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Ensuring the Global Participation in the Internet Economy for Development

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ENSURING THE GLOBAL PARTICIPATION IN THE INTERNET ECONOMY FOR DEVELOPMENT

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FOREWORD

The OECD Committee for Information, Computer and Communications Policy (ICCP) has reviewed progress made on the implementation of the 2008 *Seoul Declaration for the Future of the Internet Economy* as part of its 2011-12 programme of work. The review: *i*) points policy makers to new issue areas that have arisen since the Seoul Ministerial; and *ii*) identifies issues for possible future work.

This report, which is part of the paper series developed for the review, addresses the theme "Ensuring the global participation in the Internet Economy for development". The ICCP Committee discussed the report and approved its declassification in February 2013.

The report was drafted by Ms. Caroline Paunov and Ms. Verena Weber with contributions from Mr. Rudolf van der Berg under the guidance of Ms. Anne Carblanc of the OECD's Directorate for Science, Technology and Industry (DSTI). It is published under the responsibility of the Secretary-General of the OECD.

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Main points

In the Seoul Declaration, ministers stated their determination to "support expanded access to the Internet and related ICTs, especially for people in developing countries" and they "recognised 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". The review in the area of the Internet and ICTs for development focuses on; *i)* increasing access to the Internet economy; *ii)* developing skills in emerging and developing countries; *iii)* promoting applications and their use; and *iv)* Internet-related innovation: the case of cloud computing.

Markets and policy developments

In the area of *increasing access to the Internet economy*, significant progress has been made in international interconnection by the deployment of submarine fibre systems, especially in connecting Sub-Saharan Africa and in increasing capacity along the transpacific interconnection to South-East Asia. Further progress could be made in better connecting South America. In terms of national connections, mobile networks seem to be the most promising way to connect the majority of people living in emerging and developing countries. In 2010, 90% of the world was covered by a mobile signal (ITU World Telecommunications/ICT indicators Database). Over the past years, the number of mobile phones and smartphones in developing and emerging countries has increased at a fast pace which will further drive traffic growth. Overall, the growing number of subscriptions and especially mobile subscriptions in developing countries is an indication that people and organisations are willing to spend often scarce resources to get access to the Internet and that they see important additional value in being connected to the Internet.

On the *application layer*, multiple applications in areas such as agriculture, health, education and mobile banking have been developed over the past years. Evidence shows that users benefitted from these applications whereby benefits largely came from access to better quality information and services that particularly disadvantaged groups did not have previously. Opportunities for greater gains are possible as services improve by leapfrogging on developed economies who also need to develop applications e.g. on health given the challenges posed by ageing populations. The gains for disadvantaged groups are probably among the most substantial. However, success was less substantial when it came to the scale of such applications and project sustainability. Exceptions include M-PESA for mobile banking and Socialtxt and HMRI 104 Advice for mobile health applications. This was also due to the fact that few initiatives were financially sustainable to allow scaling-up.

In terms of *innovative concepts*, cloud computing has gained in importance since the Seoul Declaration and different cloud services are now used in emerging and developing countries. There is, however, room for progress since the poor interconnectivity in these regions still limits the range of cloud based applications. The major benefit of cloud computing for development is the fact that individuals, businesses and governments can access a wide range of well-developed computing resources that would otherwise not be available in developing or emerging countries. In addition, cloud computing allows them to only buy the quantity that is really needed and avoid the costs of building-up own infrastructure. Platforms designed especially for mobile devices seem to be very interesting for emerging and developing countries as the deployment of mobile networks is more advanced than the deployment of fixed networks.

Finally, the full potential of the Internet economy can only be tapped if people have the necessary *skills*, if they know how to use ICTs and the Internet for economic purposes and in their social life. Some

progress has been made in training people to use specific Internet and ICT-based applications, for instance, by training users to train other users.

Important areas for potential further work

A key message from the 2012 OECD Meeting of the Council at Ministerial Level (MCM) was the renewed emphasis on development. In the area of the Internet economy, the OECD has engaged in development issues through its participation in APEC, the Internet Governance Forum and through Workshops on the Internet and ICTs for development.

Demand for work in this domain continues to grow and could be undertaken in several areas. Regarding *communications infrastructure*, progress has been made in deploying submarine fibre, but being connected is only the first step. A reliable and competitive offer has to be available in markets before the Internet economy can truly take root in an economy. Future work will need to focus on balancing competition and reliability. In terms of mobile network deployments, work could focus on assessing mobile broadband prices in developing countries and in ensuring that enough spectrum is made available to enable the further deployment of mobile networks in particular for connecting remote and rural areas. When it comes to applications, further innovative mobile applications which can substitute for the lack of administrative and financial structures could be assessed. In addition, more work would be needed to ensure that small applications scale up and that applications are financially sustainable.

Cloud computing can greatly benefit emerging and developing economies, because they may lack the necessary resources in skills and ICTs at the domestic level. However, access to cloud resources requires the build-up of domestic infrastructure as well as policy frameworks, for example, to ensure privacy and security. Standardisation is also key to the further deployment of cloud services in emerging and developing countries. Finally, ICT *skills* have to be developed. Given limited resources there is a need to assess the relative importance of different types of investments in skills and their costs. The extent to which simple technologies can save on certain training needs also requires further analysis.

Introduction

This report on "Ensuring the global participation in the Internet Economy for development" covers the sixth theme of the follow-up work to the 2008 Seoul Ministerial Declaration.

The structure of the complete review of the Seoul declaration, on the progress made on international and national levels, tries to reflect the essential parts of the Internet economy along the lines of the Declaration's definition of the Internet Economy and includes the following seven thematic parts:

i. Laying the foundation for the Internet Economy: Access to the Internet via a high-speed infrastructure (OECD, 2012e)

ii. Understanding the data-driven economy: the development of a smart Internet Economy

iii. Innovating for economic growth and sustainability: Review of the major areas of digital content and green ICTs (OECD, 2013c))

iv. Cybersecurity and privacy

v. Empowering and protecting consumers (OECD, 2013d)

vi. **Ensuring the global participation in the Internet Economy for development**

vii. 1. Ensuring an open Internet economy

The purpose of this report is twofold:

- First, it is intended to present the progress made since the 2008 Seoul Declaration in terms of development.

- Second, it sheds light on new issue areas which have arisen since the Seoul Ministerial and where further work is required, and proposes action points.

In addition, the report will contribute to the OECD Project on Innovation and Inclusive Development (OECD, 2013b) which aims at producing new evidence on inclusive innovation and at developing policy options for developing and emerging countries.

The Seoul Declaration and development

In the Seoul Declaration, Ministers stated their determination to:

- *"support expanded access to the Internet and related ICTs, especially for people in developing countries"* and they

- "*recognised 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*".

The challenge, on the one hand is to expand the economic and social opportunities of the Internet and related ICTs to emerging and developing countries. At the same time, and stated by the second objective, it is, on the other hand, to achieve an *inclusive* development of the Internet economy in these countries. Differences in development levels not only exist between countries but are often even more pronounced between different social groups or regions within a country.

The report thus reviews the overall progress made on country levels but also sheds light on the progress made in terms of inclusive development in the four key areas of the Internet economy which have been reviewed (see next section).

The Internet economy as a platform for inclusive economic, social and cultural development

In the Seoul Declaration ministers recognised the importance of the Internet economy for economic, social and cultural development. Since the Seoul Declaration, a growing number of publications have pointed to the positive impact of broadband on development (see Stryszowski, 2012 for a detailed review).

From an economic perspective, benefits have been identified both at the firm- and at the macro-levels. At the firm-level, the Internet has increased efficiencies within firms, enhanced communication, transformed content markets (e.g. music, film, news) and enabled the creation of new businesses. Evidence of these impacts is mainly provided through case studies. At the macroeconomic level, many studies, including ongoing OECD work, highlight the positive link between an increasing adoption rate of the Internet and economic growth. For example, the OECD Internet Economy Outlook 2012 (OECD, 2012c) finds that up to 13% of business sector value added in the United States in 2010 could be attributed to Internet-related activities depending on the scope of the definition.

From a social perspective, the Internet is already bringing benefits to individuals in various ways although there is room for improvement. For instance, they benefit from positive impacts in education, improved information gathering and sharing, and access to and use of a larger variety of digital content. As consumers, they benefit from an increased transparency, more distribution channels and eventually lower prices.

Finally, from a cultural perspective, the Internet has proved to spur the development and distribution of local content (OECD, UNESCO and ISOC, 2012). The web provides an easy means for individuals to become content creators, to develop “crowd-sourced” knowledge bases, and probably most importantly, to make this content accessible globally and thus to open cultural heritage and knowledge to a much broader audience than was possible before.

However, a source of rising concern has been that the positive effects of the Internet economy are insufficiently inclusive. Beyond well-known differences across countries, within-country inequalities in living conditions, income and capabilities exist across regions, economic activities and social groups but also within these groups. Inequalities are often much greater in developing and emerging economies as the gap between the most advantaged and the most disadvantaged is wider and as those at the bottom of the distribution face more extreme living conditions than those in developed economies. The concept of inclusive growth often figures prominently in political debate: for instance, the government of India’s 11th Five-Year Plan (2007-12) focuses not only on sustainable growth but also specifies the reduction of economic disparities as its key objective.

Achieving “inclusive development” is part of a wider policy agenda but it also relates to innovation which relates to “inclusion” in a variety of ways (see OECD, 2013b and 2012b for a more detailed explanation). The Internet and information and communication technologies (ICTs) can potentially play a substantial role which would include providing low- and middle-income groups with applications to particularly support their welfare as well as entrepreneurial activities.

The Internet and information and communication technologies (ICTs) are the most transformative innovation of the recent past owing to their characteristic of general purpose technologies (GPT). They have, moreover, allowed for a whole range of innovations, not only in developed countries. ICTs are particularly relevant to the debate around inclusive innovation because accelerating technological progress

over the past years has had substantial effects on price levels. Likewise, the dissemination of mobile technology (see the access section) has allowed reaching out to low- and middle-income groups beyond that which was possible in the past, thus overcoming a baseline condition for benefits from ICTs for these groups. A variety of applications seem particularly geared at bringing fundamental changes to the most disadvantaged groups. At the same time, inequalities in incomes and skills continue to condition access to ICTs and disadvantaged groups are *de facto* offered less opportunities for accessing them.

Areas of review

The review aims at analysing key parts of the Internet economy, as well as new developments and innovation models, and how these can contribute to the further development of the Internet economy in developing and emerging countries. In addition, it looks at the skills that are already available and at those that are needed. The review focuses on:

1. Increasing access to the Internet economy
2. Promoting applications and their use in developing and emerging countries
3. Developing skills for the Internet economy in developing and emerging countries
4. The role of innovation and new business models, and how they can be applied to developing and emerging countries

The paper sheds light on several selected topics in each of the four areas. Where data are available, it also focuses on the case of low- and middle income groups, notably in the section on ICT-based applications. The objective is not to give an exhaustive overview in these four areas which would not be possible in one single paper but rather to highlight important developments over the past years. Furthermore, it proposes areas for future work.

Increasing access to the Internet economy

High-speed broadband networks are the underlying platform of the Internet economy. *Expanding access to the Internet and related ICTs*, as put forward as a key objective in the Seoul declaration, is the necessary condition to enable emerging and developing countries to profit from the economic and social benefits that the Internet offers. Since the Seoul Declaration, numerous activities have been undertaken to increase access to the Internet economy in emerging and developing countries.

Increasing access to broadband involves increasing it both at the international interconnection level and at national levels. Since international interconnection is fundamental for connecting emerging and developing countries to the global Internet, this section first focuses on developments in this area. It then focuses on developments in mobile networks and mobile broadband since mobile networks are regarded as the most promising route in connecting people and organisations in developing countries and in striving for inclusive connection.

Developments in the deployment and use of submarine fibre cables

Satellite, land-based or submarine fibre cables are the typical ways to carry data over long distances and to assure the connectivity to other countries. Submarine fibre cables are normally the preferred solution since the failure rate is supposed to be lower compared to land-line fibre cables and since they are able to carry much more data than satellites (OECD, 2013a).

Since 2008, important progress has been made in the deployment of submarine fibre cables worldwide. Where in 2008 many Sub-Saharan coastal nations were not connected to submarine cables, by 2012, all coastal nations in Africa except Somalia were connected. Today, many economies are connected to more than one submarine fibre cable, which ensures reliability, and significant efforts have been undertaken to bridge the digital divide in international interconnection. Only 21 states and territories still lack international fibre connectivity (see Table 1). During the past years, a significant part of the deployment in developing or emerging countries has been driven by the private sector, either in consortia of telecommunications companies or investors of other sectors like content providers.

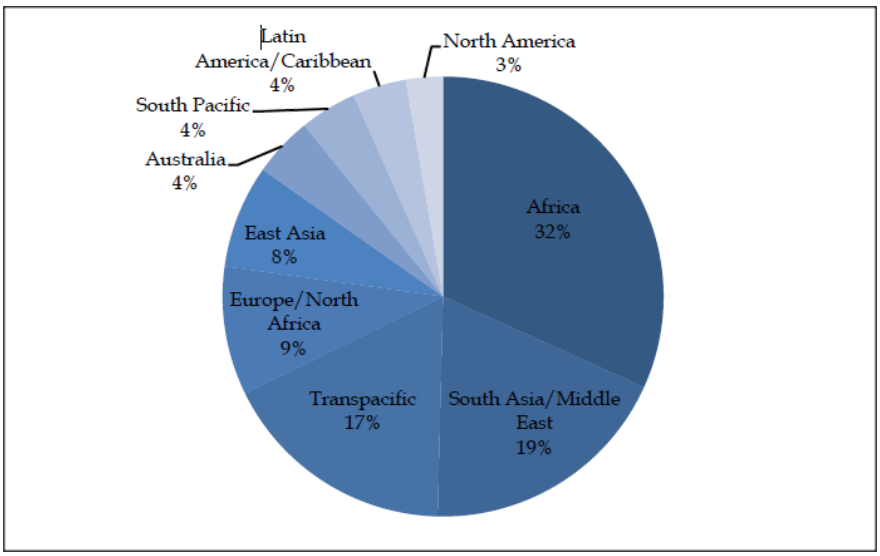
Table 1. States and territories without international fibre connectivity

Africa	Somalia (including Somaliland) – a fibre connection has been built, but has not yet been connected Saint Helena, Ascension, Tristan da Cunha (British Oversea Territory)
Asia	Christmas Islands, Cocos (Keeling) Islands (Australian External Territory)
North America	Saint Pierre and Miquelon (French collectivité d'outre-mer)
South America	Easter Islands (Chilean Special Territory), Falkland Islands (British Overseas Territory), Galapagos Islands (Ecuador)
Carribean	Montserrat (British Overseas Territory)
Oceania	Cook Islands, Kiribati, Nauru, Niue, Norfolk Islands (Australian External Territory), Palau, Pitcairn Islands (British Overseas Territory), Solomon Islands, Tokelau (New Zealand Dependent Territory), Tonga, Vanuatu, Wallis and Fortuna (French collectivité d'outre-mer)

Source: OECD based on Submarine Telecoms Forum (2012)

In terms of investments, USD 10 billion have been spent in new submarine fibre projects from 2008 to 2012. Figure 1 shows that, out of these investments, over two thirds have been made in Sub-Saharan Africa, South Asia and the Middle East, and most of these have targeted the markets of South Africa, India and China. Interestingly, telecommunication companies have accounted for 80% of investments from 2008 to 2012 as private investors were rather reluctant. Government and development agency funding amounted to 5% in this period (Submarine Telecoms Forum, 2012).

Figure 1. Investment in New Submarine Fiber Projects by Region, 2008-2012

2. 

Source: Submarine Telecoms Forum (2012)

Taking a closer look at developments in several regional areas highlights that development stages differ across regions and emerging and developing countries.

Sub-Saharan Africa. Before 2008, Sub-Saharan Africa was only connected by two fibre cables, SAT-2 and SAT-3, whereby SAT-2 only served South-Africa. SAT-3, in addition connected various countries on the west coast to Europe. No submarine fibre connection existed on the east coast and many African countries were dependent on expensive satellite connections or the also expensive SAT-3 cable. From 2008 on, huge developments have been made leading to a current overcapacity. On the west coast, four additional cables were put in service and the east coast is now connected by two cables. The only country that still lacks access to submarine fibre is Somalia.

South-America – North America/BRICS/developing countries. The connection between North-America and South-America has some of the highest interconnection prices with a pricing that is about ten times higher than transatlantic pricing (Submarine Telecoms Forum, 2012). At the moment, most of the capacity is carried *by only three cables*, SAM-1, South American Crossing and Globe Net that were all built in 2001. Wholesalers have an important control of the entire market which accounts for the high prices together with a rapidly increasing Brazilian demand for capacity. For the years 2013/2014, at least three major projects are planned which would increase capacity significantly along the North America-South America route. A further interesting development is the fact that there are four additional projects underway to connect South America to the BRICS and emerging and developing countries. The Atlantic Cable System, for example, which is expected to be fully deployed by 2014, will connect Brazil to Angola, Argentina, Uruguay besides connecting the country to Europe and the United States.

Transpacific interconnection and South Asia. From 2008 to 2012, three new submarine fibre systems - TPE, AAG and Unity/EAC Pacific - have been built in addition to four existing transpacific-cable systems and thus tremendously increased the overall capacity between the United States and East Asia. Out of these, AAG was mainly built to connect Southeast Asian countries to North America and TPE was mainly built to serve Chinese demand. Until 2014, four additional transpacific fibre systems are currently planned. In addition, Southeast Asian operators plan on deploying intra-Asian fibre systems which would

allow them to become more independent from transpacific fibre systems. As a consequence, it is expected that prices will fall since access could be provided in a more cost-effective way.

South Asia. The highest demand in South Asia comes currently from India. The main interconnection between South Asia and Europe is through the Gulf of Suez which often is known to be affected by outages due to anchors, earthquakes and also some political uncertainty in Egypt. Prices on that route are still considered rather high which leads to lower priority traffic being routed via North America (see also OECD 2013a). Some alternative routes have been built, for instance, the extension of SAT-3 which connects Europe and South Asia via South Africa. From 2008 to 2012, four cable systems have been built so that India is served by more than 10 international cables. At least three additional cables are currently being planned for 2014, partially with high involvement from Chinese operators (Sea-Me-We-5) which would significantly increase capacity.

Overall, significant progress has been made in the deployment of submarine fibre systems in emerging and developing countries, especially in connecting Sub-Saharan Africa and in increasing capacity along the transpacific interconnection to South-East Asia. Progress should be made in better connecting South America. Since there are many projects in the pipeline in this region, developments look rather promising if these news projects also contribute to balancing the power that some wholesalers currently have in the South American market. Competition and mostly private investments, often by a consortium of operators, have been the driving force behind connecting emerging and developing countries.

Reliability of submarine cables

When a fibre submarine cable is cut, a country needs other fibre systems to fall back on. Many countries are currently connected to only one fibre system and therefore face disconnection of their national Internet when maintenance has to be done on the cable or when catastrophic failure happens through earthquakes, anchors or fishermen. In 2012, Lebanon, Bangladesh and Nigeria all suffered from outages due to fibre cuts on submarine fibres, which greatly affected businesses and end-users in their countries.[1] Countries are therefore looking into ways to improve the reliability of the networks connecting their countries. Increasing reliability can however negatively impact competition. For example, private investors may be reluctant to invest into additional redundancy because multiple new or upgraded cables to a country or region may result in an oversupply of capacity, a situation which has in the past led to bankruptcies.

Access to submarine fibre systems and landings stations

Once fibre systems and landing stations are established, the crucial question for connecting countries is if and how a fair and open access to the submarine fibre systems and the landing stations is provided so that multiple operators can make use of the international interconnection and that competitive prices can be obtained at the wholesale level.

Currently, the situation in many emerging and developing countries is often non-transparent regarding how open the access to landing stations is, and under which conditions access is provided to these stations.

It can, however, be observed that although many emerging and developing countries have been connected to the global Internet and/or increased their access to global interconnection from 2008 to 2012, only some of these countries have access to one landing station. Where this is not the case, there are multiple landing stations but it is reported that these are all controlled by one single operator leading to the high risk that these operators use their monopolistic situation to charge high price premiums. In cases where cable systems are controlled by consortia, it seems that it is often difficult for Internet service

providers that are not part of the consortium to get competitive and fair access to the landing stations controlled by the consortia.

Areas for further work regarding submarine cable systems and access to landing stations

Submarine fibre cables have become the backbone of international telecommunications. Reliable and competitive access to submarine fibre is therefore of vital importance to the economic development of nations. Further work could focus on how both reliability and competition can be improved, i.e. on how to guarantee open access and fair prices for ISPs that are not part of the consortium that built these cables.

Regarding competition, more detailed analyses could be conducted to determine in which regions and countries there is a clear lack of competitive and fair access to landing stations. Where competitive access is absent, authorities should ensure that competitors that are not part of the cable consortium which built the submarine systems get access to landing stations. In addition, access and access prices to landing stations would need to be transparent.

To control monopolistic behaviours, different approaches can be taken and combined as appropriate to the specific countries, including (Esselaar et al. 2007):

- By the enactment of a statute
- By the application of competition law
- By the application of telecommunications regulations

A country that is often cited for its success in opening up access to landing stations in Singapore. The country has mainly relied on a regulatory approach. Once access to landing stations has been opened successfully, it is then important to also ensure an adequate backhaul capacity.

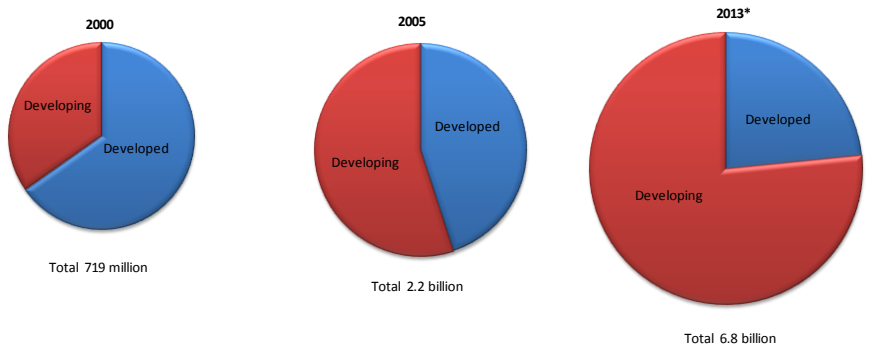
Overall, progress has been made in connecting countries to the Internet. Every time a country is connected to submarine fibre, the speeds go up and the costs go down by orders of magnitude. The digital divide is being closed by further investment in local markets. Being connected is however only part of the solution. A reliable and competitive offer has to be available in markets before the Internet economy can truly take root in an economy. Further work would need to focus on balancing competition and reliability.

Developments in mobile communications

Mobile networks are regarded as a promising way to increase access to the Internet in emerging and developing countries and it is expected that the majority of future Internet users will connect to the Internet via wireless networks (see OECD 2009b, IADB 2011). In 2010, 90% of the world was covered by a mobile signal (ITU World Telecommunications/ICT Indicators Database). Over the past years, the number of mobile phones and smartphones in developing and emerging countries has increased at a fast pace which will further drive traffic growth.

Figure 2 provides an overview of developments in the number of mobile subscriptions worldwide. It depicts two important factors: From 2005 to 2011, the number of mobile subscriptions nearly tripled to attain more than 6 billion subscriptions worldwide. In addition, the ratio of overall subscriptions changed significantly over time: While in 2000, the share of developing countries in overall subscriptions was 35%, three quarters (76.6%) of all mobile subscriptions are expected to be located in developing countries in 2013. This tremendous growth goes along with a highly increasing number of mobile and, to a lesser extent, smart phones, in developing countries which, in turn, will be one of the drivers of further growth in mobile communications.

Figure 2. Mobile subscriptions, by level of development

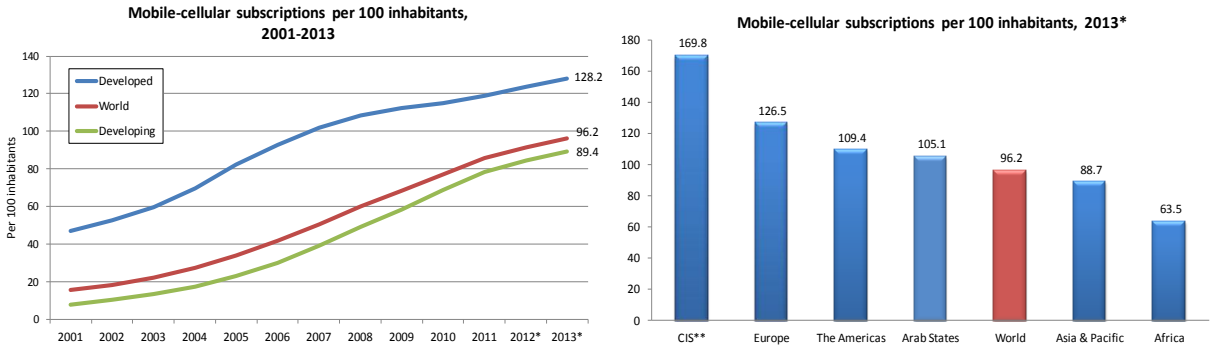


Note: * Estimates.

Source: ITU World Telecommunication/ICT Indicators database. The developed/developing country classifications are based on the UN M49, see: www.itu.int/ITU-D/ict/definitions/regions/index.html. Note: * Estimates.

In terms of mobile subscriptions per 100 inhabitants, subscriptions have especially risen at a high pace in developing countries; by rising from 49.1 in 2008 to 78.3 per 100 inhabitants in 2011(see Figure 3) Africa is currently the region with the least mobile subscriptions per 100 inhabitants. Overall, the gap between developed and developing countries has been *shrinking* in terms of mobile subscriptions since 2007. The overall divide curve has thus followed an S-shape over time.

Figure 3. Mobile subscriptions per 100 inhabitants



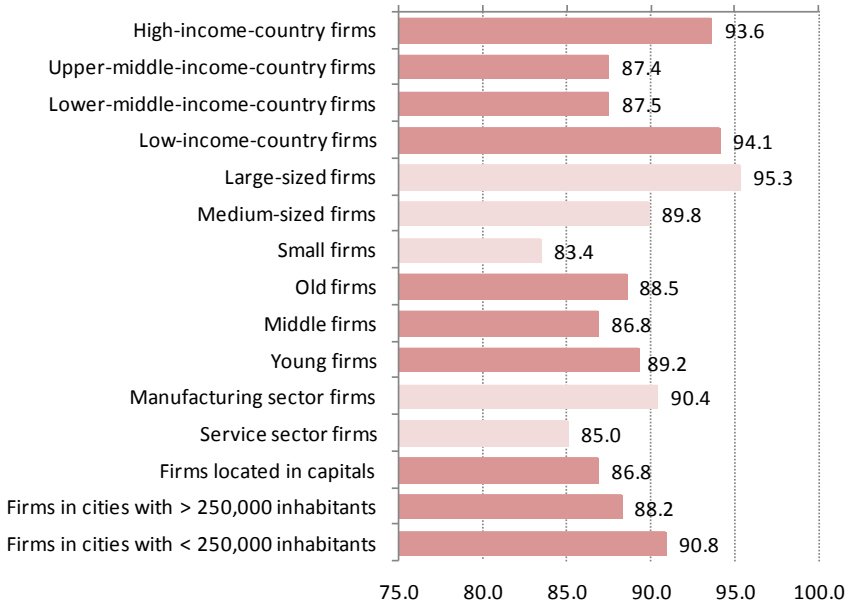
Note: * Estimates

Source: ITU World Telecommunication /ICT Indicators database. The developed/developing country classifications are based on the UN M49, regions are based on the ITU BDT Regions see: www.itu.int/ITU-D/ict/definitions/regions/index.html ** Commonwealth of Independent States. Note: * Estimates.

Another sign of a closing digital divide in the area of mobile communications is the share of businesses that use mobile phones for work purposes. Based on a sample of firms in 38 developing countries for 2009-2011, Figure 4 shows the percentage of businesses that use mobile phones. It points to the fact that for the time range of 2009-2011, no digital divide based on country, location or age could be identified: 94.1% of firms in low-income countries, 90.8% in remote locations and 89.2% of younger firms used mobile phones in their operations. Uptake was also substantial in the informal sector.[2] Table 2 shows, based on a sample of

informal businesses in 14 countries, that for African businesses, the uptake of mobile phones was even greater than uptake of electricity.

Figure 4. Share of firms using mobile phones for business (2009-2011)



Note: Statistics are based on 16 777 firm observations in 38 countries. See Paunov and Rollo (forthcoming) for further details.

Source: Paunov and Rollo (forthcoming) based on World Bank Enterprise Surveys.

Table 2. Statistics on technology use in the informal sector, 2009-2010

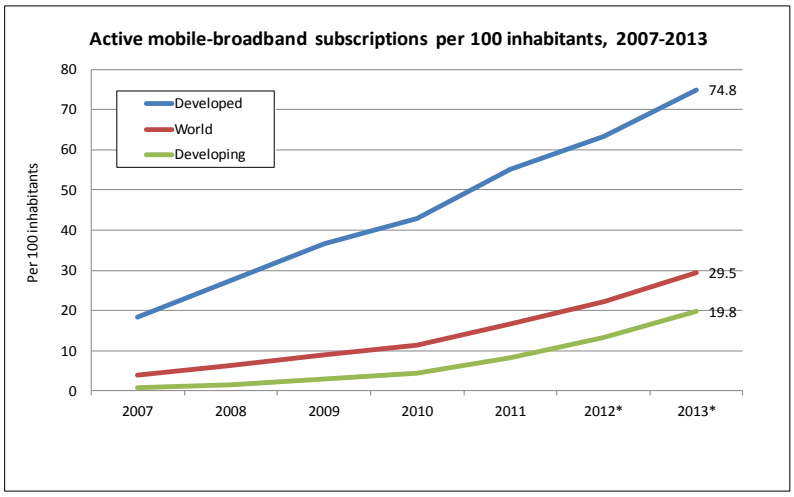
	Overall		AFR		LAC	
	Firm nbr.	%	Firm nbr.	%	Firm nbr.	%
Use of electricity						
No	553	24.9	369	29.7	178	20.7
Yes	1668	75.1	873	70.3	681	79.3
Connection to the grid						
No	145	8.7	130	14.9	13	1.9
Yes	1522	91.3	745	85.1	665	98.1
Experienced power outages						
No	765	46.1	275	31.8	489	72.0
Yes	894	53.9	591	68.2	190	28.0
Use of cell-phone						
No	1026	40.7	295	23.8	674	58.0
Yes	1495	59.3	943	76.2	489	42.1
Use of e-mail *(only for Cote d'Ivoire, Madagascar, Mauritius)*						
No	.		347	94	.	
Yes	.		22	6	.	
Use of cell phone *(only for Cote d'Ivoire, Madagascar, Mauritius)*						
No	.		87	22.8	.	
Yes	.		294	77.2	.	

Note: Information is based on firm observations for 14 countries: Angola, Argentina, Botswana, Burkina Faso, Cameroon, Cape Verde, Democratic Republic of Congo, Côte d'Ivoire, Guatemala, Madagascar, Mali, Mauritius, Nepal and Peru.

Source: Paunov and Rollo (forthcoming), based on World Bank Informal Firm Surveys.

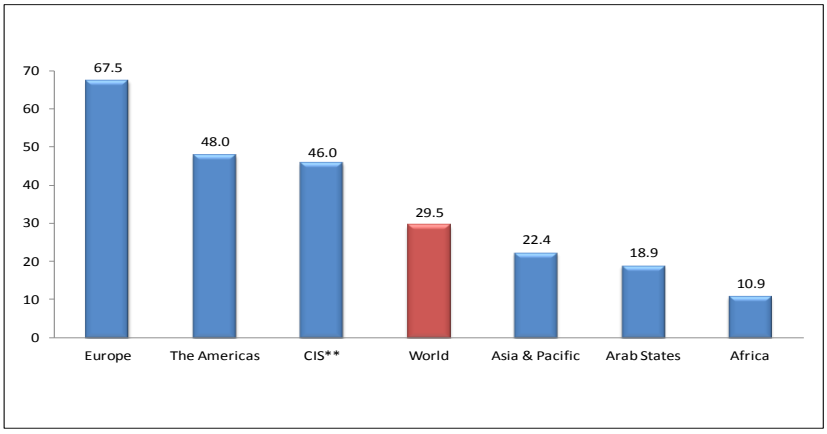
The mobile subscription discussed above provide the ground for *mobile broadband*. Statistics on mobile broadband subscriptions have only been available for the past few years, but they show important trends. Overall, it can be observed that mobile broadband subscriptions per 100 inhabitants grew significantly. In developed countries, the number of subscriptions grew from 18.5(in 2007) to 55.1 (in 2011) subscriptions per 100 inhabitants (see Figure 5). While in 2007, access to mobile broadband was close to zero in developing countries, the number of subscriptions per 100 inhabitants rose to eight by 2011 which represents a growth of 900%, but from low levels. In the coming years, it is expected that the number of subscriptions keeps rising. However, the graph also shows that while the digital divide in the number of basic mobile subscriptions is narrowing, it is currently growing for mobile-broadband subscriptions. When comparing the number of mobile broadband subscriptions over regions, Africa is clearly behind with 10.9 subscriptions per 100 inhabitants (see Figure 6).

Figure 5. Active mobile-broadband subscriptions per 100 inhabitants, 2007-2013



Source: ITU World Telecommunication /ICT Indicators database. The developed/developing country classifications are based on the UN M49, see: www.itu.int/ITU-D/ict/definitions/regions/index.html

Figure 6. Active mobile-broadband subscriptions per 100 inhabitants, 2013*



Notes: ** Estimates

Source: ITU World Telecommunication /ICT Indicators database; Regions are based on the ITU BDT Regions, see: www.itu.int/ITU-D/ict/definitions/regions/index.html. **Commonwealth of Independent States[3]. Notes: * Estimates.

Overall, the growing number of subscriptions in developing countries is an indication that people and organisations are willing to spend often scarce resources to get access to the Internet and that they see important additional value in being connected to the Internet. However, high-speed mobile networks need to be further deployed, especially in more remote and rural areas. Affordability of subscriptions is also supposed to be a key factor. Unfortunately, at this stage, only case studies and some regional studies exist on current mobile broadband prices across developing countries. A sound methodology and additional resources are needed to collect statistics on mobile broadband prices. The OECD has recently adopted a methodology for measuring mobile broadband prices (OECD, 2012d), which adds to its existing set of price benchmarking methodologies. This methodology could be used for conducting mobile broadband price comparisons in developing countries, and could be adjusted or simplified to adapt to those countries. For example, the ITU is developing a simplified set of basket for mobile broadband.

Potential areas for future work in the area of mobile communications

As just mentioned, a coherent methodology on mobile broadband prices needs to be developed in order to have a sound basis to compare different regions and continents regarding the affordability of access to mobile broadband and to assess whether there are large differences within countries and different groups of the society.

Deployment of high performance mobile networks such as 3G and LTE networks continues to be crucial and bears on the availability of spectrum. In this regard, governments should give priority to spectrum refarming, i.e. reallocating spectrum from low-value applications to high-value applications, and a transparent release of additional spectrum to enable operators to offer 3G and beyond (OECD 2009a). In some OECD countries, spectrum auctions proved to be a valuable instrument for spectrum allocation. The case of Germany showed that the most recent auction was also an efficient tool to close *access gaps* to broadband in *rural* and *remote areas*. The country linked the allocation of spectrum to the obligation of deploying broadband in remote areas. Before the winning operator could use the spectrum in cities and in densely populated areas, it had to ensure connectivity in rural and remote areas. This approach could be also considered in emerging and developing countries. In addition, any wireless network relies on a wired infrastructure in the ground. Further effort should thus also focus on deploying a powerful backbone infrastructure in emerging and developing countries. Policies are needed to spur the participation of a greater number of suppliers in the backhaul market (OECD, 2009a).

In terms of devices in use, low income groups especially, mainly use simple handsets that do not allow for complex online operations at the moment. Since an increasing number of developing countries have now started to introduce 3G mobile networks, it is expected that higher-end phones will slowly become more popular, also among people in lower income groups, starting with the use of second hand devices. A major current impediment of the use of smartphones is the lack of electricity since many smartphone models have to be charged on a daily basis. This is especially a big challenge in rural areas. New solutions could be developed, e.g. phone charging stations that rely on solar power.

Promoting applications and their use in developing and emerging countries

Recent developments

When it comes to applications, the innovation potential of the Internet and ICTs becomes obvious: Since 2008 there have been substantial developments: a large variety of different applications have been created in developing and emerging countries. This section will focus on four types of applications: those *i)* for agriculture and fishing; *ii)* health; *iii)* education; and *iv)* mobile banking. The selection is based on two factors: these applications have a potentially strong impact on low- and middle-income groups and substantial experimentation and developments have taken place over the past years. Agriculture and fishing

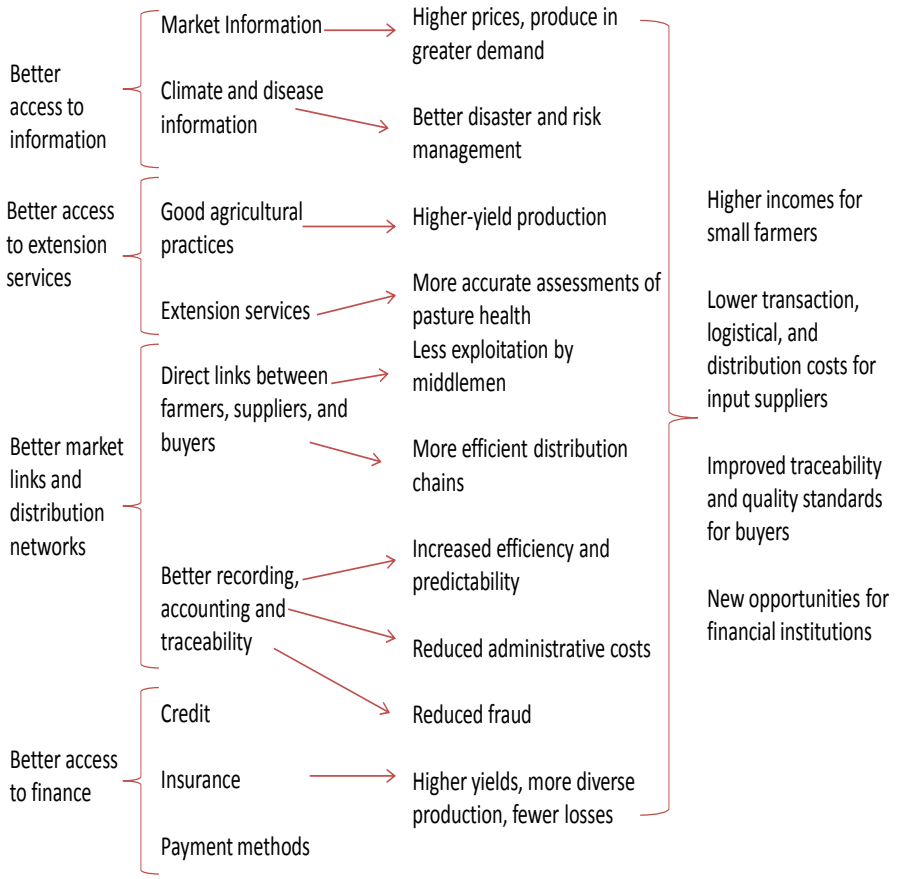
are among the principal activities of low- and middle-income groups and better access to information in dispersed locations is a major gain from the wider spread of ICTs. Health and education are key applications for welfare and, what is more, for stimulating welfare improvements. The report first discusses recent developments across each of these applications and then focuses on areas for future work to support further development.

Mobile applications for agriculture and fishing

Potential gains from ICT-based applications for agriculture and fishing

A basic role of ICTs and the Internet is to widely disseminate up-to-date and accurate information. Disadvantaged rural communities in developing and emerging countries often have the most to gain from mobile telephony, and it has often provided them with access to such information for the first time. Such simple, often cost-effective functionalities (compared to more sophisticated applications) can support the activities of these communities (Box 1). Figure 7 summarises the sources of benefits for agricultural and rural development; these range from simple access to information functionalities, to access to services and connectivity across networks, to more advanced uses related to access to finance (discussed below).

Figure 7. Sources of potential benefits from mobile applications for agricultural and rural development



Source: Zhenwei Qiang et al. (2012)

Box 1. Example of mobile agricultural and rural development applications based on information provision

KACE, Kenya: Provides daily market information on 20 commodity prices, facilitates offers and bids to match farm outputs with demand from wholesalers, and facilitates links between farmers and buyers (such as with contract negotiations and commodity transport).

DrumNet, Kenya: Covers the horticultural and oilseed industry and provides information on market trends, weather, prospective partners, and related topics. Includes finance, production, delivery, and payment functions to smooth supply chain processes among various actors (producers, buyers and processing plants, transport providers, banks, and input retailers).

Virtual City, Kenya: Provides automated systems to major buyers of tea, coffee, cotton, and dairy for collecting, recording, accounting, and traceability/distribution of agricultural products. Farmers receive faster and more accurate price, quality, and quantity information. Small and medium-size retailers can use phones to facilitate sales, deliveries, orders, and payments.

Ushahidi, Kenya: Collects and reports information on crises, disturbances, and other events by mobile phone and updates the information on Google Maps. Has been used beneficially in Kenya and Haiti, and has been licensed to many other locations (see section on cloud computing).

Farmers Texting Center, Philippines: Offers an innovative SMS-based service for answering agricultural queries mainly about rice production from farmers, extension workers, and other actors. Also provides technological updates on rice production and a virtual network to facilitate interactions among farmers and clients.

b2bpricenow, Philippines: Provides current market price information to farmers and co-operatives. Its online marketplace links these sellers to buyers and can process financial transactions using bank accounts (Web) or debit cards (mobile phones).

1920 AgriExtension (also known as Govi Sahana Sarana), Sri Lanka: Toll-free hotline service that provides crop advisory and technology advice to farmers in Sinhala and Tamil. The aim is to help farmers solve problems related to technology, inputs, and marketing. Users can call from anywhere in the country for immediate answers by call center operators. Agriculture experts are also available as a second line of support for more complicated questions.

Dialog Tradenet, Sri Lanka: Forwards agricultural commodity price information by SMS and USSD, reducing information arbitrage. Subscribers receive up to five price alerts for five fruits and vegetables from each of the three markets covered. Also provides a trading platform for farmers to identify potential buyers.

Fisher Friend, India: Provides timely information on local fish markets, the weather, the sea and critical information for fishermen. It "also increases their knowledge base by providing information on government schemes and entitlements, health services, directory services, and a marine toll-free helpline." Collaboration between the M.S. Swaminathan Research Foundation (MSSRF), Tata Teleservices in India, Astute Systems Technology, Wireless Reach, and Qualcomm.

Source: Zhenwei Qiang et al. (2011) except for Fisher Friend, India

Impacts in terms of welfare for users

The wide uptake of mobile technology by rural communities is an indication of the demand for access to information (e.g. Batchelor, 2002). Indeed, de Silva and Ratnadiwakara (2010) showed that 11% of the total production cost of a representative sample of 300 smallholders in Sri Lanka was spent on information search cost. A study of agricultural micro-enterprises and their use of ICT found that there was particular interest in receiving fertilizer and market price information (Lokanathan and Kapugama, 2012).[4] It also found, however, that face-to-face communication was still preferred to other modes of communication, an indication of potentially gradual uptake of mobile-based agricultural information services, because potential users have to adjust to using message-based systems over face-to-face communications to benefit fully from relevant mobile applications.

There is also specific evidence on the benefits of access to information for rural communities: Jensen (2007) has shown that access to timely information, in their case price information, enabled the fishermen and farmers respectively to gain better prices for their products as inefficiencies were reduced: Jensen (2007) has shown that access to timely price information enabled fishermen to increase profits by an average 8%. In addition, consumer prices fell by 4% and waste, which had averaged 5-8% of a daily catch in the past, was eliminated. The DrumNet application (described in Box 1 above) appears to have allowed Kenyan farmers to raise their incomes (Zhenwei Qiang et al., 2011). Regarding the success of functionalities such as extension services, Sri Lanka's e-Dairy helps farmers earn up to USD 262 more a year for each of their calves by providing veterinary and extension services over mobile phones. Tea growers in Kenya have reported average income growth of 9%, or about USD 300 a year, by using Virtual City's production measuring, recording, and traceability functions (ibid.).

Scale, project sustainability and aggregate impacts

The evidence above has shown generally positive effects for users of mobile applications in the past years. However, stronger aggregate effects are conditioned by the scalability of mobile applications, which is also strongly related to their financial sustainability. In fact the study of agricultural micro-enterprises discussed above found that the use of the Internet amongst the entire farmer sample was non-existent suggesting that, if at all, impacts would rather be reaped from basic mobile technologies but not at this stage from the Internet. However, even mobile-based agricultural information services were not much used except for the Indian case.

Many of the existing applications operate on a relatively small scale because they are not profitable. For instance, a study of mobile applications for agricultural and rural development which reviewed 74 cases found that only 29% had enough revenue to cover operating expenses and most received at least some funding from governments, donors or corporate social responsibility (CSR) sources (Zhenwei Qiang et al., 2011). The situation is worse for initial development costs: More than four in five projects relied on non-for-profit funding for their development and start-up phases. There are, however, some profitable services such as the information service provided to Indian fishermen in Kerala, discussed above. Moreover, further experimentation with innovative pricing models such as pay-as-you-go, micro-leasing and tiered pricing or chain financing can allow raising funds even among lower-income groups (Mendoza and Thelen, 2008; OECD, 2013b).

Applications for health

Potential gains from health applications

Health and education are fundamental elements when it comes to welfare. Internet and ICT-based applications offer opportunities of bigger outreach and higher quality of service. Since disadvantaged

groups, particularly but not only in rural areas, have been widely excluded from quality education and health services, potential benefits are probably higher compared to those for other groups. For instance, mobile phones can connect to health services or allow health workers to consult with experts in remote locations to improve their services. The applications are particularly attractive since substantial costs of expanding health and education services in "traditional ways" tend to be too high for developing and emerging countries to satisfy demand.

More specifically, regarding health applications, four types of contributions can be identified (Zhenwei Qiang et al., 2012): *a)* improving quality of and access to healthcare (e.g. treatment support through application reminders, patient tracking, emergency services, improved training for rural health workers and other professionals); *b)* increasing efficiency of health sector human resources (e.g. record keeping, clinical decision support); *c)* capturing and using real-time health information (e.g. disaster management, social accountability, disease surveillance); and *d)* promoting public health (e.g. disease prevention through public health advice and educational programmes).

Health applications in practice

There are multiple examples for each of these types of projects as described in Box 2. Many of these projects were initiated during the past years (see e.g. ADB, 2010, for an overview of some of their projects).

Box 2. Examples of mobile health applications

Child Count+, Kenya: Application registers pregnant women and children under 5 and collects basic information about their health to prioritise visits by health workers.

Sehat First, Pakistan: Social enterprise aimed at providing access to basic health care and pharmaceutical services across Pakistan through self-sustainable franchised tele-health centres. Founded in 2008 with an equity investment from the Acument Fund, Sehat First has served over 4 000 patients, mostly women and children.

Tamil Nadu Health Watch, India: Disease surveillance system introduced after the tsunami in 2004. Provides links between primary health centres in four districts to enable health experts and programme managers to co-ordinate activities more effectively and allocate resources more efficiently. Use of mobile phones allows health workers, even in remote areas, to immediately report disease incidence data to health officials, speeding up their ability to respond.

Project Masiluleke, South Africa: Increases volume of patients screened for HIV/AIDS and receives information on prevention and treatment. Sends out about 1 million messages a day and covers nearly all of the countries mobile phone users in a year. The project is supported by the Praekelt Foundation, the PopTech innovation network, LifeLine Southern Africa (the government-backed provider of the helpline), iTEACH, Frog Design and MTN.

Telemedicine support to promote maternal and newborn health in remote provinces of Mongolia: Aims at reducing infant and maternal mortality by improving rural healthcare services. Project funding obtained through a joint venture among the Mongolian Government's Mother and Child Health Research Centre, the Government of Luxembourg (Lux-Development Agency), and the United Nationals Population Fund (UNFPA).

WelTel, Kenya: SMS-based messaging system which supports antiretroviral (ARV) therapy helping patients with a series of reminders to follow prescribed treatments.

Source: Zhenwei Qiang et al. (2012) for ProjectMind and text2teach, Melhem and Tandon (2009) for Sehat First and (www.sehatfirst.com), Adler and Uppal (2008) for Tamil Nadu Health Watch, Zhenwei Qiang et al. (2012) for Project Masiluleke, CHAI/HP, Zhenwei Qiang et al. (2012) for WelTel, Child Count+, ADB (2010) for Mekong Subregion Project, Baggaley and Belawati (2010) for the Virtual University of Pakistan (VUP).

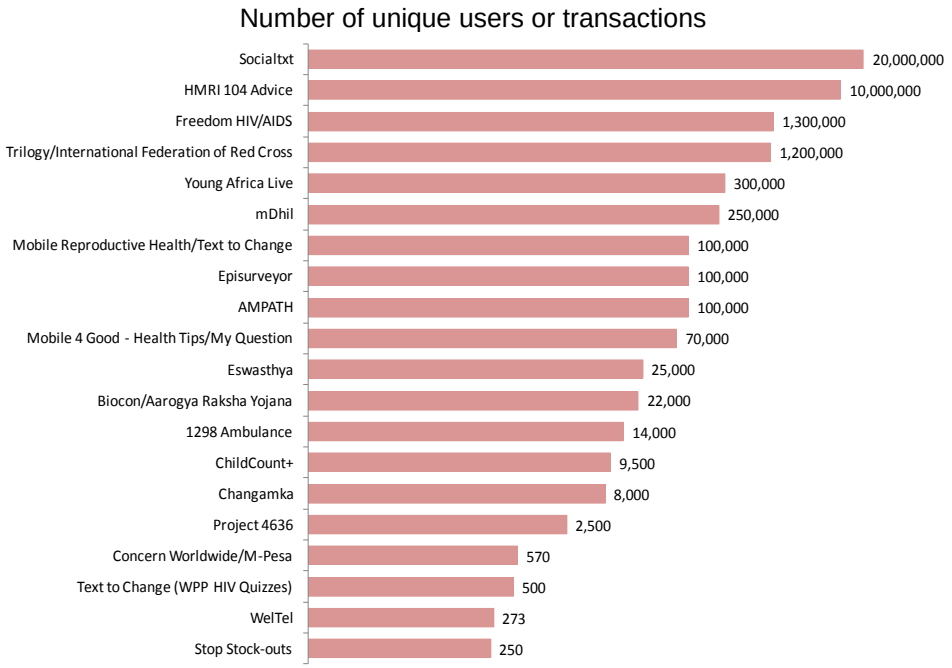
Impacts in terms of welfare

Evidence shows that many Internet and ICT-based health services have indeed had positive welfare effects. This includes for instance, Project Masiluleke (described in Box 2) which, since its start, has brought about a fourfold increase to the country's HIV/AIDS helpline. Also, the Medic Mobile, a project that seeks to provide support to community health workers in rural areas, has proved to be successful. In a pilot in Malawi, 75 such workers using the system saved substantially on transportation costs, and made it possible to double the capacity of tuberculosis treatment programmes in six months (Mahmud, et al. 2010). Another example where positive impacts were identified is WelTel, a Kenyan programme that sends text messages to people with HIV/AIDS to help them comply with their treatment regimens. A clinical trial using WelTel's mHealth intervention showed that receiving SMS reminders raised patients' compliance with antiretroviral therapy by a quarter (Zhenwei Qiang et al., 2011).

Scalability and project sustainability

As in the case of applications for agriculture and fishing, there are challenges related to extending these programmes and replicating successful applications in and between countries. While a few applications such as Socialtxt and HMRI 104 Advice have had rather wide impacts, the great majority of applications is small as described in Figure 8 and, thus, has not so far had substantial impacts at the aggregate level. This also applies to Kenya in spite of its considerable progress regarding the use of mobile technology. Few pilot projects have been able to sustain themselves once initial seed funding has ended even those that had proven feasible, clinically useful, sustainable, and scalable (WHO, 2009).

Figure 8. Scale of mobile health applications in Haiti, India, Kenya, 2010



Source: Zhenwei Qiang et al. 2011 based on Dalberg research and analysis

This is closely related to the financing models of such applications which often have not achieved long-term viability. Substantial costs of some of these health services suggest that for-profit business models for these applications will potentially be much less feasible compared to, for instance, those applications for agriculture. However, the private sector has been engaged in a variety of initiatives not

only as part of social responsibility programmes: Novartis, to provide an example, conducts the SMS for Life programme in Tanzania. SMS for Life uses a combination of mobile phones, SMS messages and electronic mapping technology to track weekly stock levels at public health facilities to eliminate stock-outs, increase access to essential medicines and reduce the number of deaths from malaria. Moreover, there have been some attempts to introduce innovative pricing strategies that would not exclude lower-income groups but still raise sufficient funding, for instance, by implementing price discrimination across incomes: Through the 1298 programme, Ziqitza operates a network of fully equipped Advanced and Basic Life Support Ambulances across two states in India. 1298's business model uses a sliding price scale driven by a patient's ability to pay, which is determined by the kind of hospital to which patients choose to be taken. Financial sustainability is assured through cross-subsidisation.

Internet and ICT-based applications for education

Potential gains from applications for educational purposes

In the area of education, expected benefits are high, especially regarding quality and access, as there is a shortage of qualified professionals in many developing and emerging countries. Several features are particularly attractive: a potential way to educate with less need for qualified staff, an opportunity to tailor learning requirements to specific needs and circumstances, the possibility to provide learning also at flexible times and locations so that those not able to comply with common teaching hours (for instance workers in rural areas among other disadvantaged groups) can access educational services. Finally there could be gains within the education sectors akin to those for health.

Applications for educational purposes in practice

Examples for mobile education applications are provided in Box 3. There have been more ambitious experiments beyond information sharing including, for instance, the development of downloadable games to increase awareness of HIV/AIDS in India (Adler and Uppal, 2008).

Box 3. Examples of mobile health and education applications

Project Mind, Philippines: Provides distance and informal education services by mobile phone. Students' performance is monitored through their answers—sent by SMS—to multiple-choice math and science questions. Exams are also administered this way.

text2teach, Philippines: Provides fast and timely educational content using mobile and satellite technologies. Content includes more than 900 multimedia materials in video, picture, text, and audio formats. Also uses SMS to receive feedback and comments.

Text to Change, South Africa: Uses mobile phone technology, specifically interactive and incentive based SMS messaging, to send out and receive information to educate, engage, and empower people on wellbeing related issues, such as healthcare, education, and economic development. Text to Change also has campaigns in South America.

Virtual University of Pakistan (VUP): Established in 2002, information-technology based university currently offering 17 degree programmes. It uses the national telecom infrastructure and delivers its lectures asynchronously through satellite broadcast TV channels with interaction provided over the Internet.

Source: Zhenwei Qiang et al. (2011) for ProjectMind and text2teach, Melhem and Tandon (2009) for Sehat First and (www.sehatfirst.com), Adler and Uppal (2008) for Tamil Nadu Health Watch, Zhenwei Qiang et al. (2012) for Project Masiluleke, CHAI/HP, Zhenwei Qiang et al. (2012) for WelTel, Child Count+, ADB (2010) for Mekong Subregion Project, Baggaley and Belawati (2010) for the Virtual University of Pakistan (VUP).

Impacts in terms of welfare for users

There is a similarly consistent positive evidence for educational projects. The Mobile Technology Initiatives for Non-formal Distance Education (MIND) project, an IDRC-backed initiative, which focused on the non-formal education sector, composed of out-of-school youth, adult learners and others with no access to tertiary education, showed that the project's SMS courses in English and mathematics had positive effects among students in the Philippines and Mongolia (Baggaley and Belawati, 2010).

Scalability and project sustainability for wider aggregate impacts

Mobile education applications face very similar challenges to the health applications reviewed above regarding scale and project sustainability. For ICT-based educational programmes, including distance education, the situation is different: Some projects such as the Virtual University of Pakistan (VUP) have expanded their activities to a network of more than a hundred associated institutions across sixty cities to cater for a wide student population.

Mobile banking applications

Potential gains from mobile banking applications

In many developing and emerging countries, people have only limited access to banking services. For example, in Kenya - where mobile banking has been most successful - only 19% of the population had access to a bank account in 2010 (AfDB, 2010). If the wide uptake of mobile telephony helps extend banking services to those who previously had no bank account (as is the case notably in Kenya as described below), its impacts can potentially be substantial for developing and emerging countries. Establishing a wider network of formal banking services is by contrast more challenging, especially if it is to reach many small communities, for instance in countries such as India, because there is, in most cases, no positive business case for banks (Banerjee and Duflo, 2011). Simple banking services help increase welfare by reducing security risks incurred by transporting and storing cash and also potentially important transportation costs such as e.g. those that migrant workers in urban areas have to incur to send money to their families in remote locations. There are potentially even larger gains if banking services support entrepreneurial activities of disadvantaged groups e.g. by helping improve the savings behaviour of disadvantaged groups or by providing credit and insurance for business activities to help reduce risks. Encouraging savings can help generate savings which in turn can support investments in human capital or business activities which can help support market opportunities of often excluded groups. More advanced insurance services can also help reduce vulnerability to unexpected events such as accident, illness, theft, or drought and, by reducing risk, support more steady building up of capacities. Finally, there are potential gains in terms of transparency compared to cash-based transactions which can, e.g. reduce corruption in the delivery of governmental services.

Mobile banking applications in practice

The most popular and successful example of mobile banking is Kenya's M-PESA. The mobile payment service, which was piloted in 2005 as a public-private initiative, was launched in March 2007 by Vodafone and Safaricom and became an instant success with 2.37 million subscribers in its first year (Maurer, 2012). According to estimates, there are about 15 million users in 2012, or roughly 70% of the adult population of Kenya (The Economist, 2012). The service is a mobile-phone money transfer service that uses text-messaging and a network of retail agents as cash-in / cash-out points. There are several other programmes that have been developed based on M-PESA, which demonstrate its wider developmental impacts. This includes, for instance, Grundfos Lifelink, an automated village well water supply system in

Kenya. The system relies on M-PESA for payment in that customers purchase an electronic pump key to access safe pumped groundwater. Payments are directly used to pay for maintenance and repay the community loan for the well.

Several other programmes have been developed based on M-PESA, and there are multiple mobile banking initiatives in other emerging and developing countries. A survey conducted among 52 operators worldwide found that there were a total of 60 million registered customers of mobile money services by mid-2011 (GSMA, 2011). However, the customer base was highly oriented towards 11 services. In addition to M-PESA they include SMART Communications and G-CASH in the Philippines which have over two million users (Maurer, 2012). M-PESA has also positively stimulated mobile services elsewhere than in Kenya, such as Ecokash, a mobile money service in Burundi. Most services are however small, especially if the actual mobile banking transactions are taken into account. Estimates suggest M-PESA accounts for more than half of mobile money transactions in the world (The Economist, 2012).

Large potential gains have attracted private and public interest in supporting mobile banking including e.g. industry consortia such as the GSM Association (GSMA), which represents mobile network operators across the world, and the Bill and Melinda Gates Foundation. An example of such collaborations is the 'Mobile Money for the Unbanked' competition for grants, created in 2009, which rewards mobile banking initiatives aimed at poor groups (Maurer, 2012).

General conclusions across applications

Applications improve welfare including, notably for disadvantaged groups

Overall, there is evidence that users benefitted from different applications with simple services. The benefits come largely from access to better quality information and services which particularly disadvantaged groups did not have previously. Opportunities for greater gains are possible as services improve in quality and design possibly also by leapfrogging on developed economies who also need to develop applications e.g. on health given the challenges posed by ageing populations. The gains for disadvantaged groups who previously had no access to information and services are probably among the most substantial.

Sustainability and scalability remain a challenge

Success is less substantial when looking at the scale of such applications and project sustainability. Exceptions include M-PESA for mobile banking and Socialtxt and HMRI 104 Advice for mobile health applications. This is also due to the fact that few initiatives were financially sustainable to allow scaling-up. Rather, most depended on public funding (including from NGOs, international development banks, etc.) which often was not set out over a longer term. The need for public funding was particularly large in the setting-up phase, a question that points to the well-known challenge for facilitating start-up funding for innovative activities including such applications. However, there are also several positive signs regarding improvements in sustainability and scalability for these applications: first, they have generated substantial interest from international foundations and donors (due also to the robust evidence on substantial benefits) but also corporate social responsibility projects. If well-managed, such funding can be applied to supporting investments in larger-scale projects and allow for the development of more sustainable business models. Second, innovative pricing strategies have made it possible to finance applications even if aimed at lower income groups. One example is tired-pricing, a form of price discrimination, whereby higher-income users cross-subsidise lower-income users in exchange for extra services or via other forms of market segmentation. In India, Ziqitza operates the 1298 programme, a network of fully equipped advanced and basic life support ambulances. 1298's business model uses a sliding price scale based on a patient's ability to pay, which is determined by the kind of hospital to which patients choose to be taken.

Potential areas for future work

Several priorities for future work could be identified based on the assessment of recent developments in mobile applications.

Beyond case studies towards lessons learned

Many case studies describe specific Internet and ICT-based applications but compiling the lessons learnt among such projects would be useful. Such evidence could help inform both public and private funding decisions and provide the incentives needed for those decisions to aim for larger scale services with an opportunity of aggregate benefits. For instance, in the field of telemedicine, WHO member countries indicated they required more information on the cost-effectiveness of such services to implement suitable policies (WHO, 2009). Specifically, it would also be important to go beyond single case studies towards a more systematic reporting about failed initiatives rather than only focusing on successes. With regards to areas for analysis, a better understanding of business models is needed to foster sustainable projects at a larger scale. Especially, tracking the different phases of business development from conceptualisation to execution would be important given different investment needs during these phases. Another requirement would be to explore how pricing models can be aligned in such a way that low- and middle-income groups can benefit from such applications while achieving financial sustainability. Several business approaches have been developed including flexible pricing (e.g. pay-as-you-go, micro leasing, etc.), chain financing (services are provided to low-income groups jointly with financing opportunities to make them affordable), and production chain innovations that lower costs (including e.g. relying on the poor themselves to provide some of the service). It would be relevant to test to what extent such models can work within the context of the specific applications reviewed here.

Infrastructure and device constraints and the application quality

In some cases, the ICT infrastructure and devices used are of technology standards below those of developed countries and many groups of the society have very limited financial resources. This forces a more pragmatic approach to providing services. In the past, too ambitious projects which exploited technological opportunities but ignored local conditions failed. One example is a project on ICT for Education in Mongolia which provided a large number of schools with computers. However, due to lack of training for their use, the absence of electricity and provision of suitable software, the project failed (ADB, 2010). By contrast, simpler more aligned projects (even those exploiting less of the technically possible) were often very successful. Since standard mobile phones will most likely continue to dominate at least over the next five years, probably longer in rural areas, applications will need to be simple. At the same time, improvements in infrastructure and access to corresponding devices will be important to widen opportunities for improved and more sophisticated applications. This stresses the importance of future work on infrastructure as discussed in the sections above.

Need for local content is important as is an international knowledge and material transfer

The value of many applications to their users strongly increases with the availability of local content; this is obvious, for instance, in the context of systems that share agricultural information where local information on weather and soil conditions are what users will attach the greatest value to. Similarly for most applications, information written in local languages and adapted to cultural contexts will be necessary. At the same time such contextualisation can impose high financing costs and, thus, constrain scalability, in particular if the content has to be specifically developed. This, however, is not necessarily the case for all applications. Many teaching materials or health applications can be more widely adopted which only require translation into local languages. For example, the Khan academy provides more than 3 000 educational videos for free covering a multitude of subjects.[5] The potential savings through these

materials can be useful to sustain but also help develop new projects. The creation of international and national repositories of digital objects, e.g. for learning purposes, is thus equally useful to pursue further as has been the case, for instance, among the University Terbuka (UT) in Indonesia, Sukhothai Thammathirat Open University (STOU) in Thailand, the International Institute of Cambodia University of Technology (IICUT) and Allama Iqbal Open University (AIOU) in Pakistan (Baggaley and Belawati, 2010). In that respect it is also worth pointing out that governments can equally contribute by making public data available and ensuring their quality. To date, several initiatives have tried to further explore the sharing of materials but a lot of services still have the challenge of creating their own materials. It is worth exploring further the challenges to improving access to content for applications, which also include questions of intellectual property rights.

Openness to experimentation and regulations

As is the case with innovative projects generally, there is a trade-off between providing space for innovators and, at the same time, protecting markets and thus consumers by implementing regulations (including notably consumer protection and privacy provisions, legislations to reduce fraud and regulate competition of private companies in the sector). The challenges apply substantially to online and ICT-based applications as their often disruptive nature creates new markets with impacts on different market actors. On the one hand, overly heavy regulation can raise the costs of such applications or even render their implementation impossible. The limited uptake of mobile banking, beyond the few success cases, has been attributed to regulatory constraints which do not allow non-banking entities to offer payment services. On the other hand, lack of regulation can lead to abuses which could be detrimental to the uptake of applications e.g. if mobile savings were lost. A build-up of undue market power can also reduce the development of competitive services. In the context of developing countries, both the lack of regulation (e.g. with regards to the role of mobile operators and impacts on competition) and overly stringent regulations (regarding e.g. banking regulations) have been identified as obstacles. Considering specifically where regulations and their absence impose undue costs on products is equally relevant to study also from the perspective of the financial viability of such initiatives.

Need for creating interoperable platforms and open standards

In addition to the financial dimension, the lack of open and interoperable platforms (see also the cloud computing section) has been identified in many instances as a severe constraining factor (see e.g. Zhenwei Qiang et al., 2011). Open interoperable platforms can stimulate the development of applications and increase their scale at much lower costs and more quickly than if the infrastructure had to be created from scratch by a wide pool of potential customers. It can also facilitate mobile application payments to providers. Examples of developments in that direction are applications like Nokia's Ovi Life Tools (OLT) and, to a lesser extent, insofar as only subscribers of Telefonica can access it, Telefonica's BlueVia. Since such platforms have a strong public goods characteristic, it is relevant to study further roles for policy intervention and examples of successful interventions.

Strengthening the importance of wider and coherent national policy agendas

All applications above are substantial domains of public policy, notably education and health. The applications that provide agricultural and banking services for the disadvantaged are also closely linked to social policies and financial agendas. Their importance within such broader agendas will often be essential given the limited financial sustainability of many of these initiatives in spite of their potential to help save on and improve public expenditures. Changes in this respect have been slow. For instance, with respect to ICT-based health applications, African, Eastern Mediterranean and South-east Asian regions have lagged behind others in terms of coherent national policy implementations and initiatives (WHO, 2009). However, it is also worth noting that already in 2009, countries such as Brazil, China, India, Mexico but

also Mauritania, Mali and Sudan had national tele-health policies in place. Also, the development of distance education in Cambodia, Laos and Viet Nam has been encouraged in the three countries' national policies and plans (Baggaley and Belawati, 2010). Tracking more generally how different countries have incorporated online ICT-based applications into their overall policy agendas would be helpful.

Collaboration gains internationally

Many initiatives have been implemented in isolation and, in some cases, this has led to costly repetition of similar mistakes. There have been several initiatives at the international level. For instance, already in 2006, the WHO Regional Committee for Africa called on Member States to adopt and implement eHealth strategies to improve their health systems. This was followed up by other declarations including the Ouagadougou and Algiers declarations of 2008 and the Framework for Implementation of the Algiers Declaration of 2009. It is relevant for future work to explore where international gatherings can help support international collaborations on these applications; the continued challenge for gaining larger scale and financially more sustainable models suggests exploiting ways that effectively improve sharing e.g. by cross-country exchange forums on specific applications.

Developing skills for the Internet economy in developing and emerging countries

Developments in skills

There are several dimensions through which skills obviously condition benefits from the Internet and ICTs. A *first dimension* is the most basic capacity to use specific ICT-based applications from the end user side. The evidence on specific applications aimed at helping disadvantaged groups reviewed above has shown that uptake can be enhanced by including a training element which can often be highly cost-effective. For instance, the application Fisher Friend in India (see Box 1) employs a 'train the trainer' approach: A group of young local fishermen were trained on how to use the application, and these "master trainers" are showing other fishermen how it works. This procedure has been important for wider uptake. Another approach has been to initially provide not only digital but also traditional offline services that users know well so as to facilitate the transition to more cost-effective digital services. For instance, the United Villages model in India provided a network of friends that can conduct online transactions if end users prefer (Adler and Uppal, 2008).

The *second* are skills requirements for upstream users, often professionals such as health professionals who need the skills to be able to apply mobile health applications. Many applications for health or education or other services have found insufficient expertise among professionals providing such services which has reduced potential uptake and best possible use of opportunities provided by the Internet and related ICTs (Zhenwei Qiang et al., 2012). Skills requirements often go beyond those most closely related to applying ICTs and require professional approaches towards reforming management systems; this includes e.g., the need to incorporate ICT-based applications as part of programme evaluations so that programme managers have incentives to apply those applications.

In addition, at a more advanced and *third dimension*, significant gains can be obtained from local Internet and ICTs skills such as for example, local web-creation and software design skills: The popularity of homegrown sites in many emerging economies shows a clear advantage for such applications. A lot will depend on the capacities of national higher education systems to form software developers. The success of the Indian software industry has, in that respect, been a stimulus for other emerging and developing countries to improve such capacities also in search of developing a competitive software industry.

ICTs themselves can potentially support education efforts notably if Internet and ICT-based education programmes of sufficient quality can expand the number of students who can be trained. The positive

appeal of social media for large young populations can also help overcoming the constraints imposed by skills shortages, notably by relying on innovative educational tools as described above in the section on Internet- and ICT-based applications. However, a pragmatic approach towards skills barriers will be important since skills shortages cannot be fast and easily overcome particularly when it comes to reaching disadvantaged groups.

Besides increasing Internet and ICT skills, an important success factor of applications and content designed for developing countries will be whether they are easy-to-use and user-friendly, and thus reach even the low-skilled. The very success of mobile phones in contrast to computers owes a lot to their simplicity. It is by emulating the simplicity in applications for disadvantaged groups that a lot can be achieved. This is a principle that should be kept in mind and failure to do so risks excluding a large number of users and lead projects to fail whereas, if initial uptake is achieved, small steps can be taken towards building skills while users benefit from simple functionalities. This might not take full advantage of ICTs but holds a better chance of success over a longer period.

Areas for future work

The need for wider investments in skills particularly in emerging and developing countries is not new, nor is the need for ICT skills. Given limited resources, there is, however, a need to assess the relative importance of different types of such investments and their costs. The extent to which simple technologies can save on certain training needs of application usage but also the importance of local software development needs an assessment in specific contexts.

The role of innovation in the Internet economy: The example of cloud computing for development

Innovation is taking place at a rapid pace in the Internet economy. This section highlights one innovative concept that grew in importance since the Seoul Ministerial Meeting and that is supposed to significantly change the way computing is undertaken and the way computing resources are provided: *cloud computing*.

Definition of cloud computing, cloud service and deployment models

Cloud computing can be understood "as a service model for computing services based on a set of computing resources that can be accessed in a flexible, elastic, on-demand way with low management effort" (OECD 2013c). This means that users of cloud computing infrastructure and services do not have to make capital-intensive upfront investments in IT infrastructure and software any more, but, instead, can pay for computing resources in a flexible pay-as-you-go model. They do not have to plan the provision of their computing resources in advance since they can access computing resources on demand. Furthermore, applications and information stored in the cloud can be accessed through multiple fixed and mobile devices as long as a network connection is available.

Cloud computing providers, on their side, have significantly lower operating costs - due to their global scale and capacity to aggregate the demand of multiple users of cloud computing than companies and governments of all sizes would have if they ran their own IT infrastructure. They are able to provision computing resources in a rapid and elastic way, allowing rapid adjustment to changing requirements.

Overall, a multitude of different cloud computing services exist that include software, platform and infrastructure services. The existing *service models* can be categorised into: *i*) infrastructure as a service (IaaS); *ii*) platform as a service (PaaS); and *iii*) software as a service (SaaS). IaaS provides raw computing resources, such as storage, processing and networks and enables users to deploy their own applications and software. PaaS provides users with a more structured platform and users typically rely on programming languages and further tools of the cloud provider to deploy their own applications and services. With SaaS,

cloud users directly access the applications of the cloud providers. The spectrum of these applications is vast and ranges from e-mail applications to business applications such as customer relationship management tools. On top of the service models, there are several delivery models that include private, public, hybrid and community clouds (see also OECD 2013c) for a more detailed description of cloud service and deployment models).

The role of cloud computing for development

The major benefit of cloud computing for development is the fact that individuals, businesses and governments can access and benefit from a wide range of well-developed computing resources that would otherwise not be available in developing or emerging countries. In addition, cloud computing allows them to only buy the quantity that is really needed. The different service and deployment models of cloud computing provide a wide array of potential cloud IT services and platforms.

Individuals, in developing countries, for example, can mainly benefit from multiple SaaS applications such as private e-mail accounts, text and spreadsheet programmes and storage services. These programmes are often free of charge and allow not only for a more efficient digital communication, but also for composing documents, carrying out calculations and managing daily life in an easier way. In addition, there are services that provide individuals a free platform on which they can develop their own applications.

Platforms designed for mobile devices seem to be very interesting since the deployment of mobile networks is more advanced than the deployment of fixed networks in emerging and developing countries. One very successful example of a platform that was particularly developed for integrating input from mobile devices is Ushahidi (see Box 4). Many services with social and business purposes have been created since its launch. It proved to be a very valuable tool for spurring inclusiveness. As long as a mobile device and some connection is available, content can be uploaded, even from very rural sites and a major benefit of many applications that have been developed on the platform was that they gathered information from disperse geographical areas and different groups of the society.

Box 4. Example of cloud computing services in emerging and developing countries: The Ushahidi platform

Ushahidi (meaning “testimony” in Swahili) is an open source cloud computing platform that allows users to create their own services on top of it. It is a free service that enables the programmer to collect information from multiple web sources, to do “crowd-sourcing”, to create timelines and provide mapping services. In addition, a key component of the website is to use mobile phones as a primary means to send and retrieve information. It was initially launched in Kenya to collect eyewitnesses’ reports of election violence. Since its creation, it has been used across the world for various purposes. In India, for example, a software engineer built a disaster-tracking map on the Ushahidi platform when the city of Mumbai faced the bomb attacks in July 2011. It was also used for other disaster tracking purposes during earthquakes in various locations. Other examples of how the website is used include geospatial visualisation services e.g. on (human) trafficking, monitoring elections in various countries such as India, Mexico and Afghanistan, observing medicine stock-outs in Zambia, building ICT knowledge bases (e.g. in the area of agriculture) and tracking business incubators and tech organisations in Africa.

Source: OECD based on Ushahidi

Businesses, including start-ups and SMEs have often more financial resource constraints in emerging and developing countries than in more developed countries. Particularly small firms can often not afford the purchase and the maintenance of expensive IT infrastructure, including hardware and software (IADB, 2011). Through the use of cloud computing, these companies do not have to make expensive, up-front capital investments, but can buy computing resources on demand and only pay for the actual amount they use. In addition, these services will in most cases be more developed and of higher quality than the

infrastructure and software they could afford to buy and install (e.g. in terms of the quality of service, regular updates and the security measures provided by the cloud services).

Cloud computing also provides an important opportunity for individuals and small groups to create new businesses more easily, since less seed capital is needed. Both in developed and developing countries, a growing number of start-ups and small companies have been created by fully relying on cloud computing for all of their IT processes and services which allowed them to save fixed infrastructure cost. In India, for example, start-ups such as Sparsha Learning[6] (educational services) or Whitesharkk[7] (web apps services) fully rely on PaaS services. Cloud computing thus provides an attractive means to lower entry barriers for small firms and to allow them to participate in the overall Internet economy.

Governments in emerging and developing countries rely more and more on IT infrastructure and are confronted with the need to expand their current infrastructure. Since cloud computing can provide computing resources in a very cost-efficient and energy-efficient way, it would be particularly interesting for governments in emerging and developing countries to investigate in the use of cloud computing. Several OECD countries have already taken initiatives to move government services to the cloud (e.g. the Unites States and Denmark), and could serve as valuable use cases. Potential applications have a broad range, from programmes that track the use of public funds to knowledge management systems and legal case management systems.

The above shows that cloud computing could become a very valuable tool for economies in emerging and developing countries since it provides a platform for the development of new businesses in these countries and improve societal development, including education, health care, and governmental services. However, there are also challenges regarding the deployment of cloud computing in developing countries that need to be addressed. These challenges that need to be overcome and other areas for further work are discussed in the next section.

Areas for further work to spur the role of cloud computing for development

Infrastructure: Internet access and the provision of electricity need to be improved

Cloud computing services can only be used if an Internet infrastructure (i.e., wired or wireless broadband) is in place. As the section on infrastructure has shown, significant progress has been made in connecting emerging and developing countries to the Internet and in the number of mobile broadband subscriptions. However, more efforts have to be made to connect more people, businesses, schools and government agencies to the Internet, especially in rural areas so that developing countries can benefit from cloud computing.

A second major infrastructure challenge is the lack of electricity or a reliable electricity supply in many regions. In order to move content to the cloud and to run computers, a reliable supply of electricity is needed. This electricity supply could also come from alternative energy sources, such as wind or solar power. Work has to be undertaken to analyse how to ensure adequate energy supply for cloud computing services and on how best to combine the provision of cloud services, electricity and connectivity.

Awareness and education measures need to be put in place

It is crucial that individuals and businesses in developing and emerging countries understand the inherent benefits and challenges of cloud computing. Since a wide range of different cloud computing services exist, the concept has become a buzzword lately and, as a consequence, there is a lack of a clear understanding. In addition it is observed that SMEs – also in developed countries – have difficulties in fully understanding the concept. It is thus fundamental to create awareness of the concept in developing countries, by, for example, showing some best practices, and conducting educational activities that are

adapted to the needs in these countries. Another solution governments have in order to promote the benefits of cloud computing is that they take the role as lead users of the cloud. In this area, knowledge transfer should occur from countries that are already experienced in the use of cloud computing by the public sector.

Privacy and security challenges need to be addressed

Privacy and security challenges are more or less the same for developed and developing countries. In the area of privacy, a globally interoperable approach by governments would facilitate the deployment of cloud computing. More particularly, policy makers should address the questions of whose laws apply to the data stored in the cloud, including who can access this data, and under which circumstances processing of data in the cloud amounts to a cross-border transfer.

In the area of security, cloud computing does not provide completely new challenges but since it is based on networked computing, a risk management approach needs to be taken to assure the availability, integrity and confidentiality of data. In addition, authentication and identity management challenges need to be addressed as individuals conduct more of their online activities through cloud-based services. Since challenges are the same for developed and developing countries and since some parts of the world have already worked on these issues, a knowledge transfer should occur in both the areas of privacy and security.

Standardisation is key for the further deployment of cloud computing in developing countries

Open standards are important for spurring the use of cloud computing in emerging and developing countries. Several standards institutes are currently working on a set of standards for different cloud computing applications (see also OECD 2013c for a more detailed discussion). Institutes, international organisations and public authorities should work together in further developing these and in including cloud service providers from emerging and developing countries in current standardisation efforts. Furthermore, public authorities could mandate open standards when they decide to rely on cloud computing services.

Promote cloud computing as a platform for big data

Cloud computing is an enabling platform for the use of “big data”, i.e. data with significant; i) volume (challenging the capacities of traditional IT systems); ii) velocity (with data collection, access, and processing at almost real-time); and iii) variety (combining data of different types including structured and unstructured data). For developing countries specifically, the use of big data promises to generate significant value by informing policymakers on, and helping them meet major social and economic challenges. Examples include i) crowd-sourcing event data from sources as diverse as telephone, SMSs, and social networking sites such as Tweeter, to evaluate, for instance elections or to use it for disaster tracking purposes, and ii) providing data processing and analytic capacities for low skill tasks that cannot be substituted by machines (see for example Amazon Mechanical Turk).

Conclusion

Since the 2008 Seoul Declaration, significant progress has been made with respect to the development of the Internet economy for emerging and developing countries: infrastructure has connected countries better and more. There has also been progress in the development of applications serving disadvantaged groups in areas that include agriculture and fishing, health, education and mobile banking. Many of these applications have had demonstrated benefits for their users but a challenge often remains with regards to the scalability of activities.

This study focused on the four areas of infrastructure, skills, applications and cloud computing and singled out some important themes. The impacts of ICTs have also been substantial in other areas that could not be covered here but would warrant investigation. Two notable areas are the impacts of the Internet and ICTs on good governance (e.g. reducing corruption and increasing transparency) and the impact of the Internet and ICTs on different businesses.[8]

NOTES

1 http://dailytimes.com.ng/article/internet-supply-nigeria-disrupted and http://bgpmon.net/blog/?p=601 and http://www.google.com/hostednews/afp/article/ALeqM5giGB17XwbV8P6ot7Uy3jv_bM4ZIQ?docId=CNG.2617a5813d3cd45e9f090ff4722280ef.781

2 The informal sector covers non-registered business activities.

3 Countries include Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan.

4 The 2011 study, Teleuse@BOP4, conducted in Bangladesh, India, Pakistan, Sri Lanka was based on 10 147 people interviewed from May-June 2011 who had used the phone to make a call in the last 3 months, were between ages of 15-60 and belonged to the lower income deciles.

5 www.khanacademy.org/

6 www.sparsha-learning.com/

7 www.whitesharkk.in/

8 See forthcoming OECD work on innovation for inclusive development.

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