key is keeping transaction costs (*e.g.* customer acquisition and billing) to a minimum. Another way of achieving the same result is to have many low-volume users connecting to the Internet from common-use facilities such as telecentres and cybercafés. The earlier focus on fixed connections such as ADSL or VSAT links for telecentres is increasingly being replaced by access supplied via mobile operators, HSPA or even 2.5G connections. This shifts the debate from a mobile-versus-telecentres frame to a mobile-and-telecentres frame.

Applications

Teleuse@BOP qualitative research shows that low-income users are indeed using cybercafés and mobiles in complementary ways, downloading music in cybercafés, transferring it via Bluetooth to mobiles and then listening on handsets, for example.

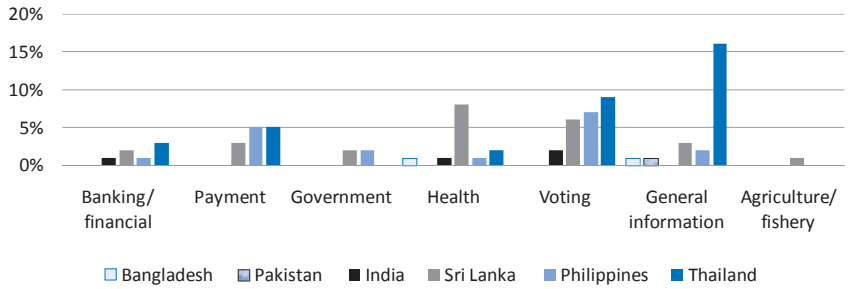
The Teleuse@BOP3 survey specifically probed levels of awareness, trial and use of more-than-voice services over the mobile. These were found to be generally low, especially amongst the lower SEC groups in Pakistan, India and Bangladesh (the Indo-Gangetic Plain constituting the hardest case). Awareness, trial and use were low even for services such as premium SMS-based voting for "American Idol"-type talent shows in Southeast Asian countries and Sri Lanka (Figure 3.6 and Figure 3.7). This was not surprising, as these services are just now being offered and business models for serving the poor have yet to be worked out.

Figure 3.6: Awareness of Mobile2.0 services at the bottom of the pyramid (% of socio-economic classification D and E teleusers)



Source: LIRNE*asia* (2009), Teleuse@BOP3 survey findings.

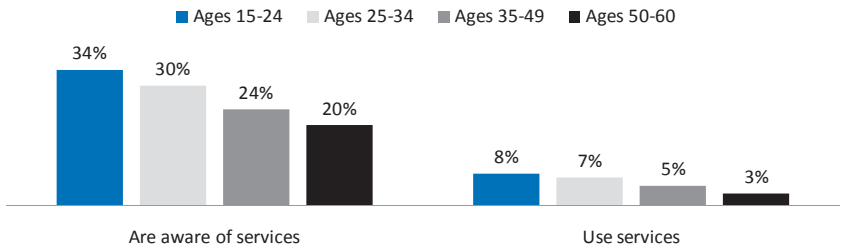
Figure 3.7: Use of Mobile2.0 services at the bottom of the pyramid (% of socio-economic classification D and E teleusers)



Source: LIRNE*asia* (2009), Teleuse@BOP3. Survey findings.

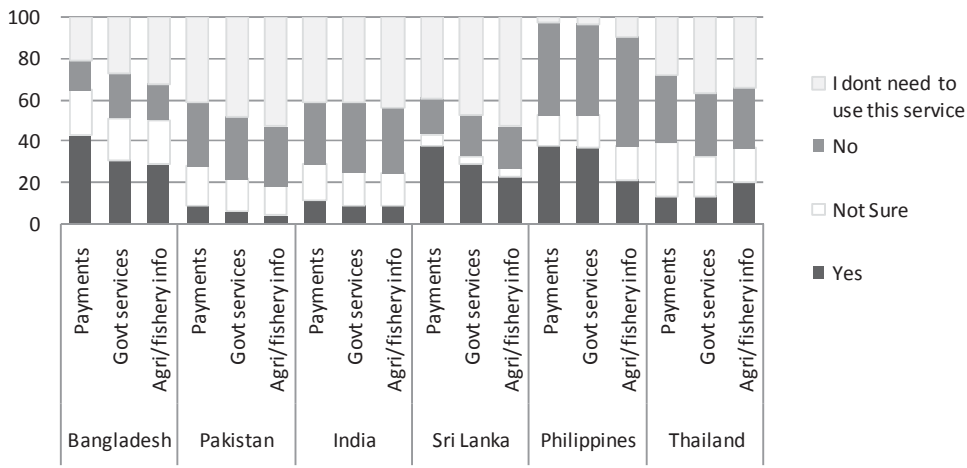
However, uniformly higher levels of awareness, trial and use amongst younger users suggest that there is considerable potential (Figure 3.8). The survey also found variable degrees of readiness to try different services amongst current teleusers (Figure 3.9).

Figure 3.8: Awareness and use of Mobile2.0 (more-than-voice) services (% of socio-economic classification D and E teleusers, all countries)



Source: LIRNE*asia* (2009) Teleuse@BOP3. Survey findings.

Figure 3.9: Willingness to try accessing payment, government or agriculture/fishery information services via mobile (% of SE socio-economic classification C D and E teleusers currently unaware of such services)

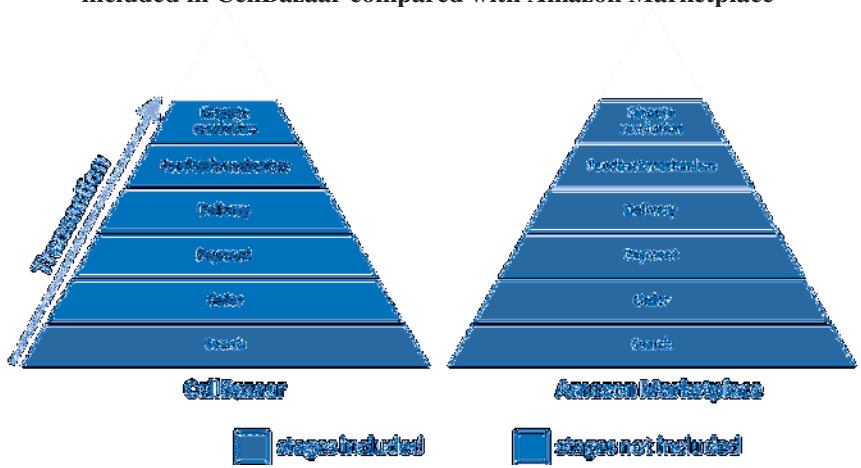


Source: LIRNE*asia* (2009) Teleuse@BOP3. Survey findings.

It is becoming clear that agricultural information is most efficiently provided via mobile. Findings from the Warana Wired (old and failing; standard computer-centred) and Warana Unwired (new and successful; mobile-centred) projects in Maharashtra, now being applied on a larger scale in Vietnam by Microsoft Research, vividly illustrate this.[9]

Companies such as CellBazaar in Bangladesh are introducing e-commerce to BOP users who would otherwise never have access to such services. CellBazaar is designing its services for the highly constrained capabilities of the cheapest, simplest GSM phones on the market and is therefore focusing only on the search phase of the transaction (Figure 3.10).

Figure 3.10: Stages of a commercial transaction included in CellBazaar compared with Amazon Marketplace



Everything else takes place outside the CellBazaar system, but using the conversational and messaging capabilities of mobile phones. Analysis shows that the enterprise is still in the promotional phase, seeking to attract users at low prices (around a minimum of USD 0.35 for a transaction in the case of SMS) and sacrificing high returns. The rather clumsy user experience through the familiar SMS format is being improved through WAP in the case of CellBazaar, and may be improved by others using the USSD (Unstructured Supplementary Services Data) functionality that is also part of GSM.

As with the sugarcane farmer who can obtain market information even while on a tractor, the mobile interface in CellBazaar has inherent additional benefits with regard to transactions that cannot be completed fully on the Web (*e.g.* purchase of a used car or a cow). Unlike comparison shopping on a desktop that requires the taking of notes or printouts before venturing out for actual transactions, the mobile interface allows comparison shopping as-needed, when-needed.

The Govi Gnana Seva (GGS) system for delivering agricultural market prices in Sri Lanka has gone through many incarnations since 2002. First it

focused on collecting spot prices from Sri Lanka's largest fruit and vegetable wholesale market and displaying them on large electronic screens, intending to reduce price dispersion within the market itself. Then it sought to deliver spot prices to those distant from the market through SMS and an interactive voice response system. When pilot project funding ended, prices were collected and disseminated over radio and television. Starting in 2009, the system is being redesigned to deliver spot and rudimentary forward prices to mobile phones. This will allow for a range of behaviours that would not be possible if prices were delivered only to desktops in telecentres or elsewhere. Here the mobile can be used directly in negotiation, with additional information being pulled up by either party.

The use of mobiles in reducing friction in fish markets in Kerala, India and grain markets in Niger has been well studied. In both cases it was found that producer prices increased, consumer prices decreased and waste was eliminated (in the case of the perishable commodity, fish) because producers could access a larger number of hitherto isolated markets newly connected through mobiles. In contrast with Warana and GGS, the Kerala and Niger cases do not involve any kind of organised data collection but simply the use of mobiles for information gathering and decision-making by individual market actors.

Mobiles are attracting considerable attention as payment devices, especially for the poor. Clearly, payment is one of the more complex functions performed on the Internet, and in combination with other functions can yield higher-level participation in the Internet Economy. In particular, there is interest in the use of mobiles in facilitating remittances by temporary migrant workers.

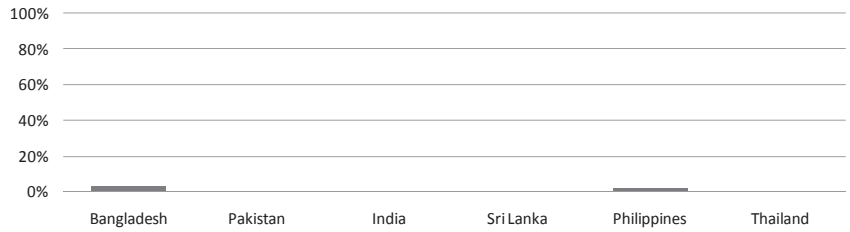
LIRNE*asia* research shows that compared to their Pakistani, Indian, Sri Lankan and Filipino peers, Bangladeshi overseas migrants called home most frequently: 87% of Bangladeshi migrants called home at least once a week, while 34% called home daily. The survey found that, on average, Bangladeshis also paid the most for communication with family and friends back home, spending USD 48 per month to keep in touch, as compared with USD 15 by Indians.

Bangladeshi migrants mostly work West and East/Southeast Asia. On average, they earn approximately USD 485 a month, of which USD 203 is sent home. The most popular mode of communicating with home was the telephone, though unlike the other nationalities, 28% also made calls through the Internet.

Bangladeshi domestic migrants appeared to be making the most use of mobiles for sending money home. Hand-carrying cash remains the most popular way of remitting money, but a significant number are sending

money home through mobiles despite the absence of a formal mobile payment system. Bangladeshi migrants are using "flexi-load" (whereby one customer can transfer value to another's prepaid account). Often migrants maintain good relations with village flexi-load sellers who "cash out" the value of load transfers to the migrant's family (less the commission, which may be as high as 20% or as low as zero). Ironically, in the Philippines, the only country in the study where mobile-remittance services are legal, fewer migrants used such systems (Figure 3.11). The explanation is related to the availability of alternatives. It appears that remittance alternatives are less attractive in Bangladesh than in the Philippines.

Figure 3.11: Use of mobile remittance services (% of socio-economic classification D and E migrant workers)



Source: LIRNE*asia* (2009). Teleuse@BOP3 migrant worker study. Survey findings.

As more applications become available, it can be expected that the use of mobiles for more-than-voice will increase, giving large numbers of poor people experience with functionalities commonly associated with static desktops connected to broadband pipes. As these uses increase, it can also be expected that the demand-pull for 3G–and-beyond network standards more conducive to satisfactory mobile web experiences will become stronger and that supply will become ubiquitous. As the mobile pathway to the Internet becomes increasingly well-trodden, one can also expect complementary uses of the conventional pathway to increase, from users who wish to print or scan documents or pictures and those who wish to use bigger screens and keypads for particular tasks.

Internet/telecom access and wealth creation through service industries

The service sector has always been a residual category, including whatever does not fit within agriculture (including fishing and mining) and manufacturing. Therefore, the large and generally increasing size of service

sectors in developing economies cannot, per se, be taken as evidence that they are developing in ways that will move large numbers of people out of poverty. Nevertheless, the service sector, as it becomes more productive, does play an important role in absorbing excess labour from the agricultural and manufacturing sectors.

The knowledge sector is a subsector within the service sector. Its end-product is knowledge. Examples are education, research, and software. This subsector relies greatly on ICTs, but in fact the role of ICTs in contributing to wealth creation extends across the entirety of services, manufacturing and agriculture. ICTs play a foundational role in the emergence of a knowledge-based economy, where innovation based on systematic applications of knowledge occurs in all sectors. Without ICTs it would be difficult or impossible to codify knowledge and transmit it in a range of forms and scale at low cost.

The basic argument for access to the Internet and telecom networks contributing to wealth creation is anchored on the access to knowledge that is made possible and the reductions of frictions of time and space that can be realised. Access to ICTs alone does not result in wealth creation; it is a foundational element along with governance and financial infrastructure. Without education/skills, investment and innovation, the desired results cannot be achieved. Access to ICTs is a necessary condition, but not a sufficient one.

Do ICTs cause development?

The fact that access to ICTs is complementary makes the establishment of causal links to development outcomes difficult, though there have been several attempts, each with its own shortcomings. At the macro level, Solow famously said: “You can see the computer age everywhere but in the productivity statistics.” There are those who argue that there was a need to factor in a time lag, and studies that show the contribution. In the specific context of economic development, the World Bank made a magisterial effort in 1999 to establish the case.

At the micro level, case studies abound. Perhaps the most rigorously argued is that of producer prices, consumer prices and waste in a number of adjacent but previously independent fish markets along the coast of the Indian state of Kerala before and after the arrival of mobile phones. This natural experiment clearly established that both consumers and producers benefited and the markets cleared (eliminating waste) because fishermen called multiple fish markets while still at sea and went to the one offering the best price. It was reported that, in contrast to all boats returning to their home harbours prior to the arrival of mobiles, 35% sold their catch at a

harbour other than the one from which they set off. Jensen (2007) assumed the diversion to be costless. Aker (2009), in a subsequent study of grain trade in Niger, factored in transport costs and distance and arrived at similar conclusions.

In the same way it took the best economists and statisticians working with high-quality data more than a decade to establish the contribution of ICTs to productivity in the US economy, it will take substantial effort to make the case in the developing world.

ICTs and trade in services

The significance of access to telecom and the Internet for wealth generation may also be discussed in relation to making services tradable. There are four accepted modes of services trade, as set out in the General Agreement on Trade in Services (GATS):

Mode 1, where the seller remains in Country A and the buyer remains in Country B and trade takes place. This is most like trade in goods.

Mode 2, where the buyer travels to Country A, where the seller is. The trade occurs in Country A.

Mode 3, where the seller in Country A establishes a non-natural person (a company) in Country B to supply services to customers in Country B. The trade occurs in Country B. This may or may not involve the movement of natural persons from Country A to Country B.

Mode 4, where natural persons from Country A travel to Country B to supply services to buyers in Country B. This may occur in conjunction with Mode 3 trade or independently.

In many developing countries the principal mode of services trade is Mode 4, wherein skilled and unskilled workers travel to labour-deficit countries to sell their services and remit the earnings back home. Beyond the social problems caused by family separations (particularly amongst the low-skilled, when only the worker is permitted entry), home economies do not get the spin-off benefits of large workplaces and wage earners within their territories. In addition, Mode 4 trade is generally not governed by rules and thus tends to be unfavourable to powerless migrant workers. Mode 3, though resisted by nationalists and protectionists to some extent, brings the large workplaces closer to the buyers of services, though this does not provide as many employment opportunities as Mode 4.

Mode 1 has the greatest potential to alleviate the negative aspects of Mode 4. It allows firms and workers in Country A to sell services to buyers in Country B without physically moving there. Mode 1 is enabled by ICTs,

in particular cheap and reliable leased lines. In this mode workers do not have to separate themselves from families for long periods and the money they and the firms which employ them generate circulates in the local economy, creating further wealth. Workplaces and worker movements do create pressure on infrastructure, but the long-term result is generally the building of adequate infrastructure that benefits more than the service export companies.

More than developing service industries serving the domestic market, ICT-enabled industries that export their services create wealth and pull more people out of poverty. Of course, the modern business practices that allow for differentiation of functions and the outsourcing of non-core activities will eventually seep into the domestic economy as well, creating the conditions for inshoring as opposed to offshoring or the export of services. This results in domestic firms becoming more efficient and/or customer responsive and jobs being created outside the major urban agglomerations.

Offshoring and inshoring have been flourishing in Southern and Western India since the 1990s. It is generally accepted that these regions make a disproportionate contribution to the Indian economic growth story. Unpacking the specific contributions of services trade made possible by ICTs and various other factors such as the demographic dividend is beyond the scope of this chapter. Suffice it to say that the growth of the organised and export-oriented service industries made possible by ICTs has made a significant positive contribution to India's recent economic growth spurt and the resultant escape from poverty by large numbers of Indians, and that these lessons may be extrapolated to other countries.

Policy and regulation conducive to the Internet Economy

The traditional conception of policy and regulation derives policy frameworks and regulatory instruments from public administration theory, with contributions from explicit or implicit theories of the state. In the case of developing countries, the state was seen as lacking certain elements or attributes – for example, adequate respect for sanctity of contract. Case after case, investors would be given promises and assurances, but once investments were in place and the investors' negotiating power atrophied, assurances would disappear and outright or administrative expropriation would take place. Investment insurance was seen as a remedy, as was the creation of sector-specific regulatory agencies and regimes to govern specific industries, especially those in capital-intensive infrastructure that were especially vulnerable to administrative expropriation.

The tendency was to import regulatory regimes and practices from developed market economies, especially ownership, market-entry and regulatory reforms created by pro-private sector governments in the UK and the US in the 1980s. However, scholars pointed out the need to align regulatory solutions with the institutional conditions of host countries.

Given one of the special attributes of the state in developing countries, lack of capacity for effective reforms, external expertise was brought in to advise on transactions (where results were not too bad) and on the design of new policy and regulatory frameworks and instruments (where results were less satisfactory, tending toward the wholesale transplantation of developed economy frameworks and instruments). Over time and at considerable cost the frameworks and instruments are being adapted to local conditions, though in many cases the adaptations take pathological forms consonant with some of the less pleasant aspects of state formation in the developing world.

The surprise, despite these mistakes, is that telecom infrastructure has greatly expanded. More than 3 billion people previously denied service by government-owned integrated monopolies are now connected to electronic networks, even in countries with no functioning regulatory agencies and the most rudimentary policy frameworks. Of course, there are low-mobile-penetration countries, led by North Korea and Burma/Myanmar, where nothing seems to have worked. Amongst this group, several countries such as Eritrea, Ethiopia, Papua New Guinea and Turkmenistan are now showing rapid growth from low bases (Table 3.4). This demonstrates that some degree of market entry is essential to initiate market dynamics. The uniformly lower growth rates on the fixed side also support the thesis that market entry to at least a few suppliers is a necessary condition for rapid growth.

Table 3.4: Low-mobile-penetration countries, excluding micro-states

	Active SIMs, 2003 (,000)	Active SIMs, 2008 (,000)	CAGR, 2003-08 (%)	Active SIMs/100
DPR Korea	-	-	-	-
Myanmar	66.5	375.8	41.4	0.76
Eritrea	-	108.6	-	2.2
Cuba	35.4	331.7	56.5	2.96
Ethiopia	51.3	3 168.3	128.1	3.93
P. New Guinea	17.5	300	103.5	4.67
Burundi	64	480.6	49.7	5.95
Turkmenistan	9.2	347.6	148	6.98

Note: CAGR: compound annual growth rate. No data reported for DPR Korea. Its 3G License was issued in 2008.

Source: ITU (2008), ICT statistics database. Retrieved from *www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx*.

Table 3.5: Fixed performance of low-mobile countries, excluding micro-states

	Fixed lines, 2003 (,000)	Fixed lines, 2008 (,000)	CAGR, 2003-08 (%)	Fixed/100, 2008
DPR Korea	980	1180	4.8	4.97
Myanmar	363	708.9	18.2	1.44
Eritrea	38.1	40.4	1.2	0.82
Cuba	724.3	1103.6	8.8	9.85
Ethiopia	404.8	908.9	17.6	1.13
Papua New Guinea	62.9	60	-1.2	0.93
Burundi	23.9	30.4	4.9	0.38
Turkmenistan	376.1	457.9	5	9.2

Source: ITU (2008), ibid.

The conclusion that may be drawn is that market entry permitting at least a few suppliers (even as few as two in micro states) is a necessary condition for rapid growth of access to telecom services and thereby for participation in the global Internet Economy. Competition strong enough to cause operators to adopt the budget telecom network model is sufficient, at least for low-income countries. This qualification has to be made because countries such as China and South Africa have achieved high levels of mobile penetration (though not low prices and high minutes of use, as in South Asia) without adopting the budget telecom network model.[10]

The question then is: what policy frameworks and regulatory instruments are conducive to developing country participation in the global Internet Economy? The short answer is those that remove, to a greater or lesser degree, market-entry barriers and are supportive of the budget telecom network model.

Market entry and spectrum management

In light of the absolute necessity of spectrum for building access networks for voice and data in developing countries, it is meaningless to talk about market entry in the abstract. Excluding specialised services such as international gateways, most telecom service suppliers require frequencies, mostly for access networks but also in some cases for backhaul.

Market entry and spectrum assignments based on published policy frameworks and transparent procedures, consistent with the provisions in the Reference Paper that forms part of Protocol 4 of the General Agreement on Trade in Services (GATS), are obviously very good. However, even opaque market entry and spectrum assignments are better than none. Bangladesh, a country that arguably failed to meet standards of good practice on market entry in the past, has nevertheless succeeded in connecting over 40% of its SEC D and E population at the world's second-lowest mobile prices.

Even if operators can muddle through with poor spectrum management and opaque assignment in the early stages, there will be problems as networks expand and new services are offered if spectrum management, especially refarming, is not done professionally and transparently. Delays in releasing 3G frequencies in many countries, including in important markets such as India, have already hampered developing countries' participation in the Internet Economy.

Interconnection

In the early days of regulation, most experts asked to name three top priorities answered "interconnection, interconnection and interconnection". In the budget telecom network model, the highest priorities are market entry and spectrum management.

Research on customer behaviour has shown that workarounds for imperfect interconnection have been devised. The incumbent fixed operator's refusal to offer interconnection to mobile operators in Bangladesh and the failure of the regulator to compel interconnection did not prevent the people of that country from connecting to mobile networks at a CAGR of over 100% in 2002-07 and from enjoying some of the lowest prices in the world. Furthermore, there is an increasing tendency for customers to carry multiple SIMs, either switching them on the same handset or using dual-SIM handsets to keep most of their calls "on-net", thereby benefitting from the various discounts offered for friends-and-family calling within networks. This suggests that conventional interconnection is being worked around, at least by those willing to suffer the additional inconvenience of multiple SIM use.

This is not to say that cost-based, non-discriminatory interconnection is irrelevant. It is, especially in terms of reducing the differentials between on-net and off-net calls and the intended or unintended effects on illegal termination of international calls. Indeed, the oft-neglected issues of wholesale access to backhaul and essential facilities require even greater regulatory attention in light of the requirements of the budget telecom network model. As other input costs are driven down, backhaul costs become even more significant.

Regulation of anti-competitive practices

This topic is given the greatest importance in the GATS Protocol 4 Reference Paper. Yet, many policy frameworks contain lacunae in terms of enforcing prohibitions on anti-competitive practices and many regulatory instruments that do deal with it are blunt and crude. In markets defined by the budget telecom network model, success rests on ever thinner margins of cost differentials. Therefore, the effects of anti-competitive practices such as cross-subsidies and tied sales become even more potent.

As firms increasingly offer bouquets of services, in some cases including entertainment offerings, there is a need to ensure that cross subsidisation does not get out of control. The best control, of course, is to ensure that firms do not enjoy market power in any line of business. As retail prices continue to be driven down, the possibilities for anti-

competitive vertical price squeezes grow. The success of the budget telecom network model rests on price flexibility as well as protection from tactics such as vertical price squeezes.

Tariff regulation

Old-style tariff regulation is inappropriate for the effective deployment of the budget telecom network model. In any case, price or revenue regulation is difficult to apply when each firm offers bundles of services measured in tens if not hundreds. In practice, what is done is *de facto* forbearance, where all tariffs are more or less routinely approved or, at most, asymmetrical regulation, wherein only the SMP (significant market power) operator's tariffs are regulated. The weakness in this course of action is that SMP determinations and the resultant regulatory actions are extraordinarily complex and most developing country regulatory agencies are incapable of implementing them. The end result can be regulatory paralysis, to the unintended benefit of incumbent operators.

Banded forbearance, where a country will choose to be benchmarked against prices of peer countries, is a possible solution. Here, flexibility is granted to all operators, including the incumbent, within a defined band set through benchmarking. If prices go below the lower threshold they will trigger a review based on stated competition-related criteria. The thresholds will be periodically readjusted based on external factors such as taxes or price movements in peer countries.

Quality-of-service regulation

In the same way that one cannot expect silver tea service on RyanAir, one cannot expect premium service from budget telecom networks. All operators are likely to offer sub-optimal quality because of the need to squeeze as much traffic as possible. Strict and aggressive QOS regulation is inimical to the model. However, it is also naïve to expect competition to prevent operators from letting QOS fall to unacceptable levels. Therefore, gentle supervision of QOS, focusing primarily on publishing performance against benchmarks and ensuring that barriers to unhappy customers switching suppliers are kept low, would be the most appropriate.

Universal service

The idea of making universal service obligations transparent by replacing vague commitments to extend services to the un- and underserved through cross subsidies with universal service funds was a good idea in its

time and complied with the provisions of the GATS Protocol 4 Reference Paper. However, experience suggests that most universal service funds have become counterproductive. Billions of dollars of universal service levies lie unspent in government accounts or are being used for general expenditures. Where money has been disbursed it has generally gone to fixed network operators, mostly incumbents. All the while, un- and underserved areas are being connected not by subsidised fixed line operators but by mobile operators, and low-income customers, including the intended beneficiaries of universal service policies, are paying to support the inefficiencies of incumbents. A strong case can now be made that universal service funds and levy percentages no longer satisfy the criterion of being "no more burdensome than necessary to achieve the defined universal service" and therefore are in violation of the commitments made under Protocol 4 of the GATS by many countries.

Telecom regulatory environment

Evaluations of the telecom regulatory environments (TRE) of several Asian countries across the dimensions discussed were conducted by LIRNE*asia* in 2006 and 2008. The key results for 2008 given in Table 3.6 show that informed stakeholders see much room for improvement in the TRE of all the countries studied, except in the micro-state of the Maldives, where it is believed that the limited number of informed stakeholders may have precluded candid answers.

Table 3.6: Final scores for 2008 TRE studies in eight countries: mobile sector

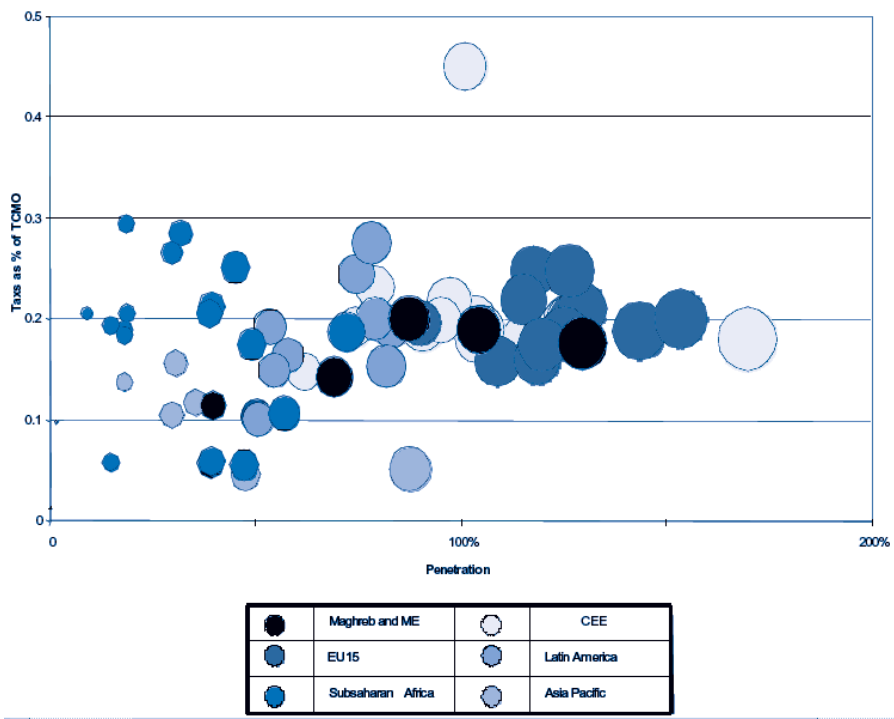
	Bangladesh	India	Indonesia	Maldives	Philippines	Sri Lanka	Thailand	Pakistan
Market entry	3.1	3.1	3.0	3.8	3.2	2.8	2.7	3.9
Access to resources	2.8	2.2	2.7	3.6	2.8	2.7	2.6	3.6
Interconnection	3.3	2.8	2.7	3.5	2.8	2.6	2.6	3.7
Tariff regulation	3.5	3.9	2.6	3.4	2.8	2.7	2.9	3.2
Anti-competitive practices	3.1	2.7	2.5	3.1	2.5	2.7	2.6	2.8
Universal service obligations	2.4	3.1	2.1	3.5	2.6	3.0	2.6	3.2
Quality of service	3.2	2.8	2.3	3.8	3.1	2.9	3.1	3.2

Taxation

Taxation was not included in the GATS Protocol 4 Reference Paper and until recently was almost routinely ignored in discussions of telecom policy and regulation. This is no longer possible because the taxation tail has begun to wag the regulatory dog. Certain policy or regulatory actions are understandable only when one posits taxation as the principal purpose and the provision of telecom services as the secondary purpose.

Studies conducted by an industry lobbyist body, the GSM Association, show that for every 100 units of currency spent on mobile service, as much as 44% is being extracted as tax (including licence fees, spectrum fees, universal service obligations, equipment important levies, sales tax, etc.), with the operator acting as tax collector. This is obviously inimical to the efficacy of the budget telecom network model. Some taxes, such as those on handsets and SIMs, are regressive and constitute entry barriers to the poor. Kenya is an exception, having recently reduced such taxes.

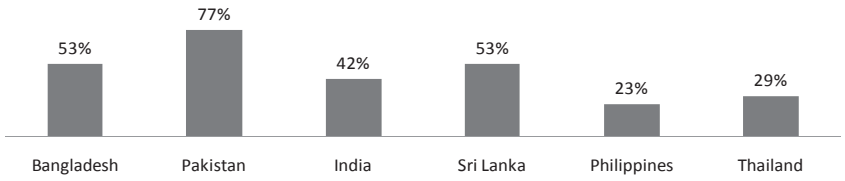
Figure 3.12: Tax as a percentage of TCMO and penetration



Source: Deloitte (2007), *Global Mobile Tax Review: 2006-2007*. London: GSMA. Retrieved 7 August 2009 from *www.gsmworld.com/documents/tax_review_06_07.pdf*.

Studies of user behaviour and attitudes amongst SEC groups D and E in South and Southeast Asia show that customers are unaware of the taxes embedded in phone charges (Figure 3.13). The GSMA has done modelling that shows that removing taxes other than those imposed on all goods and services (such as VAT) will increase government revenues. Though the goal of removing all telecom-specific taxes is somewhat unrealistic, this is an area where further research can serve public policy goals of increasing connectivity and ensuring adequate revenues for the government from a dynamic sector of the economy.

Figure 3.13: Awareness of tax component on phone charges (% of socio-economic classification D and E phone owners)



Source: LIRNE*asia* (2009) Teleuse@BOP3. Survey findings

Conclusion

Many millions of poor people are engaging in Internet-based activities such as information retrieval, payments and remote computing using relatively simple mobile handsets. A new budget telecom network business model has enabled impressive gains in voice connectivity as well as the beginnings of more-than-voice applications over mobiles. Widespread broadband access amongst the poor is likely to be achieved by extending this model. It could also serve as the basis of coherent and efficacious policy and regulatory responses that would serve connectivity goals.

This chapter demonstrates that voice connectivity was achieved for a majority of the world's people, including substantial numbers of the poor, because governments removed or lowered barriers to participation in the supply of telecom services and created conditions conducive to competition.

Where enough suppliers existed, intense competition, the critical step in implementing the budget telecom network model, occurred. The resultant, radically lower prices attracted more minutes of use, which in turn made further reductions possible. Operators were able to load their networks with

high volumes of revenue-yielding minutes because they succeeded in reducing the transaction costs of dealing with low-volume customers. Prepaid, which accommodates the needs of those with irregular earning patterns, was also a critical element because it allowed exploitation of long-tail markets by reducing transaction costs. Along with these business process innovations, the exponents of the budget telecom network model also succeeded in drastically reducing costs, especially operating expenses.

The new model makes ARPU irrelevant because what really matters is how many revenue-yielding minutes are carried on a network, not how much money is earned from customers. In the same way that airlines such as RyanAir and Air Asia make profits while conventional carriers lose money, budget telecom networks make more money than conventional operators despite offering radically lower prices. However, the budget telecom network model does increase the volatility of earnings and results in lower quality of service.

The extension of the budget telecom network model to broadband requires that small, prepaid, irregular payments be allowed, which is a significant deviation from dominant always-on, all-you-can-eat models. It appears that the former is already emerging in mobile-based broadband offerings such as HSPA. Of course, there must also be more content that is desirable to low-income consumers.

Accessing the Internet over mobile networks, whether from fixed locations, nomadically or while actually mobile, will become a major, if not the dominant, mode. This fits with the present trend where many Internet functions, such as communication, information retrieval and remote computing, are increasingly accessed over mobile networks through relatively modest and inexpensive mobile handsets. There is evidence that more-than-voice applications that foreshadow participation in the Internet Economy are beginning to gain ground amongst the poor, especially the younger generation. It may be expected that these uses will increase as the business model is refined and more services are offered.

If business process innovations enabled by competition are solving the challenge of electronically connecting billions of poor people, what is the role of government? When a business model, rather than direct government action, is delivering the goods, the most appropriate government action is that which supports the business model. Policy and regulatory actions must be derived more from analysis of the business model and less from public administration theory. Early in the present reform cycle the need to adopt policy and regulatory solutions that fit the specific institutional circumstances was identified – yet in actual practice, policy and regulatory

solutions devised for developed country circumstances tend to be applied unchanged to very different settings.

The emergence of a new business model and deeper understanding of the functioning of government institutions in developing countries offers a possibility for devising policy and regulatory solutions that are a better fit. This would, for example, involve greater emphasis on lowering market-entry barriers and making more spectrum available ahead of the previous preoccupation with interconnection. As costs come down, the relative importance of domestic and international backhaul capacity will increase, requiring greater regulatory attention. Again, as retail prices come down the importance of regulating anti-competitive practices will increase, especially with regard to vertical price squeeze.

The budget telecom network model results in heavy loading of networks, necessarily resulting in occasional problems with quality of service. Gentle supervision of QOS which places emphasis on publishing comparative performance data and lowering barriers to switching of suppliers would be appropriate. Universal service funds have outlived their utility and are inimical to the business model, and should therefore be phased out. Taxation is becoming a central motivating element of government action with regard to telecommunications. This requires further study to identify the best ways in which governments can collect reasonable revenues without disrupting the business model.

Coherence of policy and regulatory actions is a good thing. By fully understanding the budget telecom network model and ensuring that all policy and regulatory actions are consistent – not solely in terms of making the model work, but also in terms of ensuring that public policy objectives are realised by leveraging the model rather than working at cross purposes to it – policy coherence will be achieved.

Notes

1 The world's largest concentration of poor people.

2. This contrasts with the "managed competition" approach espoused by the McKinsey contributors in the World Economic Forum and INSEAD's 2009 *Global Information Technology Report 2008-09*, *Mobility in a networked world*.

3 Author calculations based on population and surface area data retrieved from World Bank (2009) *Key development data and statistics* [online database].

4 TCO calculation by Nokia, based on 1/36th of the price of the cheapest Nokia handset, 1/36th of connection charges if any, the cost of using the OECD low-user bundle of minutes and other services, plus all relevant taxes and levies.

5 Whereas Anderson focuses on the long tail of products such as low-demand books, the budget telecom network model is based on the long tail of low-volume customers.

6 This finding contradicts the recommendations for limited entry propounded by the McKinsey contributors in the World Economic Forum and INSEAD's 2009 *Global Information Technology Report 2008-09*, *Mobility in a networked world.* Given the high costs of wireline access, many countries have issued frequencies to new fixed entrants, in some cases specifying restrictions on the mobility of the handset. The lowest-cost fixed wireless access technology is the CDMA standard. However, it is also common that users and, in some cases operators, violate the legal restrictions, creating "backdoor" entry to the mobile space.

7 Fixed means that one connects to the network from one location all the time, using a "dongle" or netbook with a built-in antenna. Nomadic means that at the moment of connecting the user is stationary, though they may connect from multiple locations, again, usually from a dongle-equipped laptop or netbook. Mobile means that the user is on the move and likely connects through a handset, though netbooks or even laptops may be used in moving vehicles.

[8] A more accurate term would be average revenue per customer (ARPC), because that is what is actually counted. In today's mobile markets, where many customers are using multiple active SIMs, an even more accurate term would be average revenue per active SIM (ARPAS).

[9] Personal communication from Kentaro Toyama of Microsoft Research, June 3, 2009.

[10] The McKinsey contributors to World Economic Forum and INSEAD's *Global Information Technology Report 2008-09, Mobility in a networked world* make the mistake of seeing China and the Philippines, countries that started the reform process very early, as models for the entire developing world. The budget telecom network model emerged in South Asia only in the past few years and is now diffusing to other regions.

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Chapter 4

What Role Should Governments Play in Broadband Development?

By Tim Kelly, Victor Mulas, Siddhartha Raja, Christine Zhen-Wei Qiang and Mark Williams, World Bank[1]

The World Bank's Information and Communication for Development 2009 *report suggests that the contribution of broadband to economic growth is substantial, and may be more profound than comparable narrowband or voice-based ICTs.*

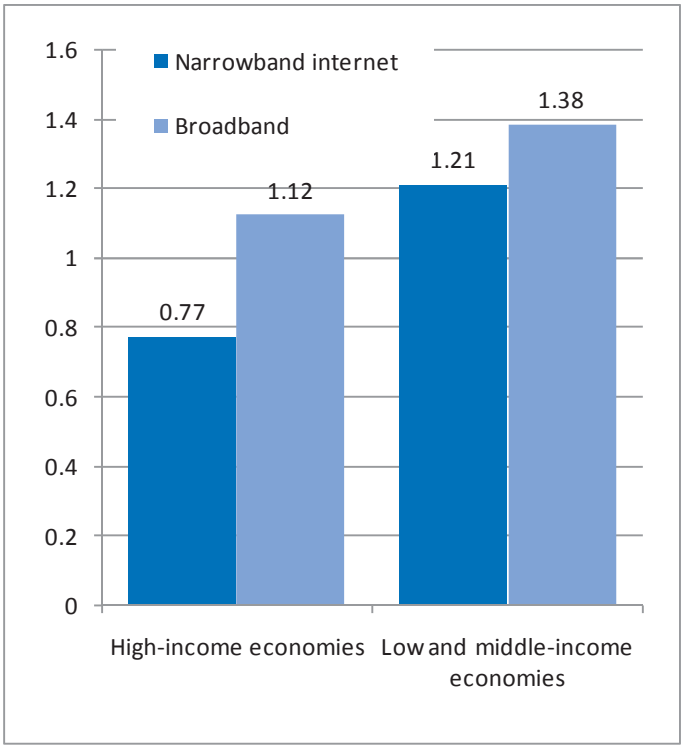
Given its significant economic and social benefits, expanding affordable access is becoming a high priority for governments of developed and developing countries alike. How is this best achieved? This chapter discusses the principles that should underlie government efforts to increase broadband access.

[1] Tim Kelly, Lead ICT Policy Specialist, *info*Dev; Victor Mulas, Consultant; Siddhartha Raja, Consultant; Christine Zhen-Wei Qiang, Senior Economist and Mark Williams, Senior Economist within the Global Information and Communication Technology (GICT) Department of the World Bank. The views expressed are those of the authors and do not necessarily reflect the opinions of the World Bank or its Member States.

Why broadband?

Broadband is a key driver of economic growth and the competitiveness of nations. A boost of 1.38 percentage points on GDP growth in developing countries can be attributed to every ten percentage points' increase in broadband penetration (Figure 4.1).

Figure 4.1: Impact of a 10% increase in penetration of selected ICTs on GDP per capita



Note: Based on an analysis of 120 economies, 1980-2006.

Source: Adapted from World Bank (2009), *Information and Communication for Development: Extending Reach and Increasing Impact*.

Broadband is a General Purpose Technology (GPT) that is having a major impact on the way we live and work. Companies use broadband to improve productivity through remote monitoring, logistics management and

online procurement. It is also used to provide services such as media content, online shopping and electronic banking.

Increasingly, broadband is the primary mechanism for accessing information – a public good essential for all forms of economic activity and good governance. It provides access to new technologies and allows companies to explore new business opportunities, interact with customers and obtain information about market prices. Better access to information makes markets work more efficiently and raises producer incomes. Ready access to information about the performance of government and politicians helps improve government accountability and quality of service provision.

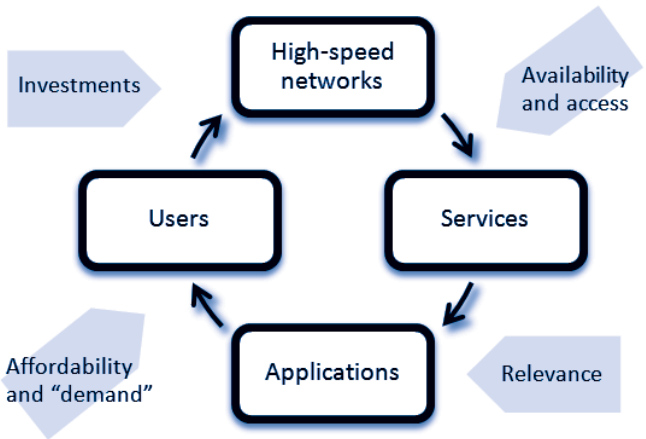
Finally, broadband networks are increasingly being used to deliver public services. Electronic voting, financial services, health care and electronic land registration are all examples of services that were previously delivered manually but are now being automated and delivered over broadband networks, often substituting online interaction for travel or the physical displacement of goods.

Despite rapid growth in broadband networks that has already taken place, broadband is still in the early stages of deployment. The future will see wider deployment, increased capacity and a shift towards a wireless platform which will enable mobility. Broadband in developing countries is likely to follow a similar path but with a greater emphasis on wireless networks.

Broadband as an "ecosystem"

Broadband is typically defined as a "high-speed communications network" that connects end users at data transfer speeds greater than some minimum (e.g. 256 kbit/s). While this is a popular definition, it is incomplete. Rather, broadband can be considered as an "ecosystem" comprising different elements that use high-speed connectivity to interact in different ways (Figure 4.2). By contrast with relatively passive dial-up Internet users, broadband users have the ability to create and share multimedia content in a variety of formats. This interactivity is an important factor that differentiates broadband from other high-bandwidth, but essentially passive, networks such as multi-channel TV. It also creates many new opportunities for value creation and innovation.

Figure 4.2: The virtuous circle for broadband: connecting the elements



Source: World Bank (forthcoming) "Broadband Policy Development in Developing Countries".

The growth of so-called *Web 2.0* services and applications that are dynamic and collaborative in nature depends on the ability of users to interact with each other, but also has implications for network development. For instance, networks previously offered uploads at lower speeds than downloads because this reflected typical use of applications such as e-mail and web-browsing. Users of today's two-way multimedia services, however, demand high speeds in both directions. Worries about a deluge of bandwidth-hungry services overwhelming the Internet abound, but these dire predictions have only come to pass in isolated incidents. The global Internet seems remarkably robust in terms of scaling to a larger number of users, more demanding applications and higher speeds.

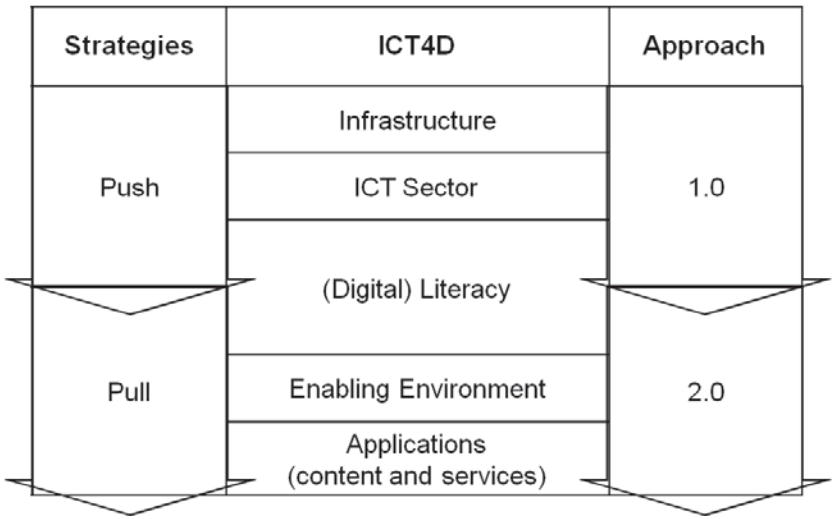
Hence, the network is part of an ecosystem that is evolving and includes more demanding users and applications. Simultaneously, users creating and sharing more content and applications that require more bandwidth should drive the supply of broadband, forming a virtuous circle. Thus, in this note the "broadband ecosystem" is defined as a multi-layered system of interconnected high-capacity communications networks, bandwidth-intensive services and applications, and users.

The role of government

Defining broadband as an ecosystem rather than simply as a network

helps to assess the role(s) that governments will need to play in using broadband as a tool in ICTs for development (ICT4D). Traditionally, governments have played a "push" role, ensuring a favourable environment for the provision of ICT infrastructure and development of the domestic ICT sector. This might be characterised as *Policy 1.0* (Figure 4.3). Increasingly, governments will need to move towards "pull" strategies aimed at promoting digital literacy, establishing enabling environments, providing including local content. This might be characterised as *Policy 2.0,* corresponding to popular concepts such as *Web 2.0* or *Mobile 2.0*.

Figure 4.3: Evolution of government approaches to ICTs for development



Source: Adapted from Peña-López, Ismael (2009), "Measuring Digital Development for Policy-Making: Models, Stages, Characteristics and Causes", unpublished PhD thesis, UOC, Barcelona.

Governments have taken very different views on whether or not to establish national broadband strategies. Generally, countries with coherent national strategies have tended to be more successful in fostering broadband diffusion. Most of the OECD countries that lead broadband penetration, including Denmark, the Netherlands, Norway, Korea, Sweden and Finland, have such strategies. But even pro-market economies that initially resisted defining a central government role have now crossed the fence. For instance, the UK government's 2009 *Digital Britain* report included a radical proposal to charge a levy of GBP 6 (around USD 10) per year on fixed-line telephone subscriptions in order to generate a fund for high-speed broadband services

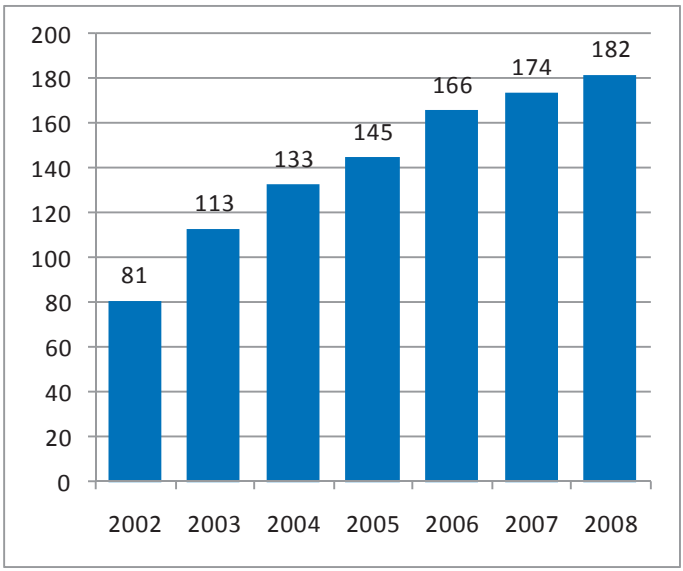
across the country. Similarly, in the United States, after ten years of debate – during which time the US has fallen from second to fifteenth in OECD broadband rankings – the new government has announced the development of a National Broadband Plan, kicking off with a series of discussions hosted by the regulator, the Federal Communications Commission (FCC).

What should be the role of government in the provision of broadband? The basic principle is that governments should intervene only based on sound economic principles and where the benefits of such intervention outweigh the costs. There are essentially two different roles for the public sector: making markets work more efficiently and ensuring equitable access for all.

Making markets work more efficiently

Already by 2008, broadband service was available in 182 economies (Figure 4.4) and by the start of 2009 the combined total of global broadband users on fixed and mobile networks exceeded 1 billion. As the vast majority of these connections have been supplied by privately-operated companies, it could be assumed that the broadband market is working quite effectively with no market failures.

Figure 4.4: Number of economies with commercially-available broadband, 2002-2008



Note: Broadband is defined as speeds equal to or in excess of 256 kbit/s.

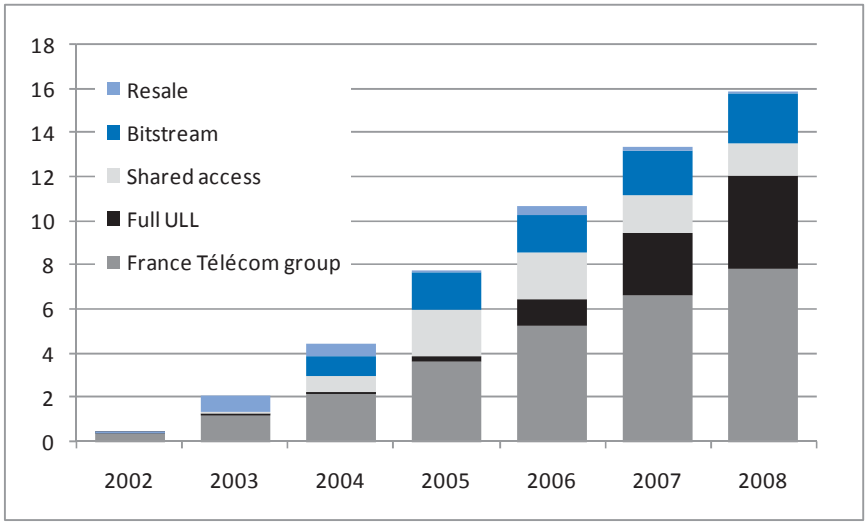
Source: ITU.

There are, however, market failures in broadband. As with many other markets, they concern the provision of public infrastructure. The structure of the broadband market itself has sometimes created problems for the development of service. The most common form of market failure is the persistence of monopoly-type structures in the provision of broadband infrastructure even when no legal monopoly exists. In many countries, the dominance of incumbent public telecommunications operators has been one of the key obstacles to the development of effective competition. Other market failures may be associated with lack of economies of scale. Difficulties in obtaining legal permission to operate, inefficient allocation of radio spectrum, poor information and limited capital markets are all further examples of market failures.

Market failures in the ICT sector have been widely recognised by governments around the world. They are typically addressed through regulatory policy: liberalising licensing regimes, facilitating efficient access to radio spectrum and regulating access to dominant operators' networks are all cornerstones of policies that have provided the foundation for the rapid expansion of broadband services. In Europe and some developing countries, key broadband policies have focused on providing regulated access to the incumbent operator's network ("unbundling the local loop"). Other economies have focused on providing low-cost access to existing infrastructure facilities such as energy and transport networks.

In France, for instance, a "ladder of investment" approach can be seen in the evolution of the broadband market At the lowest "rung" is resale of the incumbent's capacity, which required interconnection at only one point in a network. Later, bitstream access was offered at a regional level, whereby the entrant interconnected at multiple regional points and constructed a backbone network between them. As full unbundling of the local loop was mandated, full-service operators such as Iliad (free.fr) further generated growth in direct competition to the incumbent, France Télécom (Figure 4.5) while building their own networks.

Figure 4.5: Evolution of broadband subscribers in France, illustrating the "ladder of investment"

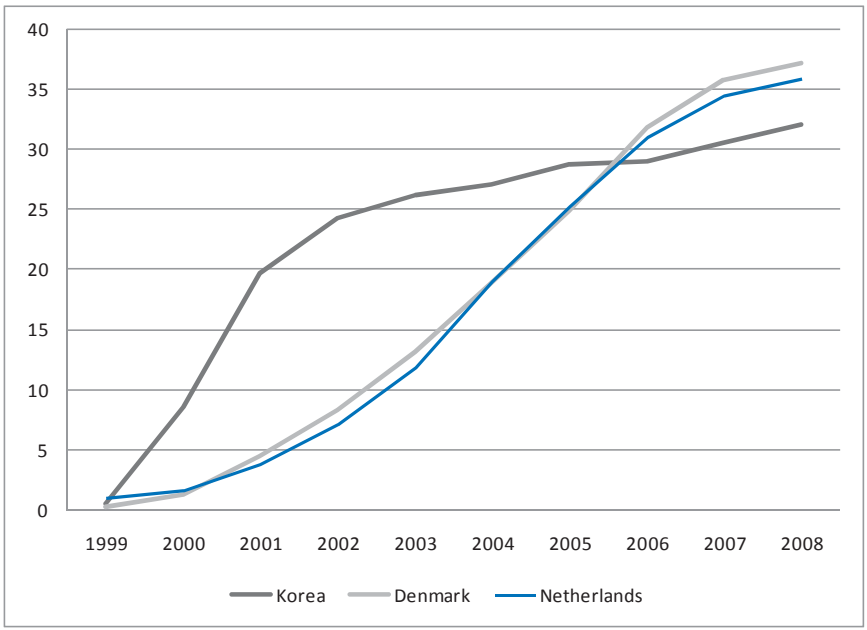


Note: this is not a uniform data series.

Source: Mulas, Victor (forthcoming), "Potential for Broadband Diffusion in Latin America", based on EU data.

Some countries, such as the Republic of Korea, have gone further than this market regulation approach by providing financial incentives to operators to invest and compete. In the early days of broadband development, this allowed Korea to "defy the S-curve" and expand its market at a faster rate than might otherwise have been expected (Figure 4.6). The government of Korea has intervened consistently in both the supply and demand sides of broadband diffusion, with more than six major programmes since 1985. Initially, the government funded a backbone national network that connected public institutions throughout the country and provided incentives to operators to expand fibre optic networks. It developed an extensive e-government programme that digitised and connected public institutions. The Korean government also provided funds to foster demand through multiple policies such as ICT training and promotion of local applications.

Figure 4.6: Defying the S-curve: broadband take-up in the Republic of Korea compared with other leading broadband economies



Source: Mulas, Victor (forthcoming), "Potential for Broadband Diffusion in Latin America", based on OECD data.

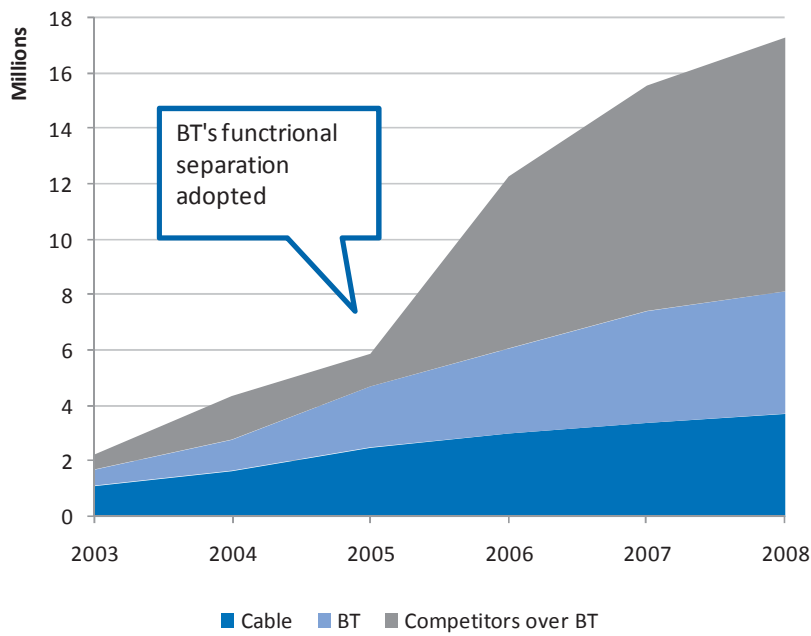
Although other economies, such as Denmark and the Netherlands, have subsequently overtaken Korea in per-inhabitant broadband penetration, Korea still leads in terms of household penetration, with 94% coverage by the end of 1998. This initial lead has helped Korea to realise economic and social benefits. For instance, since the late 1990s Korea has seen a doubling of the percentage of its national GDP coming from the ICT services sector. Korea has also emerged as one of the leading economies in terms of improved educational attainment in the OECD's PISA (Programme for International Student Assessment) survey.[1]

The Korean case can be characterised as a public/private partnership in which the government provided administrative guidance to the private sector and worked via public/private institutions to foster national targets and goals. In other countries, the regulator set the tone by establishing an environment conducive to intensive competition.

In the United Kingdom, the structural separation of the incumbent, British Telecom, appears to have had an immediate beneficial effect on

broadband uptake (Figure 4.7). Interestingly, BT itself offered this solution in 2005, following Ofcom's review of the market, perhaps as a way of heading off a more radical restructuring. BT and Ofcom agreed that a new and operationally separate division, Openreach, would be created, staffed with BT employees responsible for network operations, which would run at arm's-length from BT management. Openreach would then provide services to all players on the basis of "equivalence of inputs". An independent body, the Equality of Access Board, was created to ensure compliance. Although BT's direct market share declined after 2005, the overall market boomed.

Figure 4.7: Impact of BT functional separation on broadband take-up in the UK



Note: this is not a uniform data series.

Source: Mulas, Victor (forthcoming), "Potential for Broadband Diffusion in Latin America", based on EU data.

Ensuring equitable access for all

In broad terms, the second major role of governments in the provision of broadband is ensuring equitable access for all. This focus on equity counterbalances the emphasis on efficiency just outlined. Most governments have taken a pro-active approach to stimulating network roll-out in rural and other underserved areas. This was traditionally done through internal cross-subsidisation by the state-owned monopoly operator. Following market liberalisation, this approach has been replaced by explicit subsidy mechanisms such as Universal Service Funds.

As an example, between 1998 and 2000, Canada achieved the world's highest broadband penetration levels despite very low population density. The problem of providing service in remote and rural Canada was studied by the Independent Telecommunications Review Panel, which, in an annex to their 2006 report, argued that the government should set a goal of providing affordable and reliable broadband services in all regions of the country by 2010. The panel mapped the availability of broadband and estimated that just under 90% of Canadians would have access by 2007, leaving around 3 million people without it. For the approximately 300 000 of these living in the most remote communities, satellite would be the most practical solution. Areas with fewer than 1 200 people living within a more than 5km radius from a broadband point of presence were found to be uneconomic to serve; this was further affected by terrain. WiMAX could help reduce the number that could not be served economically by 1.2 million, but for the remaining 1.5 million (plus the 300 000 to be served only by satellite) some form of targeted cross-subsidy would be necessary to achieve the goal of universal broadband service by 2010.

One of the most high-profile initiatives is a scheme to provide broadband to Canadians in the far North, in Nunavut and Northern Territories. The Nunavut Broadband Development Corporation has been established as a not-for-profit, federally registered corporation with multi-stakeholder membership whose goal is to bring broadband to 25 unserved communities. Under a five-year plan signed in January 2009 (as part of Canada's economic stimulus programme), matching funds from Infrastructure Canada and local customers will raise some CAD 43.2 million to bring broadband by satellite to the region.

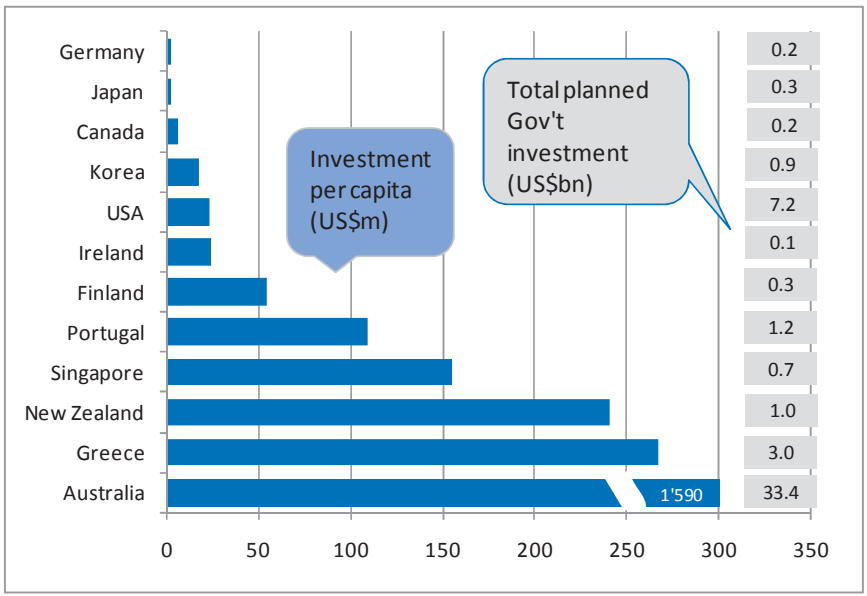
Providing broadband in rural areas poses significant economic and technical challenges. Costs in areas of low population density are higher and, unlike with other ICTs, the provision of broadband (*e.g.* digital subscriber line technologies) has technical constraints by which speeds diminish as distance from a central location increases. The rapid growth of the broadband market has therefore focused primarily on urban centres,

leaving the majority of people in rural areas underserved. As public and private services are increasingly provided online, the inability of some parts of the population to access broadband becomes more of a public policy problem. Once broadband usage reaches a critical mass (*e.g.* 25%) it will be considered indispensable if balanced development is to be achieved without discrimination based on geographical location.

This has led governments to consider a more active approach to ensuring broadband is available throughout their territories. In Korea, the government adopted a comprehensive strategy which focused on providing financial incentives to operators to invest in their networks. In Europe, countries such as Sweden and France have used a mix of demand aggregation, public/private partnerships and USO approaches to ensure broadband coverage. A government plan in Norway subsidises the roll-out of broadband infrastructure in areas where none exists. The Norwegian government's goal is to connect 99% of their population through fixed broadband coverage.

Most recently, broadband investment has featured in fiscal stimulus plans around the world. Australia has committed around USD 33 billion, while the US administration has set aside USD 7.2 billion for rural broadband (Figure 4.8). Broadband is seen as providing a quick win in these stimulus plans because on the supply side it stimulates investment and employment, while on the demand side it creates opportunities for entrepreneurship and spill-over effects that benefit the general economy.

Figure 4.8: Government planned spending on broadband as a component of economic stimulus packages



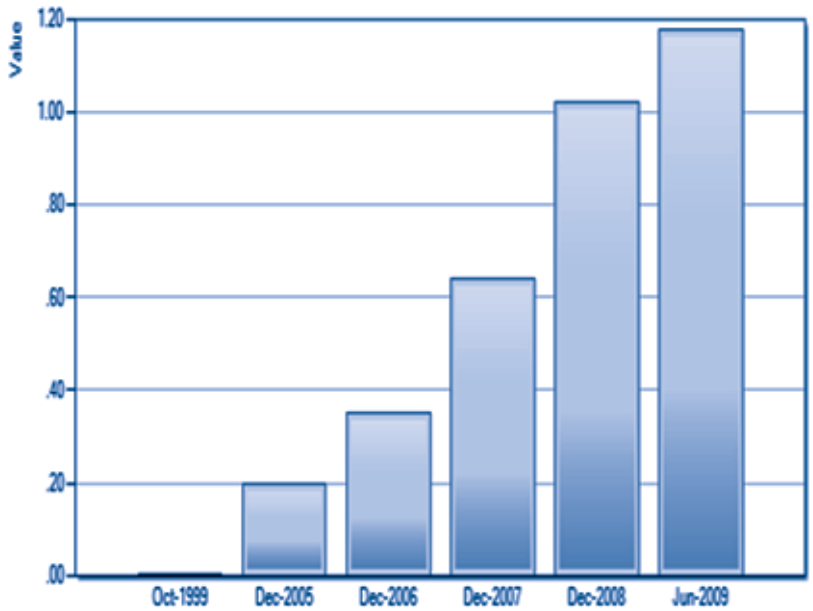
Source: World Bank, based on data from ITU, Booz and Co and OECD.

Developing country case studies

Examples of developing country broadband development strategies are less evident than for developed countries because there remains a significant digital divide in broadband development between nations. Indeed, because mobile communication has leapt significantly ahead of fixed line communication in most developing countries, it is likely that broadband will develop on a wireless rather than fixed line platform. Egypt is a case in point. As of mid-2009, Egypt's 49.4 million mobile subscribers outnumbered its 11.6 million fixed-line subscribers by more than four to one. The number of fixed-line subscribers began to decline for the first time in the first half of 2009. Furthermore, whereas the fixed-line market is still largely a monopoly of the state-owned incumbent, Telecom Egypt, the mobile market is highly competitive, with a third entrant, Etisalat Misr, licensed in 2006. All three operators have 3G licenses allowing them to offer mobile broadband services. NTRA, the national regulator, estimates that as of 2008 just over half of Egypt's Internet users had broadband access, but there were fewer than one million ADSL subscribers in total (a

penetration rate of just over 1%: see Figure 4.9). By mid-2009, the number of mobile broadband subscribers had reached 170 201 and mobile operators had acquired several Internet Service Providers to help them sell services in competition to ADSL.

Figure 4.9: Broadband subscribers in Egypt (per 100 inhabitants)



Source: Presentation by Olfat Monseh (NTRA).

Egypt is working with a public/private partnership model whereby property developers are given the rights to install passive infrastructure (*i.e.* dark fibres) which can then be leased to different network access providers (*i.e.* Telecom Egypt and other ISPs). Property developers are then free to negotiate revenue-sharing agreements with service providers. On 30 Sept 2009, Egypt announced its intention to offer two triple-play licences with a view to attracting USD 1 billion in investment over five years.

A further developing country example is provided by Chile, the broadband leader in Latin America, with a penetration rate of just over 9 subscribers per 100 inhabitants in 2008. By the end of that year fixed line broadband subscribers had reached 1.4 million, but they are only forecast to grow by a further 50%. This is because the majority of future growth is

forecast to take place in mobile broadband, which is expected to overtake fixed-line broadband by 2012. The level of competition may be limited by the fact that the leading 3G mobile operator, Movistar, is part of the Telefonica Group and therefore tied to the incumbent fixed-line operator, but the other two players in the market, Entel PCS and Claro, are owned by competing companies. It is expected that additional 3G spectrum will be auctioned in 2009.

Mobile operators are having a particular impact on improving the affordability of broadband through lower priced packages and the option of pre-paid subscriptions. They are also offering discount priced netbooks with 3G capability bundled with post-paid subscriptions. This is particularly attractive in a market where some 60% of the population do not have a laptop.

The role of the donor community

The donor community can play a role in helping developing countries to elaborate broadband strategies and develop their broadband services. By sharing information, benchmarking, providing technical assistance and support in regulation, international organisations can help governments improve the functioning of markets, stimulate investment and learn from the experiences of other countries. In this context, it is important to establish a baseline of broadband indicators for international comparisons. The OECD has set the pace in this area with its broadband indicators portal (*www.oecd.org/sti/ict/broadband*), but there is a need to expand this coverage to the developing world, especially for comparisons of prices and service offers.

The World Bank can help, for instance in providing financing for strategic investments to support the development of key parts of the infrastructure. International submarine cables, cross-border connectivity and high-capacity domestic backbone networks are all examples of areas in which World Bank investments can play a catalytic role, crowding-in private sector investment and improving service delivery. The World Bank currently supports governments in overcoming key infrastructure bottlenecks through public/private partnerships such as the EASSy cable along the East coast of Africa and the RCIP programme throughout Eastern and Southern Africa.

Broadband is an area of growth in the project portfolio of both public and private sector investment projects. The more than USD 1 billion currently committed to ICT investment projects has been a catalyst in raising some USD 7 billion in investment capital. The World Bank is

currently engaging in a major exercise to gather international experience of broadband policies and develop a toolkit which will be available to governments and regulators around the world. It would welcome collaboration with other organisations in this venture.

Notes

[1] PISA is a triennial survey of the knowledge and skills of 15 year-olds. The latest assessment presents 2006 results for some 400 000 students in 57 countries worldwide. The Republic of Korea scores above the OECD average and had the highest score in the OECD area for reading, was in the top two for mathematics and was one of the highest for science scores. More significant is the improvement in Korea's performance since 2000, which was the period of expansion in broadband both in schools and in homes.

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Chapter 5

Regulatory Issues around Mobile Banking

By Paul Makin[1]

The rise of the mobile phone in emerging markets, particularly Africa and large parts of Asia, is well documented, as is its use in a growing number of initiatives to increase the availability and variety of financial services in emerging economies. This chapter explores relevant issues by recounting the experience of the IT consultancy firm Consult Hyperion in the conception, development and deployment of M-PESA, a mobile payment service in Kenya and Tanzania, as well as their conversations with a range of financial regulators from around the world.

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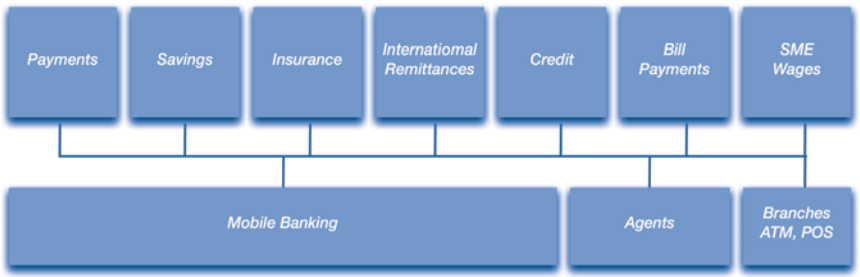
The United Nations Department of Economic and Social Affairs estimates that in Africa there are 300 million reachable adults with no current access to formal financial services; a variety of mobile services are springing up to address their needs. Rather than true mobile banking, but with the aim of evolving toward full banking services in the future, most of these services offer a subset of banking known as "branchless banking", "2G (second generation) banking", "mobile payments", "mobile money transfer" or "mobile banking" – the term used depends on the audience. For the purpose of this chapter, the term "mobile banking" is used.

Figure 5.1: Mobile banking, current and potential services



Source: Consult Hyperion.

Financial services delivered through the mobile channel are, in essence, no different than those delivered through conventional banking channels and agent channels emerging in a number of developing markets. However, as the mobile channel can reach a mass market beyond conventional banking networks, financial services offered across mobile will be optimised to serve that mass market: microfinance rather than traditional bank credit, and ad hoc bill payments (*e.g.* school fees) in addition to regular utility payments and low-cost saving products.

Many of the mobile initiatives are partially – in some cases wholly – led by non-bank organisations traditionally outside the scope of financial regulation and with whom the financial regulator has had little or no contact. This has naturally led to concern amongst regulators and, for better or worse, threatens to disrupt the regulation of the financial sector in many of the countries concerned.

The role of the regulator

The financial regulator plays a crucial role in the economy of any country. The regulator stands between ordinary citizens and financial chaos by attempting to ensure the financial stability of an economy, and that those institutions wishing to offer financial services do so in a responsible manner. So in addition to the regulator's role in maintaining financial stability, they also have key responsibility for consumer protection.

There is a third role for the regulator, however, that is particularly important for emerging economies: promoting a country's social objectives by attempting to ensure that suitable financial services are available to as many citizens as possible, and that the range and sophistication of those services increase in step with the country's needs. This third role is generally referred to as "extending the reach and depth of financial services".

Quite reasonably, many regulators tend to view this third role as substantially subservient to the first two. After all, the reasoning goes, if economic growth is threatened, who cares whether or not the entire population has a bank account? While there is a grain of truth in this view, it can lead to a tendency towards conservatism, with the unintended consequence of raising the barrier to entry for new market entrants, effectively closing the door behind existing financial service providers and protecting them from more innovative or efficient competitors.

Regulators' issues with branchless banking

In Consult Hyperion's conversations with financial regulators around the world, common themes regarding branchless banking emerged. Many felt that payment schemes such as M-PESA, with no direct bank involvement, should not be allowed – that such schemes should always be led by banks. As one regulator put it, without a trace of irony, "in view of the recent global financial crisis, we feel that only a bank provides the necessary stability".

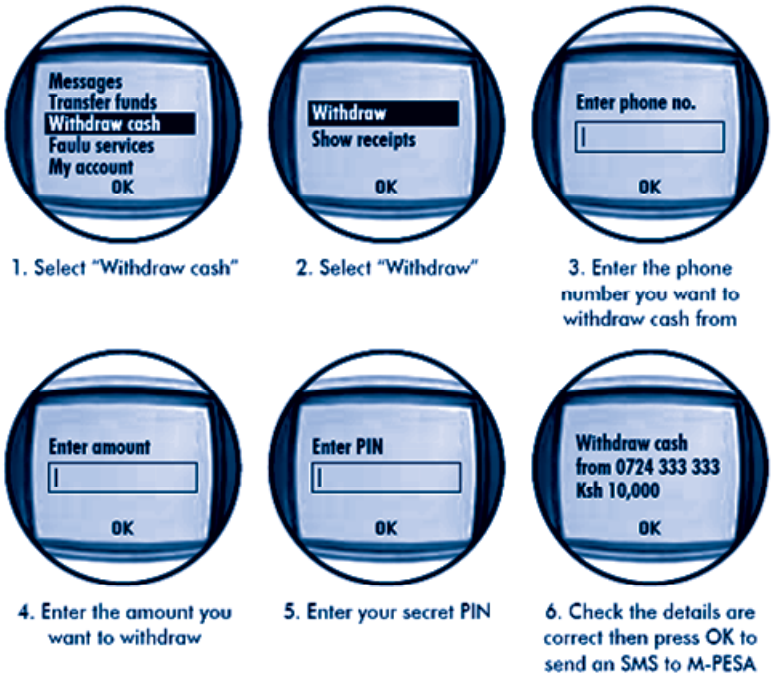
A lack of familiarity with non-bank institutions was also raised. Generally, regulators feel comfortable with their existing relationships with the banks and other financial institutions they regulate. They know what figures and reports to look at and are familiar with the levers available to influence those institutions' operations. There is no reason why any other institution should not be able to provide similar satisfactory mechanisms, but for the regulators it is a question of familiarity.

Finally, some regulators are concerned about the effect that the failure of a branchless banking scheme could have on customers and the wider economy. This is a legitimate concern, and indeed one that has been raised by representatives of a number of established branchless banking schemes when looking at some of their competitors' new offerings.

The M-PESA experience

M-PESA (M for mobile, PESA the Swahili word for money) is a money transfer service, initially deployed in Kenya, which allows ordinary Kenyans to send money across the country (or indeed face-to-face) cheaply and reliably using mobile phones. M-PESA accounts can also be used as a safe place to store small amounts of money (an aspect that perturbs some commentators but is desirable to those with no access to a true bank account). This is a clear example of "extending the reach of depth of financial services", with obvious benefits for ordinary Kenyan citizens.

Figure 5.2: M-Pesa in action



Source: workshop presentation by David Birch, Chair, Digital Money Forum and Director, Consult Hyperion.

M-PESA was developed and deployed by Vodafone, in partnership with Safaricom, the leading Kenyan mobile operator. It has been live for almost two and a half years and, at last count, had more than 7 million registered customers who were transferring USD 2 million per day between themselves.

However, absent from its list of partners is any member of the Kenyan financial community, with the exception of the Commercial Bank of Africa (CBA), who provide commercial banking services. This absence caused near outrage in some of the regulators Consult Hyperion spoke to.

The M-PESA team did contact as many high-profile members of the Kenyan financial community as possible in the hope of recruiting a partner. Whether it was because these institutions were suspicious of becoming involved with a mobile operator, or perhaps felt that the proposal was too radical and doomed to fail, no suitable financial sector partner could be found. Eventually, Vodafone and Safaricom decided to go ahead without one. This clearly posed a problem with regard to financial regulation.

The first, tentative moves towards M-PESA consisted of meetings with as many interested parties as possible – the Kenyan regulator being one of them. In this regard, the team felt fortunate to interact with a regulator who was not only careful to ensure that his responsibilities to the Kenyan economy in general, and to the financial sector in particular, were fully satisfied, but who also viewed the aim of "extending the reach and depth of financial services" as a high priority, and was willing to explore new ideas and listen to potential new market entrants.

Aware that regulators generally consult their peers when a new development is proposed, the M-PESA team also engaged with other regulators such as the UK's Financial Services Authority. Their goal was to create a feeling of normal progression and sensible development in order to diminish any view of the service as dangerously avant garde.

There is much that the branchless banking sector can learn from card industry initiatives such as the Payment Card Industry Security Standards Council – so several concepts borrowed from the card industry are embedded in M-PESA. Some of these are true end-to-end encryption (with all confidential data being held within the only secure storage on the mobile handset, the SIM), the use of hardware security modules (HSMs) at M-PESA servers and a security focus on business processes. This is backed by a comprehensive set of reporting and management tools which allow detailed views and reporting of every aspect of every transaction, both individually and en masse.

In an attempt to ensure that M-PESA was "covering all the bases", a consultant was tasked with going through the then-draft Kenyan anti-money laundering legislation to ensure that all the necessary controls and reporting mechanisms were in place, and all the necessary management functions filled and processes respected – steps which helped to ease the relationship with the regulatory authorities by bringing a familiar structure.

These efforts were not intended merely to convince the regulator to allow M-PESA to launch – though of course they helped, and M-PESA was granted a special licence. Rather, the team felt that although M-PESA is not a fully-regulated financial institution, to behave like one was the only responsible approach. It had the added benefit of preparing M-PESA for any future regulatory developments, and the not inconsequential effect of changing the mindset of staff away from that of a mobile operator towards that of a quasi-financial institution.

An issue for many emerging branchless banking schemes is "know your customer" (KYC) regulations which require that every new customer's identity be verified before they are able to use the service. Fortunately, an established national ID card scheme already existed in Kenya. The advantage of an existing ID card scheme becomes obvious when examining the difficulties experienced by initiatives launched in countries without them, such as M-PESA's own launch in Tanzania.

Regulatory developments

The success of branchless banking schemes in general, and M-PESA in particular, has driven some recent developments in regulation. Some are based on the view that only banks should be allowed to offer such services, which suggests that some regulators do not understand how the same regulatory environment can apply to non-bank institutions. To some degree this view is based on a lack of visibility of, and familiarity with, the capabilities of mobile operators.[1]

Kenya's finance minister recently launched an audit of M-PESA in order to verify that it cannot be used by money launderers and pyramid schemes (indeed, a false accusation had been made that M-PESA was nothing more than a Ponzi scheme). This move was very unpopular amongst ordinary Kenyans, who appeared to view it as an attempt by banks – who, some felt, were never interested in providing services to them anyway – to shut M-PESA down. Consult Hyperion were asked to contribute to the response by carrying out a new audit of security countermeasures and procedures, and were again able to certify that M-PESA offers bank-grade

security and controls to its customers. At the end of the process, M-PESA was given a clean bill of health, and continues to operate.

It is only a matter of time before M-PESA is brought under the full regulatory umbrella of Kenya's laws, and it will likely be regulated as an electronic money issuer. This is expected to be some way short of full regulation as a bank – M-PESA does not offer credit or lend out (multiples of) customers' funds. Europe's approach in creating a separate regulatory category – "payment institutions" – and separating the regulation of payment services from that of credit institutions could be a very useful model in this regard.

In what might be perceived as a quid pro quo, Kenya's banks will be allowed to offer their services through agents rather than being required to limit them to their own branches, with the substantial costs this entails. Again, this is nothing new: this approach has reaped substantial benefits for both banks and customers in a number of countries, with Brazil having a particularly high profile in this regard. If banks grasp this opportunity it will have a significant benefit for ordinary Kenyans, especially if they can begin to see M-PESA as an opportunity rather than a competitor. If banks chose to offer their services – loans, savings accounts, etc. – to M-PESA customers via mobile phone, they would instantly have access to more than 11 000 access points across Kenya, with cash handling and movements in and out of their accounts carried out by M-PESA, potentially saving the banks significant sums of money.

Meanwhile, in India, the development of the branchless banking sector has stalled. Around a year ago, the Reserve Bank of India introduced regulatory changes for the sector which, as well as requiring that schemes be operated by a bank, also introduced a requirement for end-to-end encryption (something only a mobile operator can offer using current technology), thus creating an insoluble problem. This effectively closed the door for all new market entrants, and a number of schemes that were close to launch were cancelled or put on hold. The Indian situation may be contrasted with that of Mexico, where the central bank has said that agents, including banks and retailers, can open mobile banking accounts for their customers because agent networks are seen as key to financial inclusion given the scarcity of branches in rural and semi-urban areas.

The establishment of the Alliance for Financial Inclusion (AFI) at the end of 2008, funded by the Bill & Melinda Gates Foundation, is a positive development. As a forum for financial regulators and others representing emerging markets, it presents an opportunity for policy-makers to review issues around areas such as branchless banking.

Principal technical issues

There are one or two technical issues concerning branchless banking solutions that impinge on their regulation. These revolve around security and concern the mobile handset's SIM and end-to-end encryption, essential for bank-grade security of transactions.

As technology stands today, there is only one way of providing end-to-end encryption for branchless banking: using the SIM. As SIMs are under the control of the mobile operator, this effectively means that only a mobile operator-led scheme can offer full security. There are two means of resolving this situation:

- **Relaxation of SIM controls.** It has been argued that the SIM will, at some point in the relatively near future, achieve the status of a public utility. This would imply that complete control of the SIM should be taken away from mobile operators and some portion of its capabilities made available, through mobile operators, to third parties.
- **Relaxation of security.** Without access to the SIM, comprehensive security is not possible – but it is unacceptable that mobile operators should be the sole purveyors of branchless banking solutions. Perhaps the lower security of SIM-less schemes should be accepted, subject to suitable controls such as a maximum number of customers, a smaller maximum transaction size and enhanced server-based controls.

These are not purely technical issues. They demonstrate the intricate connections between issues of public policy and technical minutiae, and that neither should be fixed without consideration for the other.

Principal regulatory issues

The principal issues around branchless banking and its regulation can be summarised as:

- **Risk of a high-profile failure**. If a high-profile scheme were to fail, the reputation of all branchless banking schemes would inevitably be sullied and the sector could be set back by years.
- **Non-bank institutions leading schemes**. Provided a scheme can demonstrate regulator-suitable visibility and necessary levers, why must it be bank-led? After all, one trusts a mobile operator not to lend their money to an unidentified third party – the same cannot

necessarily be said of banks. What's more, a mobile operator can offer geographical traceability of transactions that a bank never could. A customer sends money over his or her own phone, so the mobile operator knows exactly to whom it was sent and where and when it was received.

- **Suitability of KYC regulation**. KYC requirements are undoubtedly holding back the branchless banking sector. While they are, in some form, absolutely necessary, consideration should be given to whether their current application is appropriate. For example, should someone sending USD 20 once per week to relatives up-country be subjected to the same KYC checks as someone who wants to send USD 10 000? Perhaps a more limited form of KYC could be applied to the poorest customers, up to a certain transaction threshold, at which point full KYC would apply. It is difficult to imagine how a relaxation in this type of regulation would increase the risk of terrorist attacks.

Regulators in general, and the AFI in particular, need to give due consideration to these issues. They also need to be convinced that branchless banking schemes are trustworthy, *i.e.*:

- that the appropriate reporting channels are in place and that the regulator will have access to the necessary levers;
- that a scheme is fully auditable, with KYC/AML controls in place;
- that a scheme is properly secure and presents little risk to customers.

With regard to this final point, there is a clear market opportunity for one or more large insurance organisations, though concerns they might have about entering such a nascent market are understandable. Hopefully a means of addressing this market need, and opportunity, will be found in the near future.

Analysts Gartner project that the mobile payment industry will experience steady growth from the current 73m users worldwide to almost 200m users worldwide in 2012. One can expect a wide variety of mobile financial service providers springing up to deliver financial inclusion on this "platform", given regulatory stability, foresight and imagination.

Notes

[1] McEvoy, N.A. (2009), "Capabilities of Mobile Operators from the Perspective of a Financial Regulator", in GSMA's Mobile Money for the Unbanked Annual Report, July.

Chapter 6

ICTs and the Environment in Developing Countries: Opportunities and Developments

By John Houghton[1]

Developed and developing countries face many environmental challenges, including climate change, improving energy efficiency and waste management, addressing air pollution, water quality and scarcity, and loss of natural habitats and biodiversity. This chapter explores how the Internet and the ICT and related research communities can help tackle environmental challenges in developing countries through more environmentally sustainable models of economic development.

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This chapter examines the status of current and emerging environmentally friendly technologies, equipment and applications in supporting programmes aimed at addressing climate change and improving energy efficiency.

An overview is given of the role of ICTs in: *i*) climate change mitigation (*e.g.* investing in smart transport and energy efficient infrastructure); *ii*) mitigating other environmental pressures (*e.g.* biodiversity loss, water and soil pollution); *iii*) climate change adaptation (*e.g.* adapting to rising sea levels, droughts, desertification); and *iv*) international co-operation (*e.g.* technology transfer and the development of sustainable ICT value chains). Examples of current activities and opportunities are provided for each of these areas.

ICTs and the knowledge-based economy

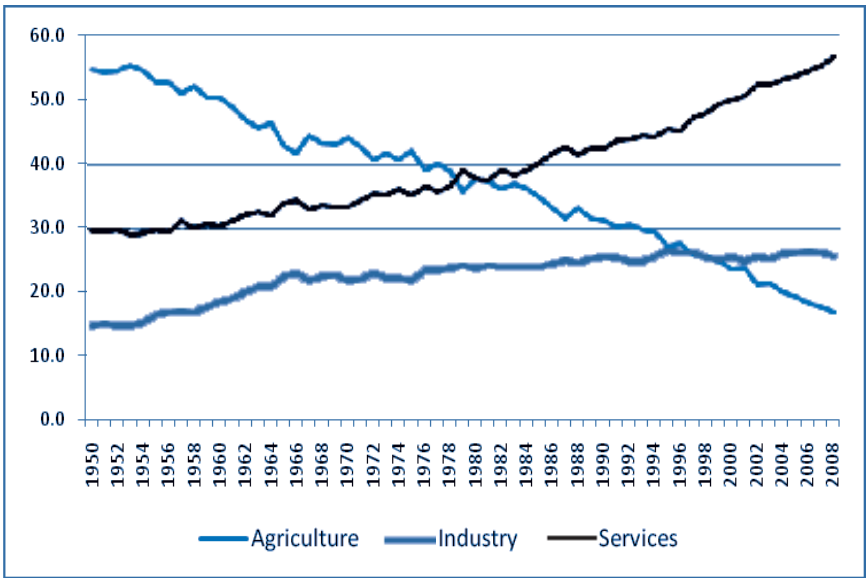
A major feature of the knowledge-based economy is the impact that ICTs have had on industrial structure, namely a rapid growth of services and relative decline of manufacturing. Services are typically less energy intensive and less polluting, so countries with a high and increasing share of services often see declining energy intensity of production – with the emergence of the Knowledge Economy ending the linear relationship between output and energy use (*i.e.* partially de-coupling growth and energy use).

Estimating that around one-third of the increase in energy efficiency in the United States could be attributed to structural change in the economy, with the remaining two-thirds to improved energy efficiency, Romm *et al.* (2000) concluded that forecasts for energy consumption and CO_2 emissions to 2010 for the North American economy should be adjusted down by around 5% due to the rapid impact of the Internet Economy. More recently, Laitner and Ehrhardt-Matrinez (2008) estimated that for every extra kilowatt hour of electricity used to power ICTs, the US economy has increased its overall energy savings by a factor of 10. This gain in energy efficiency (energy productivity) has enabled the US economy to meet 75% of the demand for new energy services through energy efficiency gains.

Traditional development models have focused on a shift from agriculture to manufacturing, the development of free markets and encouraging exports and industrialisation in labour-intensive consumer goods – a model borne out in *The East Asian Miracle* (World Bank 1993) and the emergence of China as the world's largest exporter of ICTs and related consumer equipment. Sheehan (2008) suggests a re-think, based on the evidence from the emergence of India and the thrust of China's Eleventh

Five Year Plan (2006-11). Looking at long-term trends in employment and sectoral GDP shares and growth rates, Sheehan suggests that India provides an example of "big-push" development driven by services (Figure 6.1), and that: "industrialization as it used to be understood is no longer a realistic option for most developing countries, and they need to find ways of participating in the growth of the modern services sector, which can directly improve the living standards of their people." It is notable that India's CO_2 intensity per unit of GDP is substantially lower than is typical of developing countries, comparable to that of Japan and lower than Germany's (Ghosh 2009).

Figure 6.1: Value added shares by sector, India 1950–51 to 2007–08

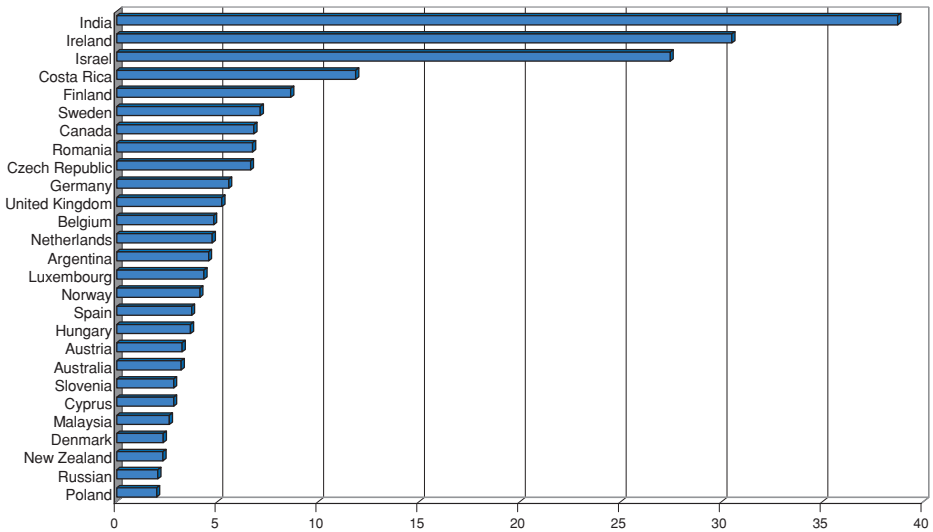


Source: Sheehan, P.J. (2008) Beyond Industrialization: New Approaches to Development Strategy Based on the Services Sector, UNU-WIDER Research Paper 2008/60: Helsinki.

ICTs have played a key role in making services tradable and in the globalisation of IT and IT-enabled services. Looking at the intensity of IT and IT-enabled services exports, Houghton and Welsh (2009) note that computer and information services accounted for more than 25% of total services exports in only three countries during 2006: India, where they accounted for almost 40% (down from 50% in 2004); Ireland, 31% (down from 39% in 2004); and Israel, 27% (Figure 6.2). Their analysis suggests

that IT and IT-enabled services exports can play an important role in a wide range of developed, emerging and developing economies, and may in the latter provide the basis for a more environmentally sustainable development path than has characterised industrialisation in the past.

Figure 6.2: Share of IT services in total services exports, 2006 (%)



Source: Houghton, J.W. and Welsh, A. (2009), Australian ICT Trade Update 2009, Australian Computer Society, Sydney.

Assessing the possibility of alternative development pathways, Berkhout *et al.* (2009) argue that the convergence of economic structures and growth rates, which plays such a central role in growth theories, does not imply that the emergence of socio-technical systems underpinning growth must also be convergent in terms of their technological composition and environmental quality. They call for greater attention to the resource and environmental quality of development as the basis for more sustainable development pathways.

ICTs and the environment

The relationship between ICTs and the environment is complex and multifaceted, as ICTs can play both positive and negative roles. Positive

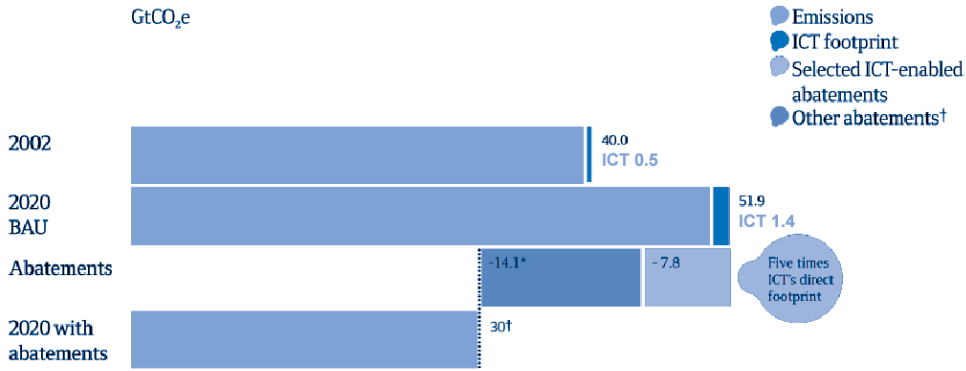
impacts can come from dematerialisation and online delivery, transport and travel substitution, a host of monitoring and management applications, greater energy efficiency in production and use, and product stewardship and recycling. Negative impacts can come from energy consumption and the materials used in the production and distribution of ICT equipment, energy consumption in use directly and for cooling, short product life cycles and e-waste, and exploitative applications (*e.g.* remote sensing for unsustainable over-fishing (Daly 2003)).

The impacts of ICTs on the environment can be direct (energy consumption and e-waste), indirect (applications such as intelligent transport systems, buildings and smart grids) or third-order and rebound (those enabled by the direct or indirect use of ICTs, such as greater use of more energy efficient transport). Exactly what the impacts of ICTs are, and to what extent there may be rebound effects (Box 1), are widely discussed topics. However, it is clear that attempts to measure the impacts of ICTs on the environment should take account of the potential rebound effects and the entire life cycle rather than simply the direct impacts of the product or application itself (Plepys 2002; Yi and Thomas 2007; Hilty 2008; etc.).

Estimates of the direct impacts of ICT industries vary with the definition of the industry and coverage of ICT-related energy uses, but the production and use of ICT equipment is estimated to be equivalent to 1% to 3% of global CO_2 emissions (including embedded energy) with a higher and growing share of electricity use. In 2006 it was estimated that ICT equipment (excluding broadcasting) contributed around 2% to 2.5% of worldwide greenhouse gas (GHG) emissions – of which 40% was reported to be due to the energy requirements of PCs and monitors, 23% to data centres, 24% to fixed and mobile telecommunications and 6% to printers (Kumar and Mieritz 2007). More recent life cycle assessments produce broadly similar results (Malmodin 2009). Data centres are a particular focus. Koomey (2007) estimated that worldwide electricity use for servers doubled between 2000 and 2005 and suggested that consumption would increase by a further 40% by 2010.

Nevertheless, the indirect enabling impacts of ICTs are greater, and a number of studies have identified their potentially significant role in climate change mitigation. For example, The Climate Group (2008) identified key areas of enabling impacts that could potentially lead to global emissions reductions by 2020 five times that of the ICT sector's direct footprint (Figure 6.3).

Figure 6.3: ICT Impact: The global footprint and the enabling effect



Note: BAU – Business as Usual. $GtCo_2e$ – giga tonnes of carbon dioxide equivalent

Source: The Climate Group (2008), *SMART 2020: Enabling the low carbon economy in the information age*, London, p. 15.

ICTs and the Internet are enabling an increasing number of products and services to be delivered online (*i.e.* de-materialisation). This affects scientific journals, books, music CDs, film and videos, software, etc., with fewer taking a physical form and less energy and potentially fewer resources being used in their production, storage and delivery. E-commerce and online shopping can save time and travel in searching and pricing. Centralised fulfilment and delivery can replace many thousands of individual trips, saving energy not only directly but also through potential reductions in traffic congestion. E-mail has replaced many millions of letters – written on paper, collected, sorted and delivered worldwide – with almost instantaneous communication having a very small environmental footprint (Schmidt and Kloverpris 2009).

ICTs offer the potential for transport and travel substitution. With tele-work or e-work, transport and commuting time can be substantially reduced and considerable benefits can accrue for individuals, employers and the community. The reduction of long-distance travel as a result of the use of data, voice and video applications over IP for webcasts, tele-conferencing and video-conferencing can also be significant, with direct impacts in terms of the environmental footprint and indirect impacts such as reduced demand on transport infrastructures and office facilities.

ICTs can also contribute to the resource and energy efficiency of many physical components of products themselves or their production processes. For example, automotive electronics in the form of ignition chips have

greatly improved the energy efficiency of motor vehicles. Industrial and household equipment and the design, construction and management of buildings increasingly include "smart technology" to better control resource and energy use, emissions, serviceability and durability.

Nevertheless, many studies have illustrated the difficulties in avoiding rebound effects and realising the potential benefits of ICTs (Box 1). It has been noted that the "paperless office" has not yet eventuated, that e-commerce may not save energy if it encourages long distance delivery, and that tele-working can increase the home use of energy and demand for electronic equipment such as routers and printers, and so on (Plepys 2002). As always, the key is not the technology but how it is implemented and used.

Looking at ICTs as tools for dealing with environmental issues from a developing and emerging country perspective, ITU (2008) noted six application categories (Figure 6.4):

1. *Environmental observation*: terrestrial (earth, land, soil, water), ocean, climate and atmospheric monitoring and data recording technologies and systems (remote sensing, data collection and storage tools, telemetric systems, meteorological and climate-related recording and monitoring systems), as well as geographic information systems (GIS).

2. *Environmental analysis*: once environmental data have been collected and stored, various computational and processing tools are required to perform analyses. This may include land, soil, water and atmospheric quality assessment tools, including technologies for analysis of atmospheric conditions including GHG emissions and pollutants, and the tracking of both water quality and availability. The analysis of data may also include correlating raw observational data with second order environmental measures such as biodiversity.

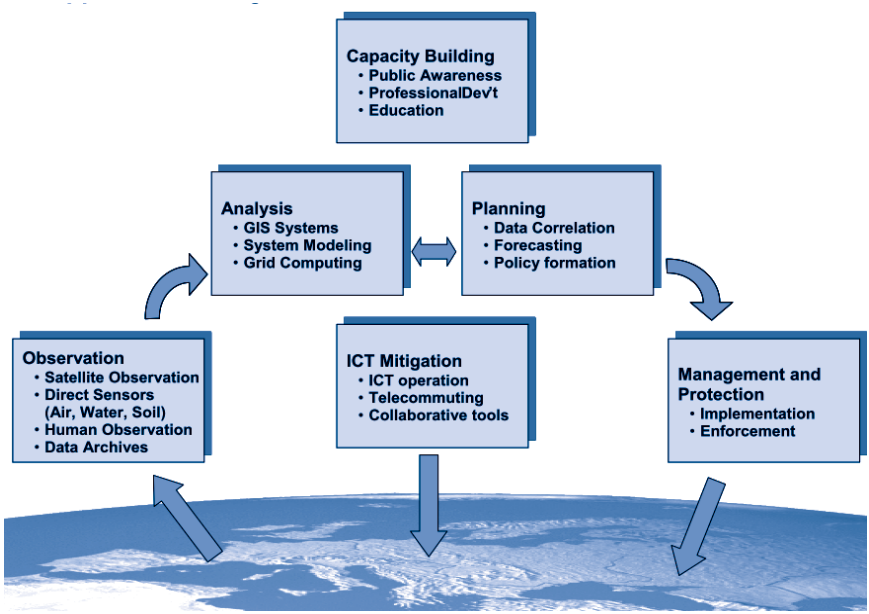
3. *Environmental planning*: at the international, regional and national level, planning makes use of information from environmental analysis as part of the decision-making process for the purpose of policy formulation and planning. Planning activities may include classification of various environmental conditions for use in agriculture and forestry and other applied environmental sectors, and often focuses on specific issues such as protected areas, biodiversity, industrial pollution or GHG emissions. Planning may also include the anticipation of environmental conditions and emergency scenarios such as climate change and man-made and natural disasters.

4. *Environmental management and protection*: involves everything related to managing and mitigating impacts on the environment as well as helping adapt to given environmental conditions. This includes resource and energy conservation and management systems, GHG emission management and reduction systems and controls, pollution control and management systems and related methodologies, including mitigating the ill effects of pollutants and man-made environmental hazards.

5. *Impact and mitigating effects of ICT utilisation*: producing, using and disposing of ICTs require materials and energy and generate waste, including some toxic waste in the form of heavy metals. ICT use can mitigate environmental impacts directly by increasing process efficiency and as a result of dematerialisation, and indirectly by virtue of the secondary and tertiary effects resulting from ICT use on human activities, which in turn reduce the impact of humans on the environment.

6. *Environmental capacity building*: efforts to improve environmental conditions rely on the actions of individuals and organisations. Capacity building includes efforts to increase public awareness of environmental issues and priorities, the development of professionals, and integrating environmental content into formal education.

Figure 6.4: ICT application categories



Source: ITU (2008) ICTs for e-Environment: Guidelines for developing countries, with a focus on climate change, ITU, Geneva, p. 25.

Mitigation: avoiding the unmanageable

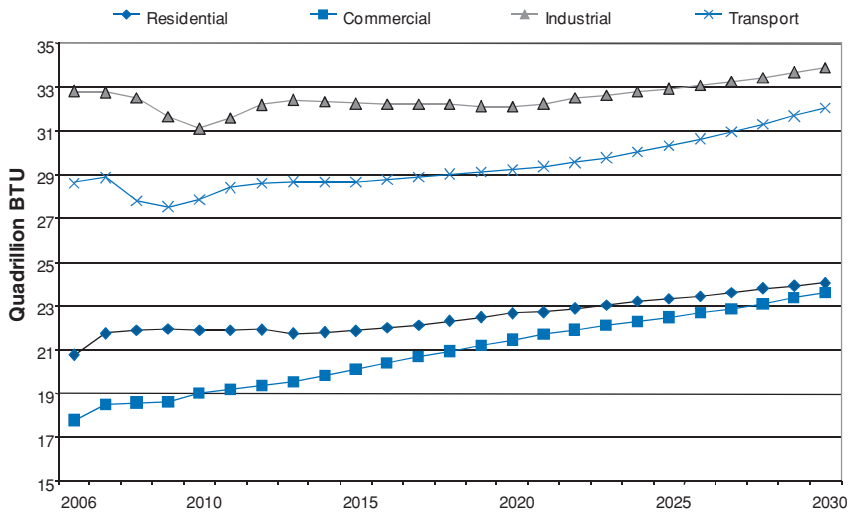
Mitigation activities are directed at reducing the adverse impacts of climate change on the environment and are crucial to meeting emissions targets. Such activities can be focused on mitigating climate change directly or on a range of other environmental effects (*e.g.* water availability and salinity, desertification and deforestation).

Climate change mitigation

There are numerous ways in which ICTs can be used to mitigate environmental impacts, including through their contribution to measuring, monitoring and managing, and enabling more efficient use of resources and operation of infrastructures through dematerialisation (*e.g.* online delivery of content such as newspapers, books and music), transport substitution (*e.g.* tele- and video-conferencing), and intelligent transport systems, logistics and freight rationalisation, smart buildings and home automation. Many studies and reports highlight areas in which ICTs can have a major impact on the environment, with a number identifying energy efficiency in

buildings, transport rationalisation and substitution through dematerialisation, and tele- and video-conferencing and tele-work as the major areas of impact, based on sectoral energy use shares and trends as well as application opportunities (*e.g.* Climate Risk 2008).

Figure 6.5: Delivered energy consumption by sector in the US



Source: EIA (2009), Annual Energy Outlook 2009, EIA, Washington DC. CSES Analysis.

Developing and emerging economies face many challenges in the provision of infrastructure as economic growth progresses, with demand rapidly increasing for reliable electricity supply, transport infrastructure and commercial buildings. The very difficulties faced in meeting this demand can, and are, driving investments towards more energy efficient solutions. The Climate Group (2008) cited a number of examples:

Energy infrastructure: Smart grids entail the modernisation of electricity distribution networks through the introduction of ICTs and sensing network technologies. Smart grids enable improved monitoring and control of the energy network as a supply chain, which means reduction in energy loss, greater network operational efficiency, better quality and reliability of energy supply, greater customer control of energy use, better management of highly distributed sources of energy generation (*e.g.* greater solar and wind generation), and reductions in greenhouse gas emissions. Smart meters add the possibility of two-way communication and supply between providers

and users (Access Economics 2009), and play a vital role in making energy and environmental issues visible to the household consumer, thereby informing and empowering consumers and enabling behavioural change.

Electricity generation capacity limitations and grid transmission and distribution losses are driving smart grid developments in India and China, which are improving energy efficiency and reducing the expansion rate of coal-fired electricity generation systems. Electricity generation accounts for 57% of India's total emissions; with rapidly increasing demand emissions are forecast to increase by 4% per annum, twice the global average. It is estimated that as much as 32% of generated power is lost along the grid (The Climate Group 2008).

With infrastructure investments for the next 20-30 years now taking place, there is an opportunity to "leapfrog" to smart grid systems that will reduce power losses and outages and realise greater energy efficiency. Indian distributors such as North Delhi Power are looking to invest in smart grid systems.

In view of potential rebound effects (Box 1), market and price signals will be particularly important in emerging and developing economies.

Box 6.1. Rebound effects?

There is concern is that lower energy costs coming from efficiency gains may result in increased use, such that the potential emissions reductions are lost to ''rebound effects". These can be direct (e.g. a fuel efficient vehicle enabling longer trips at no additional cost), or indirect (e.g. fuel costs saved being spent on other energy-intensive activities such as a long distance air travel).

In one of the most comprehensive reviews of the evidence on rebound effects, Sorrell (2007) noted, inter alia, that:

- Both direct and indirect effects appear to vary widely between different technologies, sectors and income groups and in most cases they cannot be quantified with much confidence. However, the evidence does not suggest that improvements in energy efficiency routinely lead to economy-wide rebound increases in energy consumption. At the same time, the evidence suggests that economy-wide rebound effects will be at least 10% and often higher.
- There are very few studies of rebound effects from energy efficiency improvements in developing countries. Rebound effects may be expected to be larger in developing countries where demand for energy services is far from saturated.

Rebound effects? (continued)

Energy efficiency may be encouraged through policies that raise energy prices, such as carbon taxes, or through non-price policies such as building regulations. Both should continue to play an important role in energy and climate policy. However, where rebound effects are expected to be large, there may be a greater need for policies that increase energy prices.

Source: Sorrell, S. (2007) The Rebound Effect: An Assessment of the Evidence for Economy-wide Energy Savings from Improved Energy Efficiency, UKERC. www.ukerc.ac.uk.

Motor systems: Motor systems convert electricity into mechanical power. While invisible to most of us, they are crucial to the manufacturing sector's energy use. Motors can be inefficient if they operate at full capacity regardless of load. A motor is "smart" when it can adjust its power usage to a required output through a variable speed drive and intelligent motor controller. It is estimated that motor systems in China represent 70% of total industry electricity consumption and are 20% less energy efficient than those in Western countries. By 2020, industrial motor systems in China will be responsible for an estimated 34% of power consumption and 10% of carbon emissions, or 1-2% of global emissions. Industrial energy use in China could be reduced by 10% by improving the efficiency of motor systems, as their optimisation alone could reduce China's emissions by 200 $MtCO_2e$ by 2020 – comparable to total 2006 emissions from the Netherlands (The Climate Group 2008). Recognising this potential, China's government has implemented the *China Motor Systems Energy Conservation Program* to help reach its energy efficiency targets. It is unlikely that the necessary investments would be made without such initiatives.

Buildings: Energy consumption in buildings is driven by two factors – energy intensity and surface area. ICT-based monitoring, feedback and optimisation tools can be used to reduce both at every stage of a building's life cycle, from design and construction to use and demolition. Energy modelling software can help architects determine how design influences energy use. Builders can use software to compare energy models with actual construction. Once the building is complete, ICTs can measure and benchmark its performance and compare actual to predicted energy efficiency. Occupants can install a building management system (BMS) to automate building functions such as lighting, heating and cooling, and if a building undergoes a change of use, ICTs can be used to redesign its energy model and measure the impacts of the change. It has been estimated that such tools could reduce emissions from buildings by 15% by 2020 (The

Climate Group 2008). Building standards and regulation are crucial elements in achieving such savings.

Transport: Globalisation has led to increasingly complex international supply chains and brings with it challenges for transport, storage and logistics operations. ICTs can improve the efficiency of logistics operations in a number of ways. These include software to improve the design of transport networks and allow the running of centralised distribution networks and management systems that can facilitate flexible home delivery services. Specific levers include inter-modal shift, route optimisation and inventory reduction. The transport sector is a large and growing emitter of GHGs, responsible for 14% of global emissions, and it is estimated that optimising logistics using ICTs could result in a 16% reduction in transport emissions and a 27% reduction in storage emissions globally (The Climate Group 2008). Many policy and regulatory issues influence transport and logistics, from airline route regulation to building planning and regulation to noise and pollution regulations relating to transport (Houghton 2005), representing a major challenge for policy coherence.

Mitigating other environmental pressures

Developing economies are often dependent on agriculture and fishing for both cash crops and subsistence; water can be a more pressing issue than energy use in emerging and developing economies. Deforestation can also be a major concern in some regions. Hence, mapping, monitoring and managing lands, forests and waterways are crucial to the efficiency and sustainability of key sectors. Geographic Information Systems provide major opportunities in land and waterway monitoring and management in Egypt (IISD 2005), Africa and across South East Asia and the Himalayan region (IISD 2009). As elsewhere, information is the key to enabling people to make more sustainable choices and realise benefits from their actions, as well as for education, awareness and support.

Observational data are increasingly available to users around the world through a range of portals and systems allowing for environmental observation and prediction. Examples include the Earth Observation Portal[1] and Climate Change Prediction Net,[2] while conservation is the focus of the Society for Conservation's portal.[3] There is a growing tendency to make geo-spatial environmental information more readily available through the use of common interfaces such as Google Earth and Microsoft Virtual Earth. This enables information holders to make geo-specific information available to users through a standard web interface at very low cost. Examples include The Tropical Ecology Assessment and Monitoring Network,[4] Atlas of Our Changing Environment,[5] Climate Change in Our World,[6] and others.[7]

There are a number of examples in developing countries of how mobile phones and wireless networks can provide a leapfrogging opportunity where fixed line networks are rudimentary or do not exist. Noting that agriculture is the mainstay of the Kenyan economy, Mungai (2005) provided a number of examples relating to mitigation such as the SokoniSMS service, which enables farmers to receive market prices in various market centres through their mobile phones.[8] Equipped with this information, farmers are able to determine the most profitable market to transport products to, circumventing middlemen who usually offer much lower prices and reducing the tendency to transport goods from market to market in search of buyers. Other initiatives include the use of geographical information systems in the Lake Victoria basin (Mungai 2005) and along the Nile basin (Sobeih 2005) to support natural resource management and local development. These systems can be supplemented by location or eco-system specific information kits such as the Mekong and Nile River Awareness Kits.[9] Integrated eco-system monitoring, sensing and modelling is also increasingly common (*e.g.* The Pearl River Delta (Chan 2009)).

Noting the vulnerabilities of rural communities in Southeast Asia and the Himalayan regions, their dependence on ecosystems and pressures from unsustainable and over use, Tyler and Fajber (2009) highlighted the importance of access to information and a number of innovative projects. For example:

- In Indonesia, Bogor Agricultural University is working with farmers to use climate forecasts through climate field schools. When seasonal forecasts suggested a drier than normal crop season in 2006-07, farmers stored a larger proportion of their first rice crop in anticipation of higher prices due to dry conditions for the second.
- In the Philippines, the Manila Observatory (MO) has partnered with SMART, one of the country's mobile phone service providers, for a pilot project providing telemetric rain gauges and phones in disaster-prone areas. Local farmers read the rain gauges and phone the information to the Observatory, and the Observatory uses the phones to issue early storm warnings to farmers. Farmers can also use the phones to access market information.

Adaptation: managing the unavoidable

Adaptation refers to actions designed to reduce the negative impacts of climate change that are already occurring. As the most vulnerable are at most risk, the developing world is where ICTs are likely to play an important role in climate change monitoring and adaptation (*info*Dev 2009).

Examples of adaptation include preparing risk assessments, protecting ecosystems, improving agricultural methods, managing water resources, instituting better building designs and building settlements in safe zones, developing early warning systems, improving insurance coverage and developing social safety nets (ISDR 2008; ITU 2008).

Climate change adaptation

Monitoring and providing early warning of climate change induced events such as storm and tsunami, drought and flood, famine and disease play a vital role. Examples at the international level include:

- *The Famine Early Warning Systems Network (FEWS NET)*, a USAID-funded network that brings together international, regional and national partners to provide early warning and vulnerability information on emerging and evolving food security issues. FEWS NET professionals in Africa, Central America, Haiti, Afghanistan and the United States monitor and analyse climate information for potential impacts on livelihoods and markets to identify potential threats to food security. Once identified, FEWS NET uses a suite of communications and decision support technologies to help decision makers act to mitigate food insecurity. These include monthly food security updates for 25 countries, regular food security outlooks and alerts, as well as briefings and support to contingency and response planning efforts.[10]

- *Distant Early Warning System for Tsunami (DEWS)* is a tsunami warning system for the Indian Ocean which aims to create a new generation of interoperable tsunami early warning systems based on an open sensor platform which integrates sensor systems for the rapid detection of earthquakes, for the monitoring of sea level, ocean floor events, and ground displacements. Tsunami warnings can be sent via SMS to mobile phones, by facsimile or as a television overlay.[11]

- *PreventionWeb* uses information exchange tools to provide a common platform for the disaster risk reduction (DRR) community to find and share information, exchange experience, connect and collaborate.[12]

Another area in which ICTs support adaptation is climate and impact models, which can be used to inform practitioners and decision makers in planning as well as predicting the impacts of climate change on agriculture (*e.g.* combined with crop models). SEI (2008) cite a number of examples, including:

- A South African provincial-level study undertaken by the University of Pretoria found a significant correlation between higher historical temperatures and reduced dryland staple production, and forecast a fall in net crop revenues by as much as 90% by 2100.

- A Nigerian study that applied the EPIC model to give projections of crop yield during the 21st century. The study modelled worst case climate change scenarios for maize, sorghum, rice, millet and cassava, and found that there will be increases in crop yield across all low land ecological zones as the climate changes during the early parts of the 21st century, though toward the end of the century the rate of increase will tend to slow down.

- An Egyptian study that compared crop production under current climate conditions with those projected for 2050, and forecast a decrease in national production of many crops, ranging from -11% for rice to -28% for soybeans.

- A study that mapped climate vulnerability with a focus on the livestock sector and identified arid and semi-arid rangeland and the drier mixed agro-ecological zones across the African continent, particularly in Southern Africa and the Sahel, and coastal systems in East Africa, as being particularly prone to climate change (Thornton *et al*. 2006).

Similarly, the International Crops Research Institute for the Semi-Arid Tropics' integrated climate risk assessment and management system uses remote sensing and GIS techniques to study rainfall patterns and prepare advisories for farmers in drylands of Asia and sub-Saharan Africa.[13]

Having identified areas of vulnerability, ICTs enable a range of responses, with information networks playing a crucial role. There are many examples:

- *The Arid Lands Information Network (ALIN)* states that its strategy is informed by the belief that knowledge is a source of competitiveness, where value lies in new ideas, practices, information on opportunities and new technologies as drivers of the process; that knowledge improves lives, reduces poverty and empowers people; that access to knowledge is fundamental to development and progress; and that ICTs are key for enabling access to knowledge. ALIN provides an information sharing forum that helps people to adjust to climate change.[14]

- *RANET* uses radio and the Internet to communicate hydro-meteorological information for rural development, and includes the

use of SMS emergency altering systems and community-based weather observation.[15]

- The Open *Knowledge Network (OKN)* and *openeNRICH* also provide regular information relating to climate change adaptation such as the July 2009 exchange "Climate Change Increases Food Insecurity in Kyuso, Kenya".[16]

- Focusing on mountain regions, the *Mountain Forum* and its regional partners provide information enabling residents of mountain regions to adapt to climate change (e.g. Climate Change and the Himalayas[17]).[18]

Periodicals such as *I4D*[19], *Telecentre Magazine*[20], *NewsforDev*[21], *Worldchanging*[22], etc. provide many other examples, and a number of international ICT4D agencies operate environment-related programmes (*e.g.* IICD[23]). Links and overviews can be seen through such sites as scidevnet[24], km4dev[25], t4cd[26], etc.

International co-operation

Environmental issues are, by their nature, global, and while local action is required, international co-operation is essential. Key areas include: providing and operating infrastructure for monitoring and early warning; collecting, analysing and disseminating the information necessary to enable governments and other agencies to manage, mitigate and adapt to climate change; capacity building, transferring technology and the funding necessary to enable its use.

Technology transfer

The Bali Action Plan included the commitment to help developing countries undertake nationally appropriate mitigation actions in the context of sustainable development without compromising growth, by transferring finance and technology from developed countries in a measurable, reportable and verifiable manner (World Bank 2008). While there are many examples of technology awareness and transfer activities, the transfer of technology and funding are amongst the most challenging and pressing issues.

TT:clear is a technology information clearinghouse operated by the UNFCCC expert group on technology transfer. It offers a web-based information sharing platform for access to a variety of sources of information including case studies.[27] The objective is to provide useful

information to stakeholders on all aspects of technology transfer for climate change mitigation and adaptation. TT:clear aims to help countries take advantage of opportunities for technology transfer by helping them become more aware of available technologies, existing funding and other forms of assistance, and of case studies that can be used when countries develop proposals or undertake projects. It also provides for the exchange of views and experiences on the development and transfer of technologies (ITU 2008).

The Climate Change Information Network (CC:iNet) is a web portal that serves as a clearinghouse for information sources on public information, education and training in the field of climate change. It is designed to help governments, organisations and individuals gain rapid and easy access to ideas, strategies, contacts, experts and materials that can be used to motivate and empower people to take effective action on climate change.[28]

GIS Development is a Geospatial Communication Network that promotes the use of GIS technology and applications in various areas of development. It assists communities and governments in developing productivity, policies and management capabilities by facilitating knowledge transfer. It fosters the growing network of those interested in geo-informatics and encourages the exchange of scientific know-how through magazines, a portal, conferences and training. GIS development claims to be the world's largest geospatial technical resource portal, with over 20 000 pages on various aspects of geospatial sciences. It is ranked amongst the top 100 000 websites and draws 140 000 unique visitors every month, making it one of the most popular destinations in the field.[29]

Energy Sector Management Assistance Program (ESMAP) is a global technical assistance programme which helps build consensus and provides policy advice on sustainable energy development to governments of developing countries and economies in transition. ESMAP also contributes to the transfer of technology and knowledge in energy sector management and the delivery of modern energy services to the poor.[30]

Combining information with research and education, Australia's *Desert Knowledge* provides information, expertise and experience relating to adapting to desertification, while sites such as km4dev.org, scidev.net and t4cd.org provide a wealth of information relating to climate change mitigation and adaptation and development.[31] This international flow of information, demonstration projects and on-the-ground experiences and learning plays a vital role in technology transfer.

Sustainable ICT value and supply chains

The very processes of development and globalisation have drawn far-flung regions into global distribution and logistics networks, making international co-operation essential in areas such as standardisation of energy efficiency monitoring and labelling, and international trade in electronic waste (e-waste).

Cross-border trade in e-waste

Electronic waste or e-waste is a growing problem and one of the fastest growing sources of waste. The United Nations has estimated that some 20-50 million tonnes of e-waste are generated each year, and recent European studies suggest that e-waste is increasing around three times faster than the total waste stream, accounting for around 8% of all municipal waste (Vetter and Creech 2008).

While miniaturisation and the trend towards the use of mobile devices and LCD screens reduces the energy consumption impacts of ICT equipment, its rapid adoption in households and developing and emerging economies, together with short product life cycles, is contributing to continuing increases in energy use and the production of e-waste. This is exacerbated by the increasing use of electronics in motor vehicles, home appliances and almost all forms of industrial and consumer equipment (Bio Intelligence 2008).

There have been major gains in reducing the use of materials of concern in electronic equipment and in legitimate recycling initiatives, but much that is collected is still being leaked to sub-standard treatment plants or illegally exported.[32] Greenpeace reported that inspections of 18 European seaports in 2005 found that as much as 47% of waste destined for export, including e-waste, was illegal. Despite attempts by governments to ban the illegal export *and* import of e-waste, India, China and Africa (*e.g.* Ghana and Nigeria) remain major destinations.[33]

Many of the major ICT and electronics firms are trying to clean up the e-waste problem with pro-active return and re-cycling initiatives, but these tend to affect local recycling more than the international trade in e-waste. International co-operation can help stop the illegal trade and ensure that recycling operations meet appropriate standards. This could be through updating the Basel Convention, regional or bi-lateral agreements, tracing and monitoring or other regulatory mechanisms. The problem is not easy to solve, however, as banning trade and forcing local recycling would likely raise the cost of, and thereby discourage, recycling. It may be that local

implementation and monitoring of internationally agreed standards for recycling is the only effective course of action (Shinkuma and Huong 2009).

Summary and conclusions

ICTs are all but ubiquitous and the potential uses and impacts of ICTs on the environment are numerous and varied. Only a few examples have been provided here. However, it is possible to note some of the key areas of impact and potential in more general terms, highlighting some of the major issues arising for policy coherence.

There are a number of crucial tasks and tools, including:

- Earth observation, remote sensing and monitoring, communications networks, grid and cloud computing, data collection, analysis and modelling, database management and decision support systems;
- Geographic information systems (GIS) and earth browsers (*e.g.* Google Earth and Microsoft Visual Earth);
- Web-based clearinghouse sites for communicating technology and learning, education and capability building;
- Monitoring and reporting on, and operation of, transaction systems and trading.

Specific applications include:

- Detection and early warning (*e.g.* for storms, floods, earthquakes and tsunami);
- Energy efficiency applications (*e.g.* intelligent building systems, intelligent transport systems, smart grids and home automation);
- Information, education and capability building (*e.g.* technology awareness and transfer, public education and support), with the key to realising potential benefits being behavioural change at the household and individual level.

Key issues for emerging and developing countries include:

- Access to infrastructure and ways to enable investments in smarter, greener energy, transport and building infrastructures, as well as access to broadband networks and the ICT equipment and services necessary to enable their operation;
- Access to data and how the masses of data collected can be brought together to provide a holistic picture of an ecosystem or

environment (*i.e.* who owns the data, who can use it and what it can be used for);

- Affordability and how emerging and new technologies can be implemented in contexts of severe budgetary constraint;
- Capability and how the necessary skills can be brought to bear on environmental issues in developing and emerging economies.

Areas for concern for developing and emerging economies include:

- Understanding life cycle impacts in the many different contexts and circumstances that exist in developing and emerging economies, and not assuming that developed country life cycle assessments will apply, while operating within the constraints of available data (*e.g.* insufficient national statistical collections to support input-output analysis and life cycle assessments);
- Managing possible rebound effects, which are likely to be greater in rapidly growing markets where there is unmet demand for energy and resources, and the related difficulties of establishing an equitable international price for carbon and regulating for appropriate price signals;
- Ensuring that there is sufficient technology transfer and enabling funding flows to developing countries.

Fundamentally, ICTs are about information and communication – these roles are vital. Data must be collected, analysed and interpreted, transformed into information that enables individuals to make smarter, greener choices, and communicated in such a way as to inform and educate, influence and change behaviours. It is not simply a matter of price signals shaping behaviour (even if it were possible to get those signals right) but also of informing, monitoring performance and providing non-price feedback in such a way as to motivate and reward individuals and communities for creating sustainable livelihoods.

As Plepys (2002) noted: "…it is necessary to look at both ecological and social dimensions." The positive ecological dimension rests on ICT's potential to deliver greener products, optimise the ways of their delivery, and increase consumption efficiency through dematerialisation, e-substitution, green marketing, ecological product life optimisation, etc. The environmental potential offered by the ecological dimension will be fully utilised only under an optimised social dimension, which deals with the behavioural issues of consumption."

Notes

1 *www.eoportal.org*.

2 *www.climateprediction.net*.

3 *www.scgis.org*.

4 *www.teamnetwork.org*.

5 *http://na.unep.net/digital_atlas2/google.php*.

6 *http://earth.google.co.uk/outreach/kml_entry.html#tClimate%20Change%20In%20Our%20World*

7 *http://earth.google.co.uk/outreach/kml_listing.html#cenvironment%20science#s1#e20*.

8 *www.gkpnet.org/projects/public/ict4dinitiatives/view.do gkpprojectid=32600*.

9 *www.mrcmekong.org/ and www.nileteap.org/nrak*.

10 *www.fews.net*.

11 *www.dews-online.org*.

12 *www.preventionweb.net*.

13 *www.icrisat.org*.

14 *www.alin.or.ke*.

15 *www.ranetproject.net*.

16 *http://196.201.231.147/eNRICH/viewContentItem.do?View=viewItem&itemid=137921&ptltid=302*.

17 *www.icimod.org/home//pub/publications.content.php?puid=126*.

18 *www.mtnforum.org/index.cfm and http://www.mtnforum.org/rn/index.cfm*.

19 *www.i4donline.net/articles/current-article.asp?articleid=1910&typ=Features*.

20 *www.telecentremagazine.net*.

21 *www.newsfordev.org/index.html*.

22 *www.worldchanging.com*.

23 *www.iicd.org/sectors/environment*.

24 *www.scidev.net/en/climate-change-and-energy*.

25 *www.km4dev.org*.

26 *www.t4cd.org*.

27 *http://unfccc.int/ttclear/jsp/index.jsp*.

28 *http://unfccc.int/cc_inet/items/3514.php*.

29 *www.gisdevelopment.net/aboutus/portal.htm*.

30 *www.esmap.org*.

31 *www.desertknowledge.com.au*; *www.km4dev.org*; *www.scidev.net*; *www.t4cd.org*.

32 *http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/764*.

33 *www.greenpeace.org/international/campaigns/toxics/electronics/where-does-e-waste-end-up#*.

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Chapter 7

Policy Coherence in ICTs for Education: Examples from South Asia

By Mitakshara Kumari and Nilaya Varma[1]

Education is a key requirement for social and economic prosperity. In the developing economies of South Asia it is often seen as the only means to social mobility and financial self sufficiency. Recognising the significance of education, governments across the region have devoted considerable resources in terms of money and comprehensive programmes for improving access, quality and delivery mechanisms.

*This chapter presents preliminary outcomes of a survey commissioned by info*Dev *and conducted by PricewaterhouseCoopers India on the use of ICTs for education in India and South Asia, which includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Sri Lanka and Pakistan.*

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Recent years have seen a groundswell of interest in how information and communication technologies (ICTs) can be deployed in the education sector. One of their most vital contributions is easy access to learning resources. It is widely believed that ICTs can be important potential levers for introducing and sustaining educational reform efforts, as well as useful aids for both teaching and learning. However, despite evidence of increasingly widespread use of ICTs in education initiatives around the world, little guidance exists for policy-makers and donor staff in developing countries contemplating the increased use of education-related ICTs.

With the objective of defining clear guidelines and policies on the use of ICTs for education and bridging the gap between education investments and development in India and South Asian countries, *info*Dev commissioned PricewaterhouseCoopers, India to conduct a regional survey. The project seeks to gather the most relevant and useful information on the use of ICTs in education activities in India and South Asia, which includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Sri Lanka and Pakistan. It will serve as a repository for all innovative initiatives as well as a basis for designing strategies to effectively integrate ICTs into education so that the best possible benefits may be realised.

This regional survey is the third in series commissioned by *info*Dev, following one on Africa and another on the Caribbean region. It focuses specifically on policy coherence in the application of ICTs for education.

The proliferation of ICT tools for education is an emerging trend in South Asia. ICTs in developing countries are often seen as an opportunity for achieving developmental goals. Whether it is due to perceived need, a desire to duplicate other countries' success stories or the regional success of the ICT industry as a whole, ICTs are being used enthusiastically – often without a real understanding of their relevance and impact.

As such, initiatives are often introduced without proper policy frameworks to support their success. Furthermore, the nature of adopting ICTs for education requires combining micro-level planning at the smallest unit (classrooms), to the highest level of macro-planning (basic infrastructure policies, connectivity policies, communication policy for the nation as a whole). Thus, policy coherence must be achieved at many levels, amongst policies ranging from education to ICT, telecommunication and infrastructure.

The South Asian countries in the PriceWaterhouseCoopers study, broadly recognising the importance of ICTs for development, have all established some sort of policy framework for the growth of information and communication technologies. ICT applications in all sectors are an evolving phenomenon; it is interesting to note, however, that education is both a

consumer and producer of ICTs. Without a robust educational framework, the know-how required for development of ICT applications would not be possible – so using ICTs to reinvigorate the education process is especially important.

A broad classification based on educational achievement and infrastructure would place Sri Lanka and Maldives at the top end, with near 100% literacy, universal primary education and basic infrastructure in place. India, Bhutan and Pakistan would be in the next tier, with lower literacy rates but systems in place to achieve higher educational attainment in future. Nepal, Bangladesh and Afghanistan would be in the final tier – all experience significant political, geographical and educational upheaval and struggle to institutionalise processes and achieve basic services.

A broad comparison of education and ICT indicators in the focus countries will be available in the full report to be published on the *info*Dev website in mid 2010.

Policy frameworks for ICTs for education

In most of the focus countries policy articulations for ICTs for education are made in one of the following ways, as depicted in Figure 7.1:

Figure 7.1: ICTs for Education articulations

Source: PriceWaterhouseCoopers India.

India, Sri Lanka and Pakistan have either developed or are in the process of developing distinct ICTs for education policies. A common feature is the importance of ICTs *both as a subject and as an instructional aid*.

India's policy-making process was initiated through a stakeholder dialogue on formulating a Draft National Policy on ICT in School Education, led by the Ministry of Human Resource Development, the Global e-Schools Initiative (GESCI) and the Centre for Science, Development and Media Studies (CSDMS). Based on feedback received, the draft policy has now been published for comments and revision. However, even before the focused policy action, ICTs had been mainstreamed in several education initiatives and flagship programmes of the government.

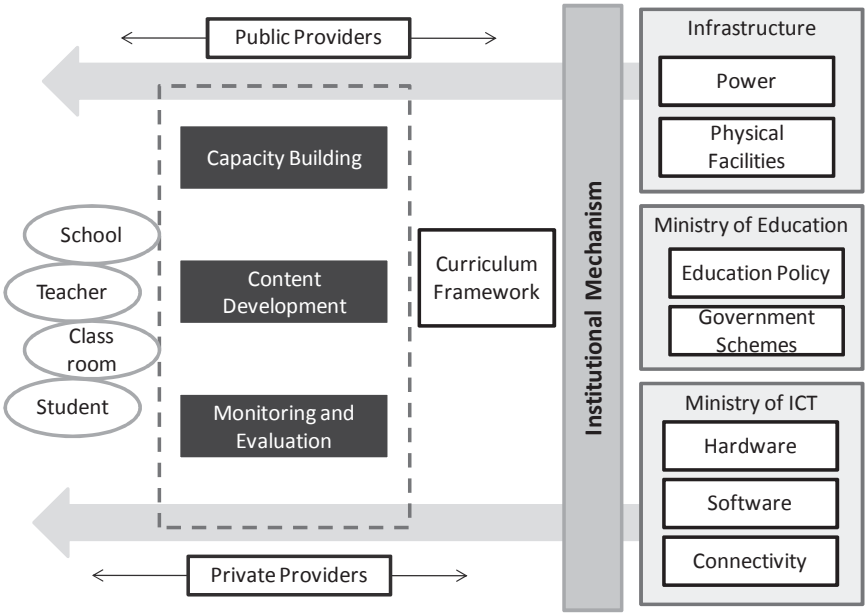
Sri Lanka's National Policy on Information Technology in Education (NAPITSE)[1] was formulated in 2002, whereby ICTs would be used both in education and management of education systems.

Pakistan formulated its National Information and Communication Technology Strategy for Education (NICT)[2] through a consultative process in 2004-05. The policy recognises the importance of ICTs for creating access, improving quality of learning, strengthening teacher education and improving student achievement.

For all these countries, policy/strategy documents need to be backed with detailed implementation plans. Sri Lanka had a strategic plan of action from 2002-2007, but the targets set out in their ambitious policy have yet to be realised. Further separate financial allocations must be made in support of the initiatives outlined. Very few countries' policy documents have extensively outlined a monitoring and evaluation methodology to gauge the success of the initiatives or tools used.

ICTs for education initiatives in the different focus countries are successful precisely because they are able to pull together many different elements, supported by a robust yet flexible policy framework. A broad graphical depiction of what may be understood as an "ICTs for education ecosystem" is depicted in Figure 7.2. Core infrastructure policies provide for electrification and physical facilities, ministries of education have responsibility for articulating larger education policies and ministries of ICT instigate broad communications policies and policies on developing hardware, software and connectivity.

Figure 7.2: ICTs for Education ecosystem



Source: PriceWaterhouseCoopers India.

These policies may then be translated into initiatives and schemes by public and private providers through different mechanisms. Initiatives specific to ICTs for education have several critical elements such as capacity building, content development and monitoring and evaluation strategies. Together these are geared towards the student in his or her environment, ensuring that ICT initiatives actually result in improved teaching and learning. In addition to these elements, factors such as detailed implementation plans, financial allocations, institutional capacity and community demand for ICTs are all essential in ensuring that ICTs are effectively integrated into the education system.

Major elements of ICTs for education policy

Use of ICTs for education is a horizontal activity that requires the coming together of elements from different verticals to enable meaningful learning experiences for students. The following need to be included in any ICTs for education policy:

- curriculum;

- content/digital resources;
- infrastructure;
- capacity building;
- monitoring and evaluation frameworks;
- ICTs for education management;
- Policy Plus:
  - implementation plans;
  - financial allocations;
  - political and administrative will;
  - community demand for ICT.

Content and curriculum development

This is the most significant aspect of ICTs for education. Whether ICT applications can yield meaningful results will depend primarily on the quality of the content and curriculum being offered in classrooms. There is a need to ensure that ICTs are not used simply to teach the old curriculum using computers and other tools at hand, but that concepts are taught in a fundamentally new way by leveraging the advantages that ICTs provide. Visualisation, experimentation and learning-by-doing are some of the hallmarks of this new method.

Introduction of ICTs into the learning environment is therefore an opportunity to rethink the teaching and learning paradigm. As models of learning change, what is taught in class and at what level should also be re-thought. This is an opportunity to instil 21st century teaching and learning skills.

Content needs to be designed that is relevant to the target group. Content development and curricular reform are important pillars – if these are ill-designed it will be difficult to see any utilisation or performance improvement through ICTs, even if all other aspects are in place.

The policies of almost all focus countries underscore the need for appropriate curriculum and content. Curriculum is usually prescribed for ICTs as a subject starting at the secondary school level; the primary level goal is to improve general ICT literacy and facility with technology. There is also mention of using ICTs as a tool for teaching other subjects, though

strategies for content development in the focus countries are articulated to varying degrees.

India

The Draft National Policy on ICT in School Education, published by the Ministry of Human Resource Development in 2009[3], stresses the significance of achieving general ICT competency for all school levels, appropriate curriculum for ICTs as a subject at the higher secondary level, and the need for ICT-enabled teaching and learning practices. The policy outlines requirements of different levels of ICT literacy and competency from basic to advanced, and proposes an implementation strategy to ensure that these levels are achieved. It also articulates the need to develop modular courses in different areas of ICTs at the higher secondary level.

Given India's linguistic, cultural and social diversity, the policy recognises the significance of good quality, locally relevant content in multiple local languages. It spells out a strategy to develop content in a phased manner by focusing first on the more difficult to teach and understand concepts and making quality digital resources available for all concepts and disciplines, moving finally towards a model of highly interactive digital resources such as virtual laboratories. National and state level web-based digital repositories are envisaged that will host content for students and teachers in a range of formats from question banks to activities, notes, etc. Appropriate licensing norms to facilitate open and free access to resources will be highlighted, with knowledge of issues such as copyright and restrictions on content reuse imparted to all users. Further, educational standards and instructional design models will be widely distributed to ensure quality in the digital content being produced by different agencies.

School libraries will be revamped to function as gateways for access to quality digital content, thereby playing a crucial role in catalysing usage of digital resources in all classes. Libraries will have adequate Internet connectivity and move towards digital cataloguing and automation.

Content development is entrusted to the public and private domain. Agencies such as the Central Institute of Education Technology (CIET), National Council of Educational Research and Training (NCERT), Indira Gandhi National Open University (IGNOU), State Institutes of Educational Technology (SIETs) and Doordarshan (National Broadcasting) have dedicated resources for developing and disseminating digital content at various levels for a variety of objectives from informal educational messages to structured course modules. Private companies such as EduComp, Everon, NIIT, Aptech, IL& FS, Intel and Zee Interactive systems are working extensively to develop and deliver quality digital content. These

companies, in addition to selling their products to individuals and schools, have entered into MoUs with various state governments in order to design and deliver content through well-defined initiatives focusing on government schools.

Sri Lanka

Sri Lanka's 2002 National Policy on Information Technology in School Education (NAPITSE) was formulated to "envisage and foresee the future global challenges in IT education and lay the foundation for appropriate human resource development to meet such challenges". Additionally, it seeks to improve the information literacy of all its citizens, create lifelong learning opportunities through the school system and enable the use of ICTs as a tool in teaching and learning at all levels of general school education. Specifically, the NAPITSE articulates the need to:

- Introduce, sustain and enhance ICT involvement into general education in schools and create opportunities for ICT-based learning and teaching.
- Introduce IT into pre- and in-service teacher development and training programmes and create opportunities for system-wide professional development of teachers.
- The NAPITSE also mentions the need to set up a multimedia education software and web development centre.

Recognising the lack of relevant content in local languages as an impediment to adoption of ICTs by a large number of people, the Government of Sri Lanka, through its Information and Communications Technology Agency (ICTA), has launched the Shilpa Sayura Project to create digital content in Sinhalese. Shilpa Sayura enables students to use ICTs at telecentres to study eight subjects in order to prepare for national examinations. In addition, the National ICT Literacy Project aims to increase the e-literacy level of the population by providing training through a network of rural service delivery centres called *nensalas*.

Pakistan

The 2005 National Information and Communications Technology Strategy for Education (NICT) stresses the use of ICTs both as a subject and critical instructional aid. It aims to improve student learning using ICTs through locally relevant content created by training teachers who develop their own teaching and learning materials. It also suggests distribution of *CD-ROM*-based software (including items from and links to relevant

websites and education portals) to schools, professional development centres and teacher training institutions to help pre- and in-service teachers expand their content knowledge.

The NICT also articulates the need for overall curricular reform in light of tools and pedagogical techniques made available through ICTs so as to enrich education at every level. It stresses the need to use ICTs to provide access to internationally or nationally produced quality content to supplement existing textbooks and materials. This content, by being flexible, interactive and multi-modal (radio/TV etc.), will improve student learning.

The policy suggests that ministries, education departments and district education offices establish limited area search engines – online database collections of appropriate content for use by students. International open educational resources and models for curriculum and content development may be used after adapting them to national requirements based on guidelines.

Bhutan

Bhutan's 2004 Information and Communication Technology Policy and Strategies (BIPS) aims to create appropriate curriculum for ICTs as a subject based on market needs, as well as curriculum for general ICT literacy and competency for all school students.

The 26th Education Policy Guidelines & Instructions (EPGI-2007) state the government's intention to make teachers and students who complete basic education (*i.e.* class X) ICT literate. To this end, since April 2007 Bhutan Telecom has made all dial-up Internet packages free. Therefore, all schools with computer and Internet facilities are urged to introduce relevant ICT programmes for students and encourage the use of computers and Internet for learning, especially after school hours and during weekends when the facilities are often underutilised and students have ample time to practise and learn. The Department of Education's Curriculum and Professional Support Division has developed a standard ICT literacy framework which schools are urged to use to initiate and carry out IT literacy programmes.

A strategic component of local content development is the Dzongkha localisation project currently being executed by the Department of Information Technology (DIT). A beta version of Dzongkha Linux was released in 2006 with the capacity to undertake common desktop computing tasks such as word-processing, spreadsheets and PowerPoint presentations in Dzongkha, Bhutan's national language. This symbolises the beginning of a commitment toward open source software development. Diminishing the

language barrier is another feat. The DIT, the National Library and the Institute of Language and Cultural Studies are collaborating to establish the National Digital Library of Bhutan (NDLB), which aims to present aspects of Bhutanese life, traditions and culture and provide resources for scholars.

The other focus countries, namely **Afghanistan, Maldives, Bangladesh** and **Nepal,** while stressing the importance of locally relevant content, do not have separately articulated strategies for developing it. Instead they are focused on creating qualified IT professionals in order to boost their local ICT industries, which will in turn create local capacity for content development. In addition, ongoing initiatives focus on creating locally relevant content in local languages.

Afghanistan

Afghanistan's ICT Policy highlights the need to promote effective ICT training courses at the secondary and tertiary levels. It focuses on creating curricula and developing material for teacher training and trainers. Content development capacity in Afghanistan is still being developed, with a focus on training faculty, IT professionals and supporting the general ICT industry. International content may be accessed through distance education centres. Partnerships for content development are also encouraged: for example, the Ministry of Education, with assistance from The Asia Foundation, has undertaken digitalisation of science subjects for grades 10-12 in the form of DVDs.

Maldives

In Maldives, the Ministry of Planning and National Development's Seventh National Development Plan is dedicated entirely to expanding current ICT levels. It highlights the need to provide access to computers for all students, especially at the secondary level, and to develop a national curriculum for primary and secondary education focusing on ICT skills and usage including the Internet.

Bangladesh

Likewise, the Bangladesh National ICT Policy 2009 stresses the need to produce more trained ICT professionals through improvement of curriculum of ICTs as a subject. The policy has several strategic focus areas for use of ICTs in education and research from primary to tertiary levels. Content development is highlighted as important, including the need to create a

central repository for e-learning content for teachers and students and to provide incentives for content development.

Nepal

The Nepal IT Policy 2000 highlights the need to have "computer education for all by 2010". It proposes a phased introduction of ICTs as a subject at the secondary level. Nepal's Open Learning Exchange (OLE) is a non-profit organisation dedicated to assisting the Government of Nepal in meeting its Education for All goals by developing freely accessible, open-source ICT-based educational teaching and learning materials. OLE has set up a digital library, E-Pustakalaya, which includes all required curriculum textbooks in local language.

Box 7.1. Content and curriculum development: summary

- Curriculum for ICTs as a subject is prescribed in almost all focus countries at the secondary level (India, Sri Lanka, Pakistan, Bhutan, Nepal, Bangladesh, Maldives and Afghanistan).
- At the primary level, curriculum focuses on general ICT literacy and improving facility with technology.
- Use of ICTs as an instructional aid is emphasised in the policies of some countries (India, Pakistan, Bangladesh (2009) and Sri Lanka).
- Strategies for content development are articulated in very few countries (India and Bhutan), though many do have specific initiatives (e.g. Shilpa Sayura in Sri Lanka).
- Pakistan's NICT is the only policy that clearly emphasises the need for overall curricular reform in light of tools and pedagogical techniques made available through ICTs.

Key constraints in developing relevant content:

- lack of IT professionals in the country;
- lack of funding, infrastructure and resources;
- lack of local content development initiatives;
- no clearly defined standards for digital educational content;
- no focus on digital content in traditional curriculum.

Capacity building

Human resource development is an important aspect of capacity building for integrating ICTs into education. Teachers, administrators and managers all need to be adequately equipped to maximise the potential of ICTs in improving teaching and learning practices.

Policies in all of the focus countries include some sort of articulation for teacher training in ICTs. Training institutes are being equipped to provide this service.

India's Draft National Policy on ICT in School Education underscores the need to reform pre-service training curricula for teachers to include relevant ICT courses. Furthermore, ICT competency will form part of the eligibility criteria for teacher appointments. Appropriate ICT infrastructure will be made available at all teacher training institutions. The draft policy recognises that periodic in-service training comprising induction and refresher courses will be key to the widespread infusion of ICT-enabled practices in the school system. Training will cover initial sensitisation through operational skills and ICT-enabled subject training skills, after which teachers will be expected to join online professional groups and associations in order to keep abreast of latest developments, share and develop relevant content and engage with a larger community of experts.

Recognising the significance of bringing school leaders and administrators on board to ensure optimum adoption and utilisation of ICT-enabled teaching and learning, it is proposed that all heads of schools will be given orientation in ICTs and ICT-enabled education training programmes. Schools will be encouraged to automate their processes in administration, management and monitoring of systems. To this end, school leaders will be provided adequate training in order to be able to contribute to the successful development and implementation of a School Education Management Information System (SEMIS).

Quite often, government personnel working in education departments at various levels – national, state and district – do not have adequate knowledge of ICTs. **India's** draft national policy states that training will be provided to government personnel in order to encourage them to use ICTs in day-to-day activities. Specific training would also be provided on any management information system for schools and general maintenance and upkeep of ICT infrastructure.

In **Pakistan**, the NICT places great emphasis on using ICTs to strengthen teachers' professional development and educational management. The strategy highlights the need to maximise opportunities for professional development through different ICT media such as IRI, television, ODL and

online resources. This will prove particularly useful in geographically remote areas and where face-to-face interaction for professional development is difficult and not cost-effective. Teachers will learn ICT skills as well as how to teach ICTs as a subject and integrate it within the curriculum, such that ICT training is not merely about skill development but enabling new instructional methodologies (*e.g.* project oriented, problem-based and collaborative learning). The policy recognises that while skill training in ICT is essential, teaching ICTs as a separate subject should not be the focus. It is more important for teachers to know how to teach *with* ICTs than how to use ICTs, and such instruction should be integrated within basic courses at teacher training colleges.

The NICT highlights the importance of making the correct technology available to teachers based on their assessed needs. It also suggests exploring internationally-available standards, such as those provided by the International Society for Technology in Education (ISTE), and adapting them for teacher training in local conditions.

The policy further highlights the need to provide adequate resources to teachers through various platforms to enable them to develop their own teaching materials. A national education portal is envisaged to enable teachers to communicate with each other, learn from each other's experiences and have access to subject matter specialists to improve their own understanding. Training of administrators and education managers should be part of a planned programme to make school environments conducive to maximum use of innovative ICTs.

In **Sri Lanka** the NAPITSE articulates the need to provide training and education to all teachers in government schools to make them competent in using ICTs for teaching purposes. It also reiterates the need to introduce ICTs into pre- and in-service teacher development and training programmes and create opportunities for system-wide professional development of teachers. The policy envisages training for government officers managing education systems and encourages use of school-based ICT resources by the out-of-school population in order to provide general ICT literacy for the community. The Intel Teach programme is aimed at enabling teachers to better exploit the full education potential of the technology age. Response from education administrators, principals, and teachers has been exceptionally encouraging; over 7 500 teachers have already been trained.

The National ICT Policy 2009 in **Bangladesh** identifies the shortage of trained and qualified teachers and therefore proposes to leverage ICT tools to provide effective teacher training programmes and mitigate the shortage of good quality teachers. The policy underscores the need to incentivise acquiring ICT skills for teachers and strengthen all primary and secondary

teacher training colleges through connectivity, multimedia content, etc. It also talks about the need for more trained ICT professionals through improved curriculum for ICTs as a subject. The National Academy for Computer Training and Research (NACTR) is an autonomous educational and computer training institution charged with the responsibility to prepare, conduct and evaluate computer training syllabi for personnel engaged in Bangladesh's government, semi-government, autonomous and non-government institutions. An "ICT Professional and Skill Enhancement Programme" will also be initiated which would assess the skills of ICT professionals and meet gaps with targeted training programmes to overcome the short-term skills shortage in the ICT industry.

Nepal's IT Policy also highlights the need to provide computer training as part of pre- and in-service training for teachers. It states that computer knowledge shall be made compulsory to all newly-recruited teachers in phases so as to introduce computer education in schools, and that computer education shall also be provided to all in-service teachers in phases through distance education.

In **Maldives** nearly 80% of teacher training costs are transport-related. In response to this constraint, Teacher Resource Centres have been set up on 20 atolls and are equipped with state-of-the-art technology to provide an interactive learning experience through "smart boards" and to improve the quality of teacher training. Through the Educational Development Centre's teacher resource website, teachers can sit in front of a computer in a resource centre and search for lesson materials, download syllabi and share ideas with colleagues on other atolls. Through the virtual learning environment developed for the Educational Development Centre by Cambridge International Examinations, up to 400 teachers can simultaneously receive training by participating in an online course and interacting with one another.

At the policy level there is an emphasis on creating a larger pool of ICT professionals through certification and accreditation processes.

Bhutan's BIPS highlights the need to ensure appropriate ICT awareness and skills from computer literacy to high-level technical skills. Further, the 26th Education Policy Guidelines reiterate the need to ensure that all teachers and students are ICT literate.

Afghanistan identifies the lack of technical ICT professionals and appropriate training materials as a major constraint for using ICTs for teacher training and professional development. The Afghanistan Higher Education Portal, developed in collaboration with the Global Learning Portal and the Afghanistan Ministry of Higher Education, is an effort to empower teachers, learners and communities to improve education access

and quality. The Portal will provide education faculty in Afghanistan with technical assistance, learning resources and networking tools to support professional development.

There are several initiatives for training senior school leaders and administrators in ICTs. Administrative departments will also increasingly use ICTs to better manage public spending and planning for education. Personnel in these departments also need to be trained to use effective school management information systems and other planning tools to provide better governance.

Box 7.2. Capacity building: summary

- Training of teachers, school leaders and education department personnel.
- Role of ICTs for professional development of teachers in pre- and in-service training recognised by most countries.
- Strengthening of teacher training institutes with multimedia resources highlighted in most focus countries.
- Training and orientation for school leaders recognised as important by some countries (India, Pakistan).
- Training for education department personnel in ICTs in day-to-day activities, also as distinct SEMIS tools emphasised in India, Nepal, Sri Lanka, Bangladesh.

Key constraints in effective use of ICTs for professional development:

- Teacher attitudes towards ICTs.
- Lack of relevant content.
- Lack of access to Internet and computers after school.
- Lack of adequate funding and resources.
- Lack of training focusing on pedagogical innovation and learner-centric strategies.

Infrastructure

Infrastructure is key for deploying ICTs for education. Attention must be paid to the spectrum of infrastructure requirements, from proper buildings/rooms to electricity and power supply to sophisticated hardware,

system software and, most importantly, connectivity. Trends on all these parameters show a mixed bag of results in terms of government success in ensuring effective infrastructure availability. While a relatively high standard of education and ICT infrastructure is available in countries like Maldives and Sri Lanka, their application and content development pace is slower than, say, India, which has patchy infrastructure but a rapidly developing ICT industry able to develop many new applications and content for education. Bhutan and Nepal face geographical and climactic challenges to providing basic infrastructure.

In addition to geographical concerns, unstable political terrain in Afghanistan and Pakistan is an impediment to adequate infrastructure development. Bangladesh also has a poor track record of infrastructure availability.

Policy articulations for improving infrastructure have been made in almost all the focus countries, including policies for ICT, education, ICTs for education and infrastructure, depending on the country. The essential components of infrastructure are connectivity, hardware, software and enablers such as electricity, classrooms buildings, etc.

According to the **India's** draft policy, ICT requirements for each school will be determined based on their size and norms articulated by the state government. The draft policy envisages that all states will begin with appropriate, adequate, cost-effective state-of-the-art ICTs and other enabling infrastructure in all secondary schools. This will include computer labs with adequate hardware and software, AV rooms with digital still and video cameras, music and audio devices, digital microscopes and telescopes, digital probes for investigation of various physical parameters, adequate hardware for EDUSAT terminals etc.

Each school will have a LAN in place and dedicated broadband connectivity of at least 2 mbps. In addition to Internet connectivity in the computer labs, connectivity will be provided to terminals in school libraries, teachers' common rooms and school administrators' offices. An EDUSAT network will be planned in each state with interactive terminals and receive-only terminals. At least 1000 such terminals could be planned for each state.

A judicious mix of software will be introduced at the secondary stage, comprising a range of software from the standard office suite to graphics and animation, desktop publishing, web designing, databases and programming tools. To enable cost effective software usage and development, free and open source software applications are preferred.

India's draft policy also emphasises that the enabling infrastructure required to efficiently maintain ICT facilities will be defined, established

and maintained. This includes adequate and regular power supply and physical facilities such as large rooms, adequate ventilation, and other supporting infrastructure.

Pakistan's NICT, while highlighting the need for adequate ICT infrastructure in each of its six elements, does not outline a distinct strategy for creating this ICT infrastructure at each level. Instead the document is seen as a set of guidelines for federal, provincial and school-level administrators to develop their own capacities and tailor the strategy for integrating ICTs for education systems at their level. The NICT in Pakistan has emphasised the importance of ICTs vis-á-vis education, with some of the relevant provisions being to:

- Launch a scheme for providing low-priced computers and Internet connectivity to universities, colleges and schools through a public/private sector initiative.
- Network all universities, engineering and medical colleges and institutions of higher learning for improved quality of education.
- Set up electronic libraries to ensure economical and equitable access to world information.
- Encourage educational facilities to computerise their registration, examinations, accounting and other activities.
- Encourage educational facilities to adopt computer-assisted learning and other ICT tools to aid in the teaching process.
- Establish virtual classroom education programmes, using online, Internet and/or video facilities to provide distance learning to a large number of individuals.
- Establish a national educational Intranet (linked to the Internet) to enable sharing of electronic libraries of teaching and research materials and faculty.

The "e-**Sri Lanka**" programme, which commenced in early 2003, aimed to extend the benefits of ICT to impoverished regions by implementing a number of initiatives. e-Sri Lanka focused on providing infrastructure and installation of hardware, while the NAPITSE focuses on creating adequate human resources and developing quality content to ensure that the maximum benefit of ICT integration into education is realised.

Bangladesh's National ICT Policy 2009 proposes to do the following in order to provide ICT access to all schools:

- Install computers, Internet connectivity and appropriate multimedia educational content for every primary, secondary and higher secondary school, accessible to each student; including solar energy panels if necessary.
- Create a model school as an Information Access Centre with ICT facilities in each union open to all other adjacent school students.
- Provide Internet connectivity for all villages in the country and ensure subsidised pricing for Internet connectivity to primary and secondary educational institutions as well as technical and vocational education training programmes.

Bhutan's BIPS outlines the need to develop a plan for countrywide connectivity to ICT infrastructure, including schools, geographical centres and villages. According to the Tenth Five Year Plan, all higher and middle secondary schools have a computer laboratory each with a minimum of ten computers. Similarly, some lower secondary and community primary schools have also been supplied with two to five computers. The Plan states that the Royal Government of Bhutan has committed, through the Prime Minister's Executive Order in 2006, to support the ongoing development and enhancement of ICTs for education.[4] There is a plan to provide computers to schools as they acquire electricity supply. The government is committed to ensuring an affordable, fast, secure, sustainable and appropriate ICT infrastructure throughout Bhutan by 2010.

In **Maldives** ICT infrastructure is relatively well developed, with near 100% mobile network coverage. Nearly 90% of Internet users have broadband Internet connections and there is a relatively high penetration of personal computers compared to the rest of the region. The Ministry of Planning and National Development's Seventh National Development Plan articulates the need to provide access to computers for all students. The government hopes to ensure that each secondary school has a computer lab and sufficient capacity to maintain and operate it effectively. The government has already succeeded in installing computer labs in 60% of secondary schools, and most schools have a technician and computer teacher.

Nepal's IT Policy 2000 states that Internet facilities shall be made available free of cost to universities and public schools for four hours a day within the next five years to provide computer education in a systematic way. It also states that the distance learning system shall be introduced through the Internet and Intranet as well through radio and television. Networking systems like school-net, research-net, commerce-net and multilingual computing shall be developed. With its difficult geographical

terrain and nascent ICT and telecom sectors, Nepal has low ICT penetration figures compared to the rest of the region.

Afghanistan also has extremely low ICT penetration, for various geographical and political reasons. By 2014-15 the Ministry of Education aims to develop 100% ICT infrastructure in the centre and throughout the provincial educational directorates and 50% coverage of district education units and educational institutes around the country. A phased plan for development of ICT infrastructure has been articulated, starting at the national level with the Ministry of Education and eventually trickling down to district education units and education institutes.

Box 7.3. Infrastructure: summary

- Distinct articulation for making basic ICT infrastructure available to schools and other educational establishments in the ICT and educational policies of most countries.
- Enabling infrastructure like electricity and physical facilities still a major constraint in almost all focus countries (except for Maldives and Sri Lanka).

Key constraints in developing adequate ICT infrastructure:

- Significant difference in access to connectivity and electricity between rural and urban areas.
- Lack of resources for maintenance and upkeep.
- High cost of connectivity.
- Lack of institutional frameworks and robust implementation capacity.

ICT for education management

Use of ICTs in planning for better service delivery in the field of education is a significant aspect. School administrative processes, communication between schools and management of education systems by respective departments can all be greatly facilitated by School Education Management Information Systems (SEMIS). Standard procedures such as admissions, transfer and posting of teachers, salary payments and attendance can be greatly simplified using ICT applications. GIS applications for school planning are also being used along with student tracking initiatives.

In **India t**he Draft National Policy on ICT in Education envisages the use of ICTs in school management at all levels. Starting with introduction of local school-wide networks to enable automation of various administrative process from student/teacher tracking to records maintenance and resource planning, leading to a school management information system which will then feed into the proposed state-wide web-based SEMIS. At the state level, states will adopt an e-governance and automated school administration programme, build capacities for its implementation and deploy school-based Management Information Systems (MIS). These MIS will be integrated into the proposed national-level web-based SEMIS.

The National Education Strategic Plan (NESP) in **Afghanistan** envisages an ICT strategic plan as part of developing the overall capacity of the Ministry of Education. An Education Management System (EMIS) is being developed with assistance from donors. Lack of information and reliable data is a major impediment to improving the planning and management capacity of the education system. The Ministry also envisages that all management and administration civil service employees should have the opportunity to be "digitally literate" by the end of the planning cycle. Afghanistan also has some GIS-based data to enable school planning.

Pakistan's NICT envisages the need to ensure proper planning, management, support and monitoring and evaluation of ICT initiatives by organising ongoing efforts to ensure capacity building at the federal and provincial levels and creating an external body which advises the Ministry of Education on ICTs for education. Specifically, the NICT suggests establishing a Technical Implementation Unit (TIU) for ICTs for education which will develop the technical planning, monitoring and evaluation capacity of policy-makers, planners and administrators at national, provincial, district and school levels. It will also liaise with teacher training institutes, oversee the implementation of the NICT Strategy and support the overall monitoring of education through the national EMIS.

Sri Lanka's NAPITSE, along with a focus on the use of ICTs for education, also highlights the need to use ICTs in management of the education system. The policy outlines the need to design, develop and maintain a web site for the Ministry of Education and Higher Education to assist the school system in e-learning and information management. It also mentions training education department officials to make better use of ICTs in their day-to-day work.

In **Nepal** an EMIS has been evolving and is used to derive Flash Reports which chart progress against agreed educational indicators for the Education for All programme.

Bangladesh's Bureau of Educational Information and Statistics (BANBEIS) is responsible for collection, compilation and dissemination of educational information and statistics at various levels and types of education. This organisation is the main organ of the Ministry of Education, responsible for collection and publication of educational data and statistics and functions as its EMIS. It is also the national co-ordinator of Regional Informatics for South & Central Asia (RINSACA).

Neither **Bhutan** nor **Maldives** have distinct policy articulations for the use of ICTs in school management.

Monitoring and evaluation

Monitoring and evaluation of ICT initiatives should be incorporated into any strategy for integrating ICTs into education.

India's draft policy envisages that monitoring tools built into the SEMIS along with other information such as District Information System for Education (DISE) data will be used to monitor progress of initiatives and programmes. State governments will design their own monitoring mechanisms, mapped at each level – *i.e.* local, district, and state – to feed into the national web-based MIS for the progression of ICTs in schools and to suggest mid-course corrections. Independent third party evaluations are suggested whereby states will appoint their own agencies to evaluate various parameters such as the ICT programme, infrastructure, digital resources, capacity building and overall programme management.

As mentioned previously, **Pakistan's** NICT envisages the setting up of a Technical Implementation Unit (TIU) for ICTs for education. This body would work in an advisory capacity to the Ministry of Education to develop the technical, planning, monitoring, and evaluation capacity of policy-makers, planners, and administrators at the national, provincial, district and school levels. The TIU will also liaise with teacher training institutes, oversee the implementation of the NICT Strategy and support the overall monitoring of education through the national EMIS.

In most of the other focus countries no distinct monitoring and evaluation strategies have been articulated for ICTs for education initiatives.

Box 7.4. Monitoring and evaluation: summary

- Monitoring and evaluation strategies very weakly articulated in most countries (except India and Pakistan).
- Existing monitoring and evaluation strategies are mostly focused on programme evaluation and EMIS-type tools instead of being based on evaluation of learning levels (India, Pakistan, Nepal).

Key constraints in developing monitoring and evaluation strategies:

- No standards on which to base evaluations of the impact of ICT initiatives in education.
- Weak institutional structures and fragmentation of responsibility.

Policy Plus

Policy coherence does not only imply articulating well-integrated strategies. There are several measures that need to be taken to ensure the effectiveness of policies. Some of these are:

Detailed implementation plans. While policies in almost all focus area countries clearly highlight the need to integrate ICTs into education, there are very few clear implementation plans. Implementation strategies are briefly indicated in India's and Pakistan's policy documents. In Sri Lanka the NAPITSE was to be implemented through the "National Policy on Information Technology in School Education Action Plan, Operational Strategies", but there is very little information available on the success of its implementation.

Financial allocation. Financial allocation should back the distinct policy statements made by governments. Funding from different sources, including government, private and public/private partnerships should be explored. Policy statements in almost all the focus countries lack detailed financial allocations or frameworks for funding specific initiatives (with the exception of Bhutan's BIPS).

Institutional capacity and political and administrative will. This is the most critical constraint in the South Asian region, where there is little institutional and administrative capacity to translate good policies from paper to real initiatives on the ground. For example, of 103 policy directives in 16 areas in Bangladesh's National ICT Policy 2002, only eight were fully or largely accomplished by 2008.

Community demand for ICTs. General ICT awareness and community participation were seen as critical in effectively integrating ICTs into education. With a robust demand for ICT services in general in the larger community, there is better adoption and utilisation of technology in the school environment. Very few policy documents in the South Asian countries recognise this critical linkage (with the exception of Bhutan's BIPS and Bangladesh's National ICT Policy 2009).

Key Findings

- The imperative for ICTs for education policies in the South Asian region has largely come from a recognition of the need to develop adequate human resources in order to be competitive in the global ICT market (Bangladesh, Nepal, Sri Lanka, Pakistan).
- There is greater focus on the incorporation of ICTs as a subject into the curriculum than on using them as an instructional aid to improve overall education quality.
- Only Sri Lanka, Pakistan and India have specific ICTs for education policies. These focus both on ICTs as a subject as well as their use as an instructional aid. Of these, Sri Lanka's NAPITSE has been in operation since 2000 and Pakistan's NICT since 2005, while India's Draft National Policy on ICT in School Education is still under formulation, with the first draft having been published in 2009.
- ICT policies in Bangladesh, Bhutan, Nepal and Afghanistan include sections on education, where the need for qualified manpower and familiarising the general population with ICT through the education system is highlighted.
- Maldives does not yet have an ICT policy, but with the basic IT infrastructure in place (relatively higher Internet penetration, mobile networks, TV and radio penetration) and good educational indicators (near 100% literacy and high GERs at primary as well as secondary levels), it is in a good position to realise benefits from a dedicated ICT for education policy that focuses on quality content and delivery.
- Infrastructure remains a key bottleneck in most of the focus countries, especially Afghanistan, Nepal, Bhutan and Bangladesh.
- India and Pakistan have a certain amount of critical infrastructure in place and should focus on developing content and applications and

leveraging the potential of ICTs as a tool to strengthen the teaching and learning process.

- Maldives and Sri Lanka have been relatively successful in putting key infrastructure in place (with the exception the high cost of Internet access in Maldives). They now need to focus on using ICT tools and content to improve the overall quality of education and create access for those who have been excluded from existing systems.
- By and large, administrative capacity to translate policies into actionable plans and back specific initiatives with financial allocation and institutional structures has been a bottleneck in all the focus countries.

Notes

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2 National Information and Communications Technology Strategy for Education in Pakistan, Government of Pakistan, 2005.

3 National Policy on Information and Communication Technology (ICT) in School Education, Ministry of Human Resource Development, Government of India, 2009.

4 26th Education Policy Guidelines & Instructions (EPGI-2007), Government of Bhutan.

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The Development Dimension

ICTs for Development

IMPROVING POLICY COHERENCE

Information communication technologies (ICTs) are crucial to reducing poverty, improving access to health and education services, and creating new sources of income and employment for the poor. Being able to access and use ICTs has become a major factor in driving competitiveness, economic growth and social development. In the last decade, ICTs, particularly mobile phones, have also opened up new channels for the free flow of ideas and opinions, thereby promoting democracy and human rights.

The OECD and infoDev joined forces at a workshop on 10-11 September 2009 to examine some of the main challenges in reducing the discrepancies in access to ICTs and use of ICTs between developing countries.The workshop discussed best practices for more coherent and collaborative approaches in support of poverty reduction and meeting the Millennium Development Goals.

There is much work to be done on improving policy coherence and there is a need to engage more actively with partner countries. Making the most of ICTs requires that they are seen as part of innovation for development, rather than just another development tool.

This publication examines: access to ICTs, as a precondition to their use; broadband Internet access and governments' role in making it available; developments in mobile payments; ICT security issues; ICTs for improving environmental performance; and the relative priority of ICTs in education.

For more information

The OECD/infoDev Workshop on ICTs for Development: ***www.oecd.org/ICT/4D***

OECD work on Policy Coherence for Development: ***www.oecd.org/development/policycoherence***

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