ICT in the developing world

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Study

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Abstract

Over recent years, there have been increasing opportunities for inhabitants of low and middle-income countries (LMICs) to use information and communication technologies (ICT). ICT can potentially help LMICs tackle a wide range of health, social and economic problems. By improving access to information and enabling communication, ICT can play a role in achieving millennium development goals (MDGs) such as the elimination of extreme poverty, combating serious diseases, and accomplishing universal primary education.

This study is aimed at examining the nature and extent of impact of ICT on poverty reduction in LMICs. A specific focus is developed for the health sector, elucidating which support ICT may provide to reduce inequalities and strengthen health systems in LMICs. In addition, present EU actions in the area of improving ICT diffusion in LMICs are assessed.

Building on three literature reviews, the study first describes the conditions hampering or facilitating the support of ICT to poverty reduction in LMICs, then focuses on the specific opportunities and obstacles in the use of ICT in the healthcare sector and, finally, it illustrates the EU policy approach for promoting ICT in LMICs. Evidence from desk analysis is complemented by the opinions of 145 surveyed experts, ten of which were also interviewed.

Experts' opinions confirm the evidence of desk analysis pointing to health and education as the main areas in which ICT can play a significant role in LMICs development.

Building upon the evidence collected, the study provides policy options for future action which the EU could undertake to help LMICs profit from all the opportunities that ICT offer.

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AUTHORS

Laura Delponte (lead author), Matteo Grigolini, Andrea Moroni and Silvia Vignetti (Centre for Industrial Studies - CSIL, Milan, Italy).
Massimiliano Claps and Nino Giguashvili (International Data Corporation - IDC, Milan, Italy).

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STOA RESEARCH ADMINISTRATORS

Gianluca Quaglio (Seconded National Expert)
Nera Kuljanic (Administrator)
Scientific Foresight Unit (STOA)
Directorate for Impact Assessment and European Added Value
Directorate-General for Parliamentary Reserach Services
European Parliamenent, Rue Wiertz 60, B-1047 Brussels
E-mail: nera.kuljanic@ep.europa.eu

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ABOUT THE EDITOR

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List of abbreviations

@CP-ICT	ACP-Information and Communication Technologies Programme
@LIS	Alliance for the Information Society
2G	Second generation mobile telephony
3G	Third generation mobile telephony
ACP	African Caribbean and the Pacific
AFD	Agence Française de Développement
AfDB	African Development Bank
AITF	Africa Infrastructure Trust Fund
ALICE	América Latina Interconectada Con Europa
ART	Antiretroviral Therapy
BEREC	Body of European Regulators for Electronic Communications
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
CAREN	Central Asia Research and Education Network
CDSS	Clinical Decision Support Systems
CEPT	European Conference of Postal and Telecommunication Administration
CIF	Caribbean Investment Facility
COFISA	Cooperation Framework on Innovation Systems between Finland and South Africa
DANIDA	Danish International Development Agency
DAC	Development Assistance Committee
DCs	Developing Countries
DFID	Department for International Development
DG Connect	Directorate General for Communications Networks, Content & Technology
DG Devco	Directorate-General for International Cooperation and Development
DG Research	Directorate General for Research and Innovation
EC	European Commission
EDF	European Development Fund
e-health	Electronic health
EHR	Electronic Health Record
EHSA	e-health for sub-Saharan Africa Programme
EIB	European Investment Bank
EMEA	Europe, Middle East and Africa
EMR	Electronic Medical Record
EP	European Parliament
EPR	Electronic Patient Record
ESA	European Space Agency
EU	European Union

EUMEDCONNECT3	Euro-Mediterranean Connect project
FP7	EU Seventh Framework Programme for Research
GAID	Global Alliance for Information and Communication Technologies Development
GDP	Gross Domestic Product
GMES Africa	Global Monitoring Environment Security in African, Caribbean Pacific countries
GSMA	Groupe Speciale Mobile Association
HIPCAR	Harmonisation of the ICT Policies in the Caribbean
HIPSSA	Harmonization of the ICT Policies in Sub-Saharan Africa
HIS	Health Information Systems
I3S	Information Society, Science and Space Technologies
ICT	Information and Communication Technology
ICT4D	Information and Communication Technology for Development
ICTs	Information and Communication Technologies
IDRC	International Development Research Centre
IEG	Independent Evaluation Group
IFC	International Finance Corporation
IGF	Internet Governance Forum
INSPIRE	Provincial Information Society Strategy Programme in the Republic of South Africa
IT	Information Technology
ITES	IT-enabled services
ITF	Infrastructure Trust Fund
ITM	Institute of Tropical Medicine
ITU	International Telecommunication Union
LMIC	Low and Middle Income Country
LMICs	Low and Middle Income Countries
MAEE	Ministère des Affaires Étrangères et Européennes
MDGs	Millennium Development Goals
m-health	Mobile health
MIGA	Multilateral Investment Guarantee Agency
NGOs	Non-Governmental Organisations
NRI	Networked Readiness Index
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PDA	Personal Digital Assistant
PHR	Personal Health Records
PPAEM	Process and Programmatic Action Evaluation and Management systems
RAFT	Réseau en Afrique Francophone pour la Télémedecine

RCTs	Randomised Control Trials
RedCLARA	Cooperación Latino Americana de Redes Avanzadas
SAFIPA	South Africa-Finland Knowledge Partnership on ICT Progamme
SDC	Swiss Agency for Development and Cooperation
SIDA	Swedish International Development Cooperation
SMS	Short Message Services
SSA	Sub-Saharan Africa
STOA	Science and Technology Options Assessment
TACIT	Tackling Aids Tuberculosis through Communication Information Technologies
TEIN	Trans Eurasia Information Network
UN	United Nations
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organization
WB	World Bank
WBG	World Bank Group
WHO	World Health Organization
WSIS	World Summit on the Information Society

Executive summary

Over the last years, there have been increasing opportunities for inhabitants of LMICs to use ICTs. These technologies have been experiencing a progressive diffusion, whose pace varies considerably in different countries and for different tools. In the case of mobile phones it has been surprisingly fast and socially widespread. Together with the emerging of locally-developed ICT-based applications, this phenomenon has recently renewed the attention of donors towards ICTs and their potential impact on poverty reduction.

Through the improvement of access to information and communication, ICTs can contribute to tackling a variety of economic and social problems, including extreme poverty. On the other hand benefits of ICTs are not evenly distributed across countries and social groups. Digital Divide, resulting from unequal provision for access to information, can lead to a widening of inequality. EU policies addressing economic development and poverty alleviation shall reflect on opportunities and drawbacks offered by ICTs applications in LMICs.

ICT and poverty reduction

ICTs have become an essential component of modern life in developed and LMICs alike. They have deeply changed the way people do business, acquire knowledge and information, access to a variety of services, communicate, share views and interact. However, access to ICT benefits and opportunities is unequally distributed both across and within nations. Different use and penetration of ICT reflects country's level of economic development, as well as technological choices. Driven by wireless technologies and liberalization of telecommunication markets, the rapid adoption of mobile phones in some of the poorest countries in the world has far exceeded expectations. Differently, penetration of fixed landlines or wired broadband has proceeded much slower in LMICs. In the last seven years, the number of people having access to a computer and to the internet has been increasing in LMICs, but the divide with respect to developed economies remains large.

The literature review points to a general consensus on the relevant and positive role of ICTs in underpinning economic progress. This is generally assessed in terms of impact on: i) growth and productivity, ii) trade in ICT goods and services, iii) investment and public funding, and iv) contribution to job creation.

Differently, the significance of ICTs for poverty alleviation and reduction depends on how a specific technology can be integrated into the livelihood strategies of the poor. For example, there is abundant evidence that mobile phone technology can help alleviate poverty, by providing services that were previously unavailable to poor and remote communities. Although most evidence is limited to project level case studies, areas that are reported to having had a good rate of success are education, surveys and polling, agriculture, banking the unbanked, data analysis, and health. In such cases ICT4D projects contributed to improve quality of life indicators, such as longer life, lower infant mortality and lower illiteracy through mobile telecommunications.

While some benefits of ICTs uptake have already materialized in LMICs and succeeded in changing the life of people, most of the ICT potential remains to be fully exploited, especially for the lowest income groups. The use of ICTs is far from being common in schools, business, government and health systems. The availability of ICT services reach first the urban, better off and educated groups, while the urban poor and rural areas are less involved and their capacity to fully benefit from ICTs is limited.

The impact of ICT is indeed strictly linked to the local context and to a number of factors that pertain to both the user characteristics and the macroeconomic environment. There is a consensus on the fact that the further spread of ICTs in LMICs depends upon an enabling policy and regulatory environment, more investment in infrastructure and improved digital literacy. A poor infrastructure and uncompetitive

telecommunication market increase the cost of accessing to ICTs. Even if telecommunications services are highly valued in LMICs affordability remains a key constraint. The existence of a technology per se is no guarantee of impact if people do not have the capacity or opportunity to use it.

To sum up, even if ICTs can positively affect the society as a whole, they are not sufficient to guarantee a positive impact on economic development and especially on poverty and inequality reduction. A series of conditions must be fulfilled that rely on a combination of technical, political and cultural factors, including the choice of the technology, overcoming resistance to change and lack of local capabilities, and the presence of institutional support for the development of competitive telecommunication markets.

ICTs and health in LMICs

Health issues in LMICs are a top development priority. As in most ICT sectors of application, e-health has been displaying an impressively dynamic landscape in both developing and developed countries. Within the context of fragile and emerging healthcare systems, the use of ICTs in healthcare, generally referred as e-health, has brought about many expectations concerning the possibility to overcome barriers and costraints and bring medical care to under-served communities.

For what concerns the different categories of e-health technologies, the application of mobile telecommunication technologies (m-health) has recently seen the most impressive growth. The evident reasons are the high penetration rate of mobile phones amongst all income groups and the reliability and easiness of use of simple featured mobile phones. The most frequently reported initiatives include health call centres/healthcare telephone help lines, emergency toll-free telephone services and emergencies.

In spite of rapid introduction and proliferation of m-health pilot initiatives in LMICs, there are few reviews of the outcomes of mobile phones in healthcare in LMICs. Most evaluations of impact of m-health projects in LMICs focus on the projects' outcomes and processes rather than providing evidence of clinical impacts. In particular, most studies illustrate how the use of m-health can improve the efficiency and the outreach of healthcare service delivery and attach great attention to the advantage of the mobile technology in optimizing the use of the scarce resources available. Moreover, besides the use of the SMS technology, there is scant evidence of health outcomes or cost-effectiveness improvements for all the other possible use of m-health services. An important limitation is also that the large majority of m-health initiatives reported have a micro scale and their sustainability is rarely investigated.

The use of telemedicine has also recently seen a remarkable increase at the global level. Constrained by poor telecommunication infrastructure, the use of telemedicine in LMICs is often limited to the use of email or web messaging, whereas in developed countries most telemedicine services focus on diagnosis and clinical management and have been integrated in the health systems.

The use of HIS is more advanced in developed countries that have more advanced ICT infrastructure to support such systems. The African Region and the South-East Asia Region are reported to be the most dependent on paper-based medical reporting. With the exception of Brazil, India and China, LMICs generally struggle to find the necessary financial and human resources to scale up HIS at the national level.

Scattered evidence is available for e-learning tools, whose reported benefits include removing geographical barriers to access to knowledge, bringing medical knowledge in areas where this is chronically lacking, and strengthening collaborations with medical schools in high income countries.

There are several challenges that hold back a larger use of e-health in LMICs. At the most basic level, poor telecommunication and electricity infrastructure hampers a more widespread and efficient use of ICT in the health systems of LMICs. Financial cost of large scale e-health programmes is reported to be another key barrier. Specific constraints relate to uncertainty about the cost-effectiveness of e-health

solutions, lack of policy support and uncomplete legal frameworks (e.g. ownership, confidentiality and security of data), skill shortage and insufficient interoperability of HIS at the local, regional and national level. Finally, implementation of e-health in LMICs, especially in low income countries, appear to be strongly donor driven.

The EU approach in promoting ICTs in LMICs

EU approach

The role of ICTs in the EU development policy was firstly recognised in a communication issued by the EC in 2001 stating the relevance of ICTs as enablers of socio-economic progress. ICTs acquired more prominence within the EU aid policy framework in 2011 with the Agenda for Change where ICTs are identified as powerful drivers for change with respect to job creation, economic growth, and poverty reduction. A further communication released in 2015 acknowledges that technical progress does not automatically benefit the poor.

However, differently from other donors and international development agencies who are leaders in the sector, the EU development cooperation does not have an updated policy framework to guide its interventions in the ICT4D sector. This results in a lack of strategic focus and in fragmented action.

The lack of a central repository of initiatives related to ICT4D makes it difficult to reconstruct the contribution of EU institutions in promoting ICTs in LMICs. This is partly due also to the cross-cutting nature of ICTs which is often included as a specific component of other sector programmes (which for example complicates the estimation of the annual disbursement by the EU for the ICT sector in LMICs). However, low visibility, little dissemination and the lack of documentary evidence specific to ICT4D programmes were observed.

EU intervention in support of ICT4D can be grouped in four main areas: i) support to the development of ICT infrastructure, ii) harmonisation and alignment of ICT relevant policy and regulatory frameworks, iii) establishing national research and education networks of EU and LMICs, and iv) ICT capacity building initiatives. Support to research and education network, which is based on both building eInfrastructure and fostering participation of LMICs to the Horizon 2020 programme for research, is a characteristic feature of the EU development assistance in the ICT sector.

As for other sectors, the EU support to ICTs sector projects is built upon a regional approach. As an example, the Joint Africa-EU Strategy, that provides a framework for Africa-EU relations, aims at bridging the digital divide by addressing obstacles that limit access to mobile communications and the Internet. Differently mainstreaming of the ICT theme in other priority sector strategies, including health, private sector and agriculture has progressed more slowly.

E-health does not emerge as an area of strong involvement for the EU development cooperation. At present, DG DEVCO does not have a specific framework that guide the use of ICTs within the priority sector of health. A relevant reference document is the EU eHealth Action Plan 2012-2020, which is however directed to EU Member States. As a result, the EU development approach for e-health rests on pilot initiatives, mostly focused on the use of telemedicine, and remains a mostly unexplored area.

The EU intervention in ICT4D is still characterized by a technology-centered approach. Two past STOA studies stressed an excessive use of a top-down approach, the need to strengthen the support for bottom-up initiatives and the lack of a clearly focused strategy. Since then, progress has been mixed.

Major trends and policy shift in ICT4D

In the first half of 2000, ICT issues were prominent in donor development agendas. Most donors developed their first ICT strategic frameworks, started implementing a diversified ICT project portfolio,

and some of them established ICT-specialised unit. Since then, relevant policy shifts have been observed that resulted in a partial disengagement from ICT4D initiatives. As private sector emerged as important investor in LMICs there has been less and less emphasis on supporting telecommunication infrastructure, with, attempts to mainstreaming ICT into development programs failing to effectively make a dent into poverty reduction.

Only in recent years, thanks to the stunning growth of ICTs worldwide, and especially the high penetration rate of mobile phone in LMICs, ICT4D gained a new momentum bringing about a renewed discussion amongst the donor community. In particular, donors have been increasingly financing research that investigate the impact of ICT on poverty reduction and also started questioning whether traditional approaches to ICT4D are suitable for supporting local innovation.

There are different approaches in how to mobilise resources for ICTs in development cooperation. In recent years, donors support for the ICT sector has shifted from financing infrastructure to providing assistance for ICT policy and regulatory frameworks and IT capacity building. Some donors, such as the WB and the AfDB, are increasingly financing the development of applications for mobile phones, including for the health sector. Donors generally combine a two-pronged approach for promoting ICT in LMICs that is based on targeted intervention for the ICT sector (e.g. financing broadband infrastructure, support to IT-based industries), and mainstreaming of ICTs in priority sectors.

In this respect, mainstreaming of ICT across different focal sectors has been a dominant theme amongst donors. It has been approached differently across the donor included in the review presented in this document. For example, in the British and Swedish cooperation ICT is a cross-cutting issue increasingly integrated their programmes and aid delivery systems. Differently, Germany and the WB follows a two-fold approach where ICT is both gradually mainstreamed into priority sector programmes and is also targeted as a stand-alone sector with specific interventions. France, that is also adopting a two-fold approach, has a strong sector focus for promoting ICT in the two sectors of education and health. However, mainstreaming was also reported to weaken the integrating capability of ICT and the possibility of cross-fertilisation across sectors.

The wide use of ICT in health development cooperation has only recently emerged, thanks to the high penetration rate of mobile phones that opened new opportunities for universal health coverage. Whereas some donors, including the EU or France, have been focusing on pilot telemedicine projects, others, such as the WBG and the AfDB, have been supporting the use of mhealth applications. In most cases, e-health projects in LMICs still have a small scale and a pilot nature, and the lack of donor coordination is reported to be a constraint for the scalability of successful projects.

Survey

In order to provide primary information on the topics under analysis and further explore the findings emerged from the literature review an online survey was carried out. 145 experts in the field of development cooperation, ICT4D and health have participated in the survey, providing a variety of perspectives from different job positions, job affiliations and geographical areas. Structured interviews were then carried out with ten respondents in order to deepen the discussion and enrich the analysis of different policy options.

Role of ICTs in the economic development of LMICs

There is wide consensus that health and education are the main areas in which ICTs can play a significant role in LMICs development. Another opinion emerging distinctly from the survey is that the most critical barrier among those hampering the usage of ICTs in LMICs is their poor endowment of infrastructures. The scarce affordability of ICTs, insufficient political support, and human capital deficiencies – both in terms of lack of IT professionals and digital skills among end-users - follow.

Scarce sustainability is the main weaknesses of donors' initiatives in ICT4D. Surveyed experts working for private non-profit organizations are those more concerned about the sustainability of projects, which signals a greater risk of scarce sustainability for projects carried out with a bottom-up approach. It was pointed pointed that, notwithstanding a "proliferation" of ICT4D projects and initiatives, these are often marked by short-termism, excessive focus on technological transfer overlooking the issue of local users' digital literacy, failure to take into account key context variables. All these aspects affect the durability of initiatives. The strategy of many projects in the area of ICT4D is often too narrow, failing to take into account key context variables. In line with that, lack of coherence and little attention in supporting ICT applications relevant to LMICs are identified as the other two main deficiencies of donors' initiatives. For what concerns specific ITCs, in general internet and basic mobile phone are considered the technologies which mostly impact economic development in LMICs.

ICTs and health in LMICs

According to most of survey participants ICTs should have a high or very high priority level within healthcare planning in LMICs primarily due to ICTs instruments' ability to facilitate access to health information. Facilitating access to health services and training for health workers constitute the other main benefits of e-health.

For what concerns e-health technologies, respondents indicate on average that health information systems, e-learning for health workers and electronic health records are the most common in LMICs. However, the opinions of experts on this topic tend to diverge significantly, which can be due both to the variation of e-health usage across different LMICs countries, and of the heterogeneous terminology used in this field.

Focusing on m-health applications, according to respondents' experiences the most successful in LMICs are those devoted to remote data collection, communication and training for healthcare workers, and education-and awareness activities.

The main barriers limiting the use of e-health in LMICs echo those limiting general ICTs diffusion in these countries. A poor infrastructure endowment is perceived as the most acute problem, which can simply impede the development of some e-health applications. Lack of equipment (due to poor affordability) follows, whereas obstacles in the sphere of human capital rank third. It is worth to mention that a hypothetical 'cultural bias' towards the usage of ICTs is indicated as a minor problem with respect to others. The lack of policy and regulatory frameworks is the main obstacle which mostly prevents scaling up of e-health projects (after the limited financial resources within Ministries of Health).

The actions that can mostly contribute to foster e-health usage, after the need for more funding, are reported to be the strengthening of sustainability, the increase of e-health benefits awareness and the improvement e-health initiatives coordination.

EU institutions' policies in ICTs for development

According to respondents, over the last ten years EU Institutions' support to ICT4D initiatives have not considerably improved. Experts indicate that they remained stable or with a slight improvement. A significant share of experts is actually not able to express an opinion on this issue, in line with the poor visibility and dissemination of EU ICT4D policies emerged in the literature review.

Respondents on average believe that the EU also failed to grasp at best the potential advantages that can be achieved collaborating with international organizations and leveraging different comparative advantages. A major share of respondents maintains that the EU cooperation with international organizations in the field of ICTs diffusion is insufficient.

The survey confirms the idea that ICTs should not be seen as a goal in itself but as instrumental to other areas of development. The majority of the survey's participants think that ICT4D should be integrated in

few or all other areas. Among them, health and education are indicated as key sectors. Indeed, according to the majority of surveyed experts the primary aim of EU ICT4D policies should be the reduction of health inequalities, followed by the MDGs achievement and the digital divide reduction. Employing initiatives based on ICTs to foster economic growth is considered as a priority objective only by a minority of experts.

Coming to EU policy options in this area, the results of the survey suggest that in developing their strategy EU Institutions should try to balance the top-down approach that has traditionally characterized its initiatives in the ICT4D with bottom-up interventions. Among the most important actions that EU should take in order to remove the obstacles hampering the dissemination of ICTs in LMICs there is the support in developing regulatory and legal frameworks.

The types of intervention in which EU Institutions are seen as most effective are the technical assistance to e-projects, research partnerships and infrastructure financing.

Policy options

On the basis of the collected evidence there are a number of considerations on rationales, advantages and disadvantages concerning the approaches that the EU could pursue to promote ICTs in LMICs.

To reduce EU support to ICT4D in LMICs

Given the fast spread of mobile phone technologies and the increased availability of locally developed ICTs in LMICs, experts perceive a reduction of EU support to ICT4D in LMICs as a missing opportunity: very few of them selected this option. They are convinced that ICTs diffusion *per se* can potentially deepen inequalities since the possible economic growth it can trigger does not necessarily lead to a poverty decrease. Specific interventions in the area of health, education, agriculture, microfinance can better addressed poverty alleviation and decrease. According to these views donor-driven ICT solutions are rarely the most effective and cost-effective ones to address problems faced by LMICs in relation to poverty, due to issues as the cost and expertise involved. Along this line, there could be rooms for maintaining the idea that ICT should be adopted as a solution to poverty only when there is enough supporting evidence about its effectiveness. Thus, mainstreaming systematically ICTs within donor programs is an inappropriate strategy.

Keep a top-down approach

Traditionally the core of EU interventions in the ICT4D is characterized by a top-down approach, addressing policy and regulatory frameworks or supporting the construction of infrastructures. It is recognised that by reducing systemic constraints these interventions aim at improving accessibility to ICT. Advantages of these initiatives are manifold: they concentrate on major barriers that mostly hamper the use of ICTs for development in LMICs, namely infrastructural endowment and affordability; they allow to concentrate funding in projects with a wide regional scope, that is key for creating markets with a sufficient critical mass and reducing barriers due to different regulations; they are not jeopardized by the risk of a poor durability that tend to affect bottom-up initiatives. Given that EU Institutions have already gathered experience in these ambits over years and that in the area of regulation most African countries have already taken EU countries' ICT regulatory frameworks as benchmark, a share of surveyed experts believe that there is an added value for the EU to maintain this approach.

On the other hand, as emerged in the literature review, access to ICTs is not enough to achieve development outcomes, and in particular poverty reduction. For example user barriers (e.g. IT illiteracy) have to be tackled for the poor to benefit from ICTs potential. So far EU has done little to support ICT use by the poorest, and to this regard a purely top-down approach can be limited.

A possible improvement is seen in strengthening the reach and development impact of existing top-down initiatives, for example including in infrastructures projects conditions for an open access regime with non-discriminatory and transparent prices, leveraging policy dialogue with recipient countries to increase awareness about the potential use of ICT for economic growth and poverty reduction.

Move towards a bottom-up approach

Bottom-up initiatives can address directly the poorest and allow to involve local actors in the decision making process. Such initiatives often consist in training and educational projects targeting both the public and private sectors. They are considered to be more effective for tackling the limited IT skills that hold back the poverty reduction potential of ICTs. In addition, their implementation can be eased by the fact that they rarely require high level political support.

As emerged throughout the analysis, a poor sustainability is a major risk in adopting this approach. To be successful, bottom-up initiatives have to be built on deep understanding of local contexts and seek government approval. Alignment with national strategies improves the probability of scalability and sustainability. Learning from past experiences and selecting already tested and validated solutions, rather than adopting experimental solutions that provide theoretical benefits, is also advisable.

In addition, it has to be taken into account that as this approach is less common in current EU development cooperation policies, so less experience is already in place to build upon. Due to a limited presence on the field, EU development cooperation would have to channel its aids through many small organizations, which is recognised as being not among its core advantages.

Balance a bottom-up and top-down approach

The majority of surveyed experts believe that EU ICT4D policy should rather adopt a mix of top-down and bottom-up policies. This would expand the range of possible interventions for EU development cooperation in this area, so that the most appropriate mix of initiatives could be chosen in function of different context variables.

On the other hand, a mixed approach could be more difficult to implement as it is based on a larger variety of options that need to be combined to achieve synergies. It also requires that recipient countries have a vision or strategy for the digital development of their economies and societies. Last but not least, embracing this approach would reduce the concentration of funding.

Besides specific policy options, the analysis allowed to identify key significant aspects that hamper the effectiveness of donor initiatives for ICT4D, whose consideration can help better design EU interventions for promoting ICT. In particular:

a) Lack of donor cooperation limits the scalability and interoperability of ICT4D projects. Donors have scope to improve this aspect of their policies, and in particular EU could improve its federating role among EU Member States.

b) Technology-driven approaches, poorly aligned with LMIC contexts and promoting the use (and dependency from) ICTs that are developed by industrialized countries are not likely to survive. Donors should develop projects aligned with local systems.

c) Integrating ICTs within other priority sectors allows to fully seizing the development potential of ICT in different sectors of LMICs economy and society, but it requires that sector staff is familiar with the possibility to use ICT effectively within their sector of expertise, and it increases the risk of dispersing ICT4D knowledge across donor organizations. To address these issues some donors established ICT support units. DEVCO does not have such a unit in place, but it sometimes relies on DG Connect expertise for ICT programme design and implementation (e.g. e-infrastructure projects). An alternative approach to a full mainstreaming of ICT consists of increasing the use of ICT in a limited number of sectors, as health and education.

1. Introduction

Over recent years, there have been increasing opportunities for inhabitants of LMICs to use ICTs. ICTs can potentially help LMICs tackle a wide range of health, social and economic problems. By improving access to information and enabling communication, ICT can play a role in achieving MDGs such as the elimination of extreme poverty, combating serious diseases, and universal primary education.

However, the benefits of ICTs are not fully realised in many countries: ICTs are often out of reach of the poor and those in rural areas. In addition, the digital divide, resulting from unequal provision for access to information, knowledge and networks, mean that many LMICs are unable to exploit the best from opportunities that arise. To support the diffusion of ICTs in LMICs, the EU has to move within a complex international scenario. Many observers suggest that the EU should alter its approach if it is to improve the effectiveness of its actions in the diffusion of ICTs in LMICs.

Two studies have previously been published by STOA on ICTs in LMICs, 'Developing Countries and the ICT Revolution' (March 2001) and 'Health and ICT in Developing Countries' (February 2004).

The current study is structured as follows:

- **Chapter 2** clarifies the main obstacles that currently prevent LMICs from benefiting from ICTs and which role ICTs play in the reduction of poverty. The work includes a state-of-the-art overview covering the following points:

- the level of use of different ICTs in LMICs in comparison with the developed countries;

- the role of ICTs in LMICs' economic progress;

- the role of ICTs in LMICs' poverty reduction;

- constraints and opportunities in the use of ICTs in LMICs.

- **Chapter 3** provides a specific overview of ICTs in healthcare in LMICs. The key issues it analyses are:

- a general overview of the main areas where ICTs are applied in healthcare in LMICs;

- the definition of e-health and its subsectors;

- the state and trend of major ICTs in the health sectors;

- the evidence of their impact on haelthcare in LMICs;

- challenges and constraints for furthering ICT use in healthcare in LMICs.

- **Chapter 4** analyses the role of the European institutions and the effectiveness of EU policy on ICTs in LMICs. The following aspects are included:

- current EU approaches and results from actions undertaken in the area of enabling ICT diffusion in LMICs, analysing to what extent ICTs are considered a key element of cooperation policies;

- an examination of the EU policy contribution to ICT health programmes in LMICs;

- the current actions of other developed countries on ICT diffusion;

- the possible improvements in collaboration between different DGs of the EC responsible for development;

- Overview of other donors approaches to promoting ICT;

- an analisys of the role that the EU might assume in the future.

- **Chapter 5** provides the results of a survey carried out among 145 experts of the field of ICT4D, development cooperation and/or health sectors in LMICs;

- **Chapter 6** presents insights from the structured interviews carried out among 10 experts that participated in the survey;

- **Chapter 7** provides different policy options for the development of ICT diffusion in LMICs.

- **Chapter 8** presents conclusions.

2. ICTs and poverty reduction

2.1 Introduction

This chapter aims to provide and account of ICT diffusion in LMICs with a specific focus on the role ICTs can play in achieving poverty reduction goals as laid down in the MDGs. Examples of ICT-enabled social and economic opportunities amongst the bottom of the pyramid income group are illustrated, along with successful examples of ICT applications developed by LMICs. The review also documents the existing digital divide in terms of infrastructure, institutional, policy, human and financial capital shortages that impede an equal access to the many opportunities of ICTs.

This review does not have a specific sector focus for ICT applications, but it provides a general overview of the many use of ICT in a developing country context. When possible, cross-country comparison by income group is presented to provide evidence of how the different benefits of ICTs are harnessed in different country contexts. A key issue in the literature of ICT4D consists on whether ICTs are economic and social 'dividers' or 'equalizers', given that most low income groups are hardly participating in and benefiting from the digital revolution. The existing literature on ICT4D is therefore based upon two opposite positions (Ofwona, 2014). The 'supporters' think that by embracing digital technologies, LMICs can leapfrog stages of development (Negroponte, 1998; Primo Braga 1998), whereas the critics point to the existing technological gap as a way to accumulate further distance from more developed economies (Gillwald, 2005). An example of the critics is provided by the diffusion of broadband technologies, that is facing both supply (commercial costs in remote areas) and demand side (affordability) constraints in LMICs (ITU, 2013).

A distinction between ICT impact on economic development and on reducing poverty level is made given that more evidence is available on the impact of ICT on economic growth (through the use of macroeconomic and national accounting data) than on the impact of ICT on reducing poverty. This is indeed a much debated issue, as assessing the relevance of ICT for poverty reduction requires to look at the specificities of the local ecosystems and is better analysed through case studies that allow to go beyond the money-metric approach to poverty issues.

The chapter is organised as follows: the next section (section 2) presents the methodological approach for the literature review; it discusses the key sources as well as the scoping and focus of the analysis. Section 3 provides an overview of the use and penetration of ICTs in LMICs. Section 4 describes the linkages between ICTs and economic development, whereas section 5 focus on how ICTs can be effectively used in alleviating poverty. Section 6 illustrates the main obstacles to further the use of ICTs in LMICs and improving their impact on the life of the poor and section 7 present possible opportunities in the use of ICTs. Finally, section 8 summarizes the conclusive remarks.

2.2 Methodology

A first web-based extensive research was carried out by using Google and Google scholar. The taxonomy areas of the web research included both overarching documents related to ICTs and development and more technology-specific reports. Besides these general tools, a more focused research was conducted by looking at the websites of organizations that make available policy and case studies documents for development (e.g. donors and NGOs). This includes for instance Eldis website that has a specific thematic area for ICT in development, the UK research centre ICT4 that undertakes extensive research on the potential use of ICTs in development, or the WSIS Stocktaking Database that has a large collection of publications related to ICT use in LMICs.

The web sites of other donor organizations that are particularly active in ICT4D were also consulted. These include the WB, the British DFID, the AfDB, the SDC and the SIDA agency. In addition to these internet sources, a number of academic publications from refereed journals were also used to provide

evidence from applied research and integrate the views of independent experts into the study. Given the broad scope of this study, review of peer-reviewed articles were given priority and used in full text.

Some filters were applied to identify the papers and reports that were most useful to address the scope of the present study. First, because ICT is fast changing sector, most recent bibliographic sources were selected. Secondly, cross-country analysis papers were prioritized over single country studies to draw more general lessons. Thirdly, given that the EU development cooperation has a geographic focus on Africa, where most low income countries are, a more comprehensive assessment about the development of ICT in Africa was provided. When data was available, the literature review was complemented with a quantitative analysis that looked at accessibility, quality and availability of ICTs in LMICs as compared to developed economies. The quantitative analysis aims at identifying different typologies of 'digital divides' and of ICT needs in the developing areas.

Collecting data on ICT access in LMICs has some limitations. The global Partnership on Measuring ICT for Development identifies a number of core indicators as a basis for internationally comparable statistics on ICT penetration in different sector of activity. Yet, in LMICs availability of ICT data is still low and is often uncompleted. Data were thus collected from different sources, including the WB's ICT - At a glance tables; the World Development Indicators, the database of the ITU, which is the United Nations specialized agency for ICTs; and the World Economic Forum's NRI that measures how ICT has an impact on country competitiveness.

2.3 ICTs in LMICs: some figures

The term ICTs includes a large number of technologies. Generally, it consists of the hardware, software, networks and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, and images) as well as the related services (Task Force on Financial Mechanisms, 2004). Generally, ICTs are simple and multifunctional tools that can be applied to a diverse range of society and economy sectors. Digital innovations are creating new possibilities to improve health and nutrition, expanding knowledge, stimulating economic growth and empowering people to participate in their communities.

There is a common distinction between traditional (e.g. radio, telephones and TV) and modern (e.g. computers, internet, mobile phones) ICTs, although the digitization of communication and the falling costs of computing power and memory is gradually bringing old media in modern devices (e.g. a radio into a smartphone, a computer that is used as a TV). A further classification of modern technologies distinguishes among: i) 1st generation, including mainframe (Unix, Cobol, etc.) from the origin until the eighties; ii) 2nd generation, including client-server (PC, Windows, Office, internet, etc.) from the eighties until last decade; iii) 3rd generation, including cloud computing, mobile computing, big data and analytics, social media, internet of things (i.e. increased communication among physical objects through the Internet), starting from 2007-2008. Each generation are characterised by different use and business models.

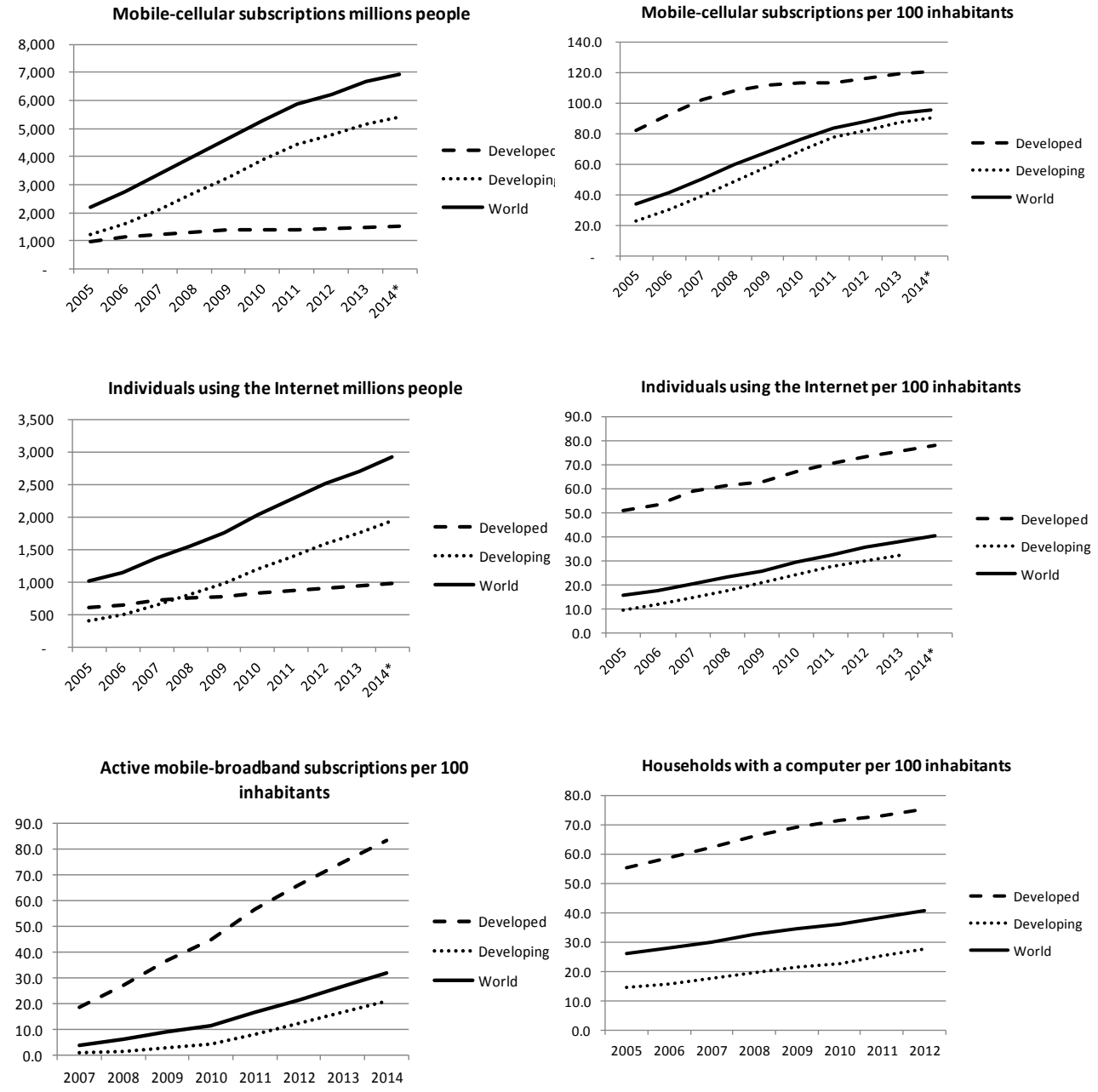
Driven by wireless technologies and liberalization of telecommunication markets, ICT have marked a tremendous growth in LMICs since the late 1990s. In particular, mobile phone access and use has been a revolutionary aspect for people at the bottom of the income pyramid. At the same time, the increasing availability of broadband services has expanded the opportunities for convergence between telecommunication, media and computing. Mobile telecommunications are thus rapidly evolving from voice and text services to more sophisticated applications (World Bank, 2011).

ICTs are rapidly expanding in large sector of the economy and the society in LMICs. However, there are ICTs that have particularly prospered. Actually, mobile phone applications are mushrooming in poor countries to overcome the limits of poor health, education, financial and transport infrastructure. There are applications for different categories of actions, such as disintermediation (e.g. Kenya is leading the

world in mobile money), access to information and knowledge (e.g. in Bangladesh English lessons can be downloaded on mobile phones) and 'crowdvoicing' (e.g. checking whether a drug is genuine) (The Economist, 2011).

The 2014 annual report of International Telecommunication Union (ITU, 2014) offers a very interesting insight on how ICTs are penetrating in developed and LMICs (Figure 1-3). Different use and penetration of ICT reflect country's level of economic development, as well as technological choices (i.e. wireless versus wired infrastructure).

Figure 1. ICT key data by developed and developing country groups



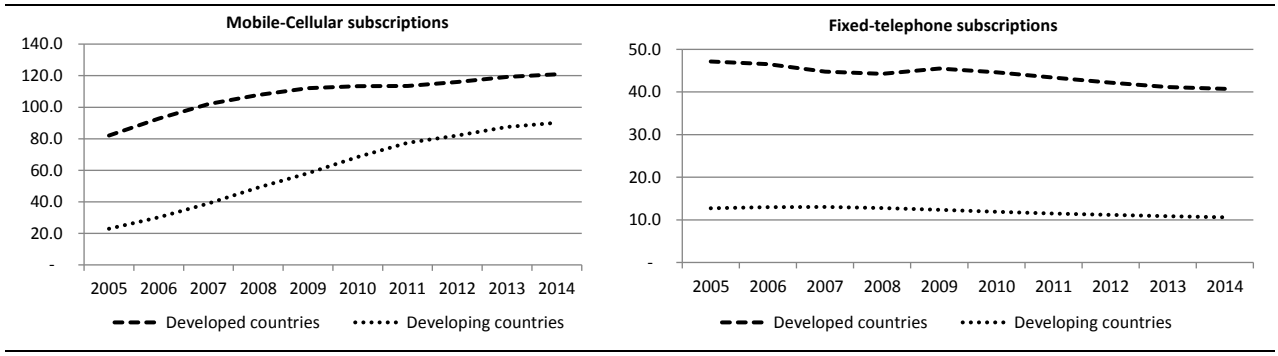
Source: Authors elaboration from ITU's Measuring the Information Society Report, 2014

First of all, the rapid adoption of mobile phones in some of the poorest countries in the world has far exceeded expectations. Nowadays, three quarters of all mobile-phone subscriptions are in LMICs and

the gap with developed economies is getting thinner. Differently, penetration of fixed landlines or wired broadband has proceeded much slower in LMICs. For instance, in Africa mobile phones have leapfrogged fixed-phone landlines that are much common in developed economies (Figure 2).

However, progress has been slower in other areas, where accessibility cost is higher both for the supply and the demand. Although the number of people having access to a computer and to the internet has been increasing in LMICs in the last seven years, the divide with respect to developed economies remains large. It is estimated that there are still 4 billion people excluded from the internet and 90% of them live in a developing country. In addition, while developed economies are progressing towards an almost universal access to broadband mobile services, these remain low (i.e. nearly 20% of population) in developing economies (ITU, 2014).

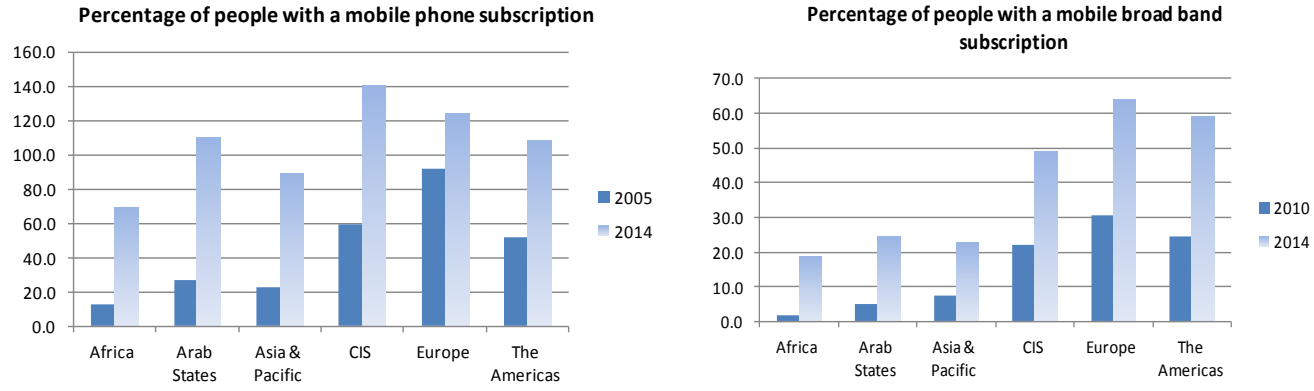
Figure 2. Comparison between fixed and mobile phone penetration in developed and LMICs

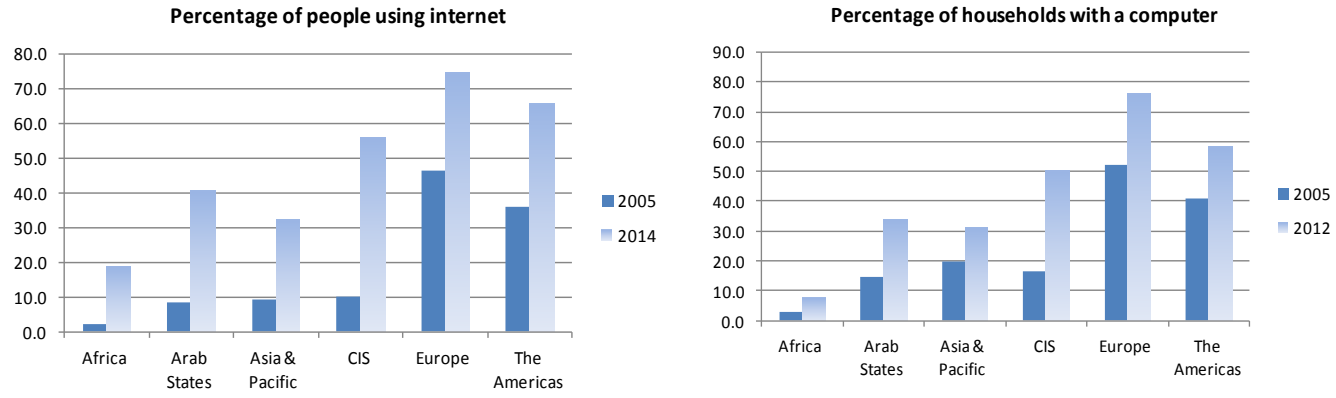


Source: Authors elaboration from ITU's Measuring the Information Society Report, 2014

GSMA (an association of mobile operators and related companies devoted to supporting the standardising, deployment and promotion of the GSM mobile telephone system), estimates that the next wave of growth in the mobile industry is the mobile internet (GSMA, 2014). Given the limited access to wired technologies in the developing world (Figure 3), most of these countries could not benefit from the initial internet revolution that was based on fixed-line connectivity. As far as telecommunications are moving towards wireless devices, e-services are been converted into mobile services, such as m-learning or m-health. Smartphones have been the major force in the global growth on mobile internet. Global sales of smartphone are expected to reach 70% of handset sales by the end of 2014, albeit this is not a global phenomenon yet. In LMICs less than 11% of the handsets are smartphone. These are still expensive products that only a small share of the population can afford in spite of declining manufacturing prices.

Figure 3. ICT key data by geographical areas





Source: author's elaboration from ITU's Measuring the Information Society Report, 2014. Note: CIS stems for countries that belong to the former Soviet Republics

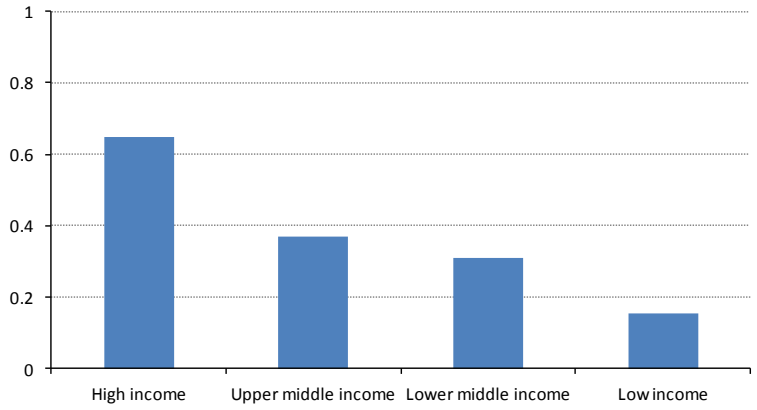
Geographically, Africa, Asia and the Pacific, are the regions with the strongest mobile-phone growth, although penetration is lower as compared to other regions. SSA provides a quite striking picture. In front of a very low infrastructural endowment (where merely 29% of roads are paved), access to and use of mobile telephony has skyrocketed over the past decade. Nearly 60% of the population has mobile phone coverage and mobile phone subscriptions increased by 49% annually between 2002 and 2007 (Aker and Mbiti, 2010). The American multinational corporation, CISCO Systems, estimates that by 2015 people in SSA will have more access to mobile network than to other core infrastructure such as electricity (GSMA, 2011). However, it is important to note that mobile phone penetration varies a lot across African countries. In 2009 it went from a minimum of 38% in Cameroon to a maximum of 110% in the Seychelles (UNECA, 2013).

From 2005 to 2014, the percentage of African people using internet is eight times larger. However, the region is clearly lagging behind both in internet use and computer access in comparison to industrialized countries. In spite of the highest growth in the world in mobile broad band subscription, a mere 19% of the Africa population has access to such technologies. Moreover, country statistics shows that there is wide variation in the rate of internet penetration among African countries. Seven countries have a penetration rate above 25% and 12 countries have a penetration rate below 2.5% (UNECA, 2013).

Broadband internet has been growing rapidly worldwide, even if penetration rate remains low in LMICs, especially for fixed broadband connections. In 2010, less than 1% of the population in Africa has a fixed broadband connection, whereas wireless broadband internet access is growing faster with an estimated number of 18 million broadband subscribers. Most internet service providers and mobile phone companies are now offering wireless internet across the continent, and the number of mobile phone companies offering 2G, 3G and 4G services has substantially increased. However the geographical distribution of the subscriber base is very concentrated in just two countries, South Africa and Nigeria that account for 81% of SSA's total broadband subscribers (UNECA, 2013).

The digital divide amongst developed and LMICs also materializes in the way ICT applications are developed and applied in different sector of the economy. The UN Index measuring the level of sophistication of e-government services shows a large difference between developed and LMICs (UNDESA, 2014) (Figure 4). Similarly, LMICs lag behind in connecting schools to the internet and in using e-commerce (WB, 2006; WB, 2009).

Figure 4. Measures of e-government services in developing and developed countries, 2014



Sources: United Nations e-government survey 2014: e-government for the future we want; UNDESA, 2014.

Note: scores are from 0 for to 1 for top performers. Income groups correspond to the classification developed by the WB. For the e-government service survey the online service component is showed only, including the following thematic: whole-of-government, multichannel service delivery, bridging the digital divide, increasing usage, open government, e-participation.

Connected mobile devices has allowed a consistent penetration of social media so that these applications have become part of the modern life on developed and LMICs alike, bringing unprecedented opportunities for social activism and social accountability. Clearly, the penetration of the social network platforms is highly dependent on income level, as it is linked to the availability of computers or smartphones along with an internet connection. Regions with lower income level have the lowest penetration rate. In 2014, penetration rate of social platforms accounted for 7% in Africa and South Asia, 5% in Central Asia, and 44% in Western Europe (We Are Social Report, 2014). However, in spite of having the lowest rate of Facebook users in the world, Africa has recently seen the fastest growing population of Facebook users thanks to its young population (UNECA, 2013).

While in developed countries convergence of ICTs is driving traditional media into modern media, in developing country contexts radio and television are still the dominant electronic mass media. For instance, in Africa radios and TVs have a higher penetration rate than any other IT devices. TVs per household rate are higher in middle income Africa countries, whereas radio is most common in low income countries. It is expected that TV penetration rate will increase from the current 30% of African households up to 50% by 2015, although convergence (e.i. using the internet for watching television or listening to the radio) will remain low in the near future (UNECA, 2013). DSTV, the African cable giant, already streams some of its programmes to smartphones everywhere in Africa, although it is the African diaspora community that is most benefiting from the service (The Economist, 2014).

2.4 The role of ICTs in the development process

There is general consensus on the relevant and positive role of ICTs in underpinning economic progress. As a general-purpose technology, the impact of ICTs on a country's economic progress goes beyond this sector of the economy and is generally more relevant in terms of externalities and spillovers than in terms of its direct contribution to GDP growth (UNCTAD, 2008).

The diffusion of ICTs into low-income countries and communities has been recent and rapid. As a result, sound evidence about the contribution of ICTs to development has only recently started to emerge and is sometimes not conclusive (Heeks, 2010). Moreover, ICT is a fast changing sector which makes most conclusions time-contingent. For instance, when mobile phone use in Africa evolves from simple communication tools into service delivery platforms, the development paradigm of this technology is

moving from an instrument that reduces communication, coordination and transaction costs, to a tool that can change the life of individuals through a myriad of applications and service (Aker, 2010). ICT is a general purpose technology, therefore assessing the economic impact of ICT is complex exercise as it requires including many different variables and relationships amongst variables beyond the ICT industry. Availability of quality and comparable data is also another relevant constraints, especially in LMICs contexts (UNCTAD, 2014).

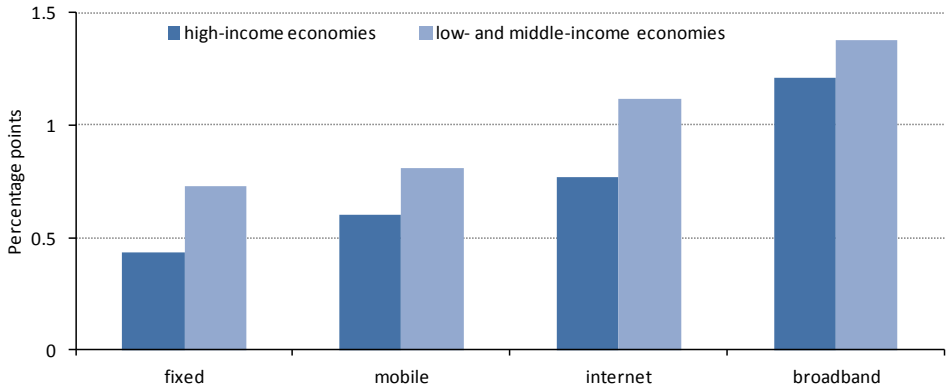
Depending from the background of the researchers analysing the relationship between economic progress and ICT, different frameworks are used and different channels are identified through which ICT can make a difference in terms of economic growth. Most studies collected for this literature review identify and quantify the positive impact of ICT on economic development through four main channels: i) growth and productivity, ii) trade in ICT goods and services, iii) investment and public funding, and iv) contribution to job creation. These four aspects are briefly analysed here below.

2.4.1 Growth and productivity

There is a large body of econometric studies that addresses the issue of the impact of ICT in general and of ICT specific technologies (e.g. broadband) on economic growth in a developed country context. Less conclusive evidence is available for LMICs due to the most recent uptake of ICT in these countries and lack of complete time series data. In both cases, most of econometric models identify a positive impact of ICT (be it the internet or mobile phones) on economic growth, even if most models have some endogeneity problems, that weaken consistency of results (Aker, 2010). This means that a possible correlation between the dependent variable, i.e. economic growth, and the independent variables used in the model could affect the results suggesting a positive impact of ICT on economic growth.

An econometric analysis conducted by the WB across 120 countries on the growth effect of different ICTs by income group shows that LMIC are to gain most for increased use of ICT (Figure 5). The study underlines that the potential contribution to economic growth of broad band is remarkable, although the robustness of results is weaker for LMICs because of the lack of a critical mass of users.

Figure 5. Growth effects of increased use of different ICT tools by country income groups



Source: World Bank, 2009

ICT use is also reported to have a great impact on market efficiency redressing some common market failures such as asymmetric information. The role of mobile phones as an instrument to reduce price dispersion in agricultural markets in LMICs is well documented in many studies. This can have important effects on the welfare of both producers and consumers. In the Kerala state of India the use of

mobile phone in the fish market led to an increase in fishermen's profits by 8% and a reduction of consumer prices by 4% (Aker, 2010).

At the enterprise level, production efficiency is often reported to improve with increased ICT use thanks to lower transaction costs and time, larger market coverage, better access to knowledge and information, and greater flexibility (UNCTAD, 2006). A World Bank study on firm gains from ICT in LMICs found out that firms that use ICT growth faster, are more profitable and productive (Table 1).

Table 1. Effect of ICT use on enterprise performance in LMICs

Indicator	Enterprises that do not use ICT	Enterprises that use ICT
Sales growth (%)	0.4	3.8
Employment growth (%)	4.5	5.6
Profitability (%)	4.2	9.3
Labour productivity (value added per worker, $)	5,288	8,712
Total factor productivity (%)	78.2	79.2

Source: World Bank, 2006

2.4.2 Trade in ICT goods and services

Thanks to the development of IT services, including software and hardware maintenance, application development, help desk, software engineering, network administration and system integration, IT consultancy services, as well as ITES, which are services that can be delivered remotely using telecommunication networks (e.g. call-centers), some LMICs managed to accelerate economic growth and integrate in the global economy. Besides its direct effects on GDP growth, the development of IT services and ITES is generally followed by fiscal, regulatory and legal reforms that benefit all type of business (World Bank, 2009).

On a large scale, India, China, Mexico and the Philippines are the LMICs that benefited most from the expansion of IT services and ITES. In India, the IT services and ITES industries contributed to nearly 25% of the country's export in 2007 and both industries accounted for 5.5% of the country's GDP (World Bank, 2009). Differently, African countries have not been able yet to exploit their comparative advantages, such as proximity to the EU market and the availability of a multi-lingual and young population, to become integrated into the global value chains of different IT products and services (UNECA, 2013).

2.4.3 Attracting investment and contributing to public finances

Mobile operators have great interest in supporting the expansion of ICT in LMICs and invest heavily to provide mobile network coverage. In SSA mobile operators are investing in developing regional backbone infrastructure. Examples of these investments include the submarine fibre-optic cable EASSy in Eastern Africa and a national backbone project in South Africa (GSMA, 2011). The mobile ecosystem has become a major contributor to the public finances of many African states. Up to 4.1% of total Africa government revenues came from the mobile industry in 2010. These figures can be striking in specific country case. For instance in 2008 the telecommunication operator MTN accounted alone for 5% of the total tax revenue of Ghana (GSMA, 2013).

2.4.4 Employment

There are rough extrapolations that attempt to quantify the number of jobs created through ICT, looking at both the people directly employed in the sector and at those that have indirectly benefited from the IT uptake. Whereas more skilled people can enter the formal labour market, many finds micro-entrepreneurial opportunities, especially within the extensive network of phone card distribution system, internet cafés, mobile phone sales and repairs services. In Africa, it has been estimated that in 2010 the mobile phone ecosystem employed, directly or indirectly, nearly 5.8 million people that corresponds to 1.4% of the total African workforce (GSMA, 2013).

In middle income countries that have been capable to become top IT goods and services exporters and ITES global payers, there have been many opportunities in relatively better paid IT jobs. In India IT service and ITES industries employed 2.01 million people in 2007 in jobs that paid from 50 to 100 % more than jobs in other service sectors. Moreover this relatively wealthy workforce has increased spending on other services leading to estimates that consider that for each new job in IT services and ITES there has been between three and four new jobs in other sectors. A similar multiplier effects was identified in the Philippines, where for each job created in the IT sector it is estimate that up to three more jobs are created in other sectors, such as food, transport and housing (World Bank, 2009).

In Asian countries, such as India, China and the Philippines, outsourced ICT services generated many employment opportunities for women. In India and in the Philippines, women already make up respectively 30% and 65% of the total professional and technical workers in IT services and ITES. Besides being massively employed in call centre, women also have a great number of highly paid IT jobs in both countries (World Bank, 2009).

2.5 The role of ICTs in reducing poverty

There is a general consensus that ICTs are powerful instruments to provide people with economic opportunities, knowledge and services that can alleviate poverty in all its dimensions. Following the Sustainable Livelihood Framework (e.i. a tool for better understanding the livelihoods of the poor), the multidimensionality of poverty is defined by five group of asset deprivation: financial, physical, human, social and natural (DFDI, 1999). Most studies in the development literature also include inclusion and vulnerability as two other key measure of poverty. In the development process ICTs promote a definition of socio-economic progress that is based upon empowerment and participation that are key to trigger a pro-poor and equitable growth process. However, the benefits of ICTs remain unevenly distributed between and within countries and in some cases the poor benefit disproportionately less (UNCTAD, 2006). The IT digital divide can prolong and deepen the existing disparities amongst income groups, gender and age groups, rural and urban citizens, educated and non-educated people. This has generated a considerable debate about the role of ICTs in poverty reduction, equitable growth and MDGs' achievement (Byrne, 2009).

Generally, it is acknowledged that the importance of ICTs in the development process is not in the technology used, but in its many enabling functions that include access to knowledge and socio-economic interactions. From a development policy perspective, two types of ICT applications can be identified. These are: progressive innovations (which can deliver a substantial impact on economic growth and productivity) and transformational applications (these are often reported in the ICT4D literature as *'Development 2.0'*) that bring about fundamental changes to the existing social structures and balance of power (Avgerou, 2009). The latters are those that have the higher potential to impact on poverty and inequalities.

The significance of ICTs for poverty alleviation and reduction depends on how a specific technology can be integrated into the livelihood strategies of the poor. However, the prevailing approach in assessing the development impact of ICTs rest on estimating the benefits for infrastructure and investments,

whereas there is scant general analysis on the impact on poverty issues such as gender effects, empowerment or social mobility (Hyvönen, 2012). Looking beyond the impact of ICTs on the money-metric indicators of poverty often requires a multi-disciplinary approach that explores to what extent ICTs have enabled a transformation of the development process and structures (Adera, 2013).

In the documentation analysed for this review there is not a commonly used methodology or approach for assessing the impact of ICTs on reducing poverty or improving the quality of life of the poor. In development studies two frameworks are mostly used. These are the capability framework that looks at how ICTs can contribute to freedom and empowerment, and the livelihoods model (Zheng, 2007; Parkinson, 2006), that investigates the impact of ICTs on individuals and communities in a broad perspective that include context, assets, institutions, strategies and outcomes (Heeks, 2009). Other studies looks at how ICT4D programmes were able to contribute to the achievement of the MDGs using thus a project purpose framework (InfoDev's evaluation of seventeen ICT4D projects, 2003).

2.5.1 Mobile phone technologies

Because investigating how ICTs can alleviate poverty requires to look at the many ICT–enabled socio-economic opportunities that unfold at the micro-level, the case study methodology has been the most widely used to understand the linkages between ICT and poverty. Most case studies identified in this literature review illustrate the successful application of mobile phone technologies in transforming the lives and livelihoods of poor people. This is because for the vast majority of the low income population, mobile telephony has been the gateway to participate in and benefit from the information society. Examples of innovative and productive ways on how poor people have used mobile phones to gain their livelihood abound (see for example The UN Asian and Pacific training centre for ICT for development web site that provides a resources on how ICT tools have been used to reduce poverty, and what are the challenges faced and the lessons learned from such initiatives. Also, GSMA (a global association of telecommunication enterprises), has made available on its web site a databank of 'Mobile for Development Life Stories' that document how mobile telecommunications are changing the lives of the poor). The mushrooming of mobile phone businesses is the most evident consequences of the mobile revolution in Africa. In both urban and rural centres, shops selling and repairing mobiles and kiosk selling SIM cards are to be found on every main street. Internet café run by local micro-entrepreneurs are also becoming important social institutions (Hyvönen, 2012).

Examples of mobile phone applications that benefited poor people in LMICs are illustrated in Box 1 (GSMA, 2012). In the literature, areas that are reported to having had a good rate of success are: education, surveys and polling, agriculture, banking the unbanked, data analysis, and health (The Huffington Post- Technology section, 2013). Evidence of ICT4D projects that contributed to improve quality of life indicators, such as longer life, lower infant mortality and lower illiteracy through mobile telecommunications is available, although most of this evidence is limited to project level case studies (Waverman, 2005). For instance in the healthcare sector, m-health services in LMICs were positively correlated to behavioural changes that are key to reduce child mortality (Higgs, 2014). In the agriculture sector, mobile phones are facilitating access to agricultural market information as in Niger where the introduction of mobile phone services has brought about a reduction of 10-16% of grain price dispersion (Aker, 2010).

Mobile phones help poor people stay in touch with their relatives that migrate overseas or to urban centres or allow for cheaper and more secure cash transfer (Waverman, 2005). Several studies in rural areas of LMICs document how access to price information through mobile phone reduces the monopsony power in agricultural and fish market (Waverman, 2005). Similarly, drawing on an household surveys undertaken in Eastern Africa countries, a team of researchers supported by IDRC, investigated the impact of ICTs (mostly radio and mobile phone technologies) on the different

dimensions of poverty. The analysis shows a direct association between ICT access and poverty and the positive impact of ICTs on improving livelihoods of the poor (Adera, 2014).

Box 1. Examples of mobile phone applications that brought tangible benefits to the poor in LMICs

m-Agri. With nearly 65% of the population in SSA living on subsistence farming, access to vital agricultural information can help reduce the variability of crop yields. In Kenya, M-Kilimo, an helpline service established by the GSMA Development Fund, provides small-hold farmers with expert advice concerning: i) agricultural tips and efficient farming practices, ii) questions on plant and animal diseases and treatment, iii) agriculture-specific weather forecasts, and iv) market price information.

m-Banking. In Kenya in 2007 Safaricom's M-Pesa allowed low income groups to have access to financial services through mobile banking. While mobile money transfer service was the first to be launched, cash deposit and withdrawal were also equally successful in providing basic bank services to previously unbanked populations. Since the launch of M-Pesa the mobile money industry has further developed offering services such as savings accounts, agriculture insurance, pensions, health insurance, micro-finance loans and life insurance products. Following the success of M-Pesa, many other mobile operators launched similar services in Sub-Saharan African, including Ghana, Tanzania, Uganda, Nigeria and South Africa.

m-Learning. It potentially offers an inclusive and non-discriminatory access to general and technical education. Community Health Workers in the UN's Millennium Villages in Uganda, Rwanda and Kenya have access to m-learning modules on their mobile phones. Downloadable contents include vital information about reproductive health and care for new-born.

m-Health. With the lowest average life expectancy of any region in the world, SSA Africa stands to benefit most from ICT use in the healthcare sector. Mobile technologies are currently used to capture and analyse data for disease surveillance, provide remote diagnoses via telemedicine, support community health workers in gathering and managing health information, improve access to health education, coordinate drug and medical supply distribution. In Rwanda, the largest national mobile operator, i.e. MTN, Voxiva Inc. and the GSMA Development Fund developed a system that enables healthcare workers in the field to use mobile phones to collect real-time data related to outbreak of contagious disease, numbers of patients and drug stocks. In Ghana and Nigeria, systems have been deployed to fight counterfeit drugs.

m-Women. There is a sizeable gender gap in mobile phone ownership in middle and lower income countries. Female mobile phone users are reported to increase earning and professional opportunities. In Liberia the mobile operator MTN, recognizing that women represent an underserved market, offered gender-tailored tariff plans to encourage the uptake of mobile phone use amongst women.

Source: GSMA, 2012

ICT gender-targeted projects also report a good rate of success. It is generally reported that women can expect greater empowerment from ICT training and use as compared to their male peers (Heeks, 2010), although gender differences in accessing to ICT persist because of socio-cultural factors. There are many examples of how ICTs create opportunities to bridge the gender divide. In Bangladesh, Grameen Bank launched in the late 1990s a pioneer programme to provide women with a mobile phone to start their own business. Subsequent programme's assessment found out that these women were able to increase the income of their household up to 30-40% (ICRW, 2010).

2.5.2 Telecenters in reducing poverty

Beyond mobile phone technologies, another well-researched area in the ICT for development literature is related to the use of telecenters in reducing poverty. These can be either rural information centres,

governmental service antenna or IT training centres. Unlike the market driven penetration of mobile phone, telecenters have been mostly promoted by donors, NGOs and governmental organizations with the purpose of bringing internet access in remote areas and amongst poor communities. A survey of a number of telecenter networks undertook by UNCTAD found out that these structures are mostly used for educational and informational purposes and that those providing business-related services are more successful in supporting the livelihoods of the poor (UNCTAD, 2008). Telecenters seem thus to deliver more effective development outcomes when they provide value-added services that also address the existing skill and education shortages beyond providing subsidized or free internet access.

2.5.3 Findings from a capability approach perspective

Whereas a large part of the literature on ICT4D tends to align technological progress with economic growth and social development, some researchers investigated social exclusion in e-societies as examples of new forms of deprivation. Within this stream of literature, the existence of a technology per se is no guarantee of impact if people do not have the capacity to use it properly. As an example, a case study in the health sector in South Africa shows how a relatively good endowment of computers made little difference in service improvement, because of the low information literacy of the rural hospitals' personnel (Zheng, 2007).

The impact of ICT is indeed strictly linked to the local context and to a number of factors that pertain to both the user characteristics (e.g. general and technical skills and culture) and the macroeconomic environment (e.g. public policies). In this respect, the concept of digital poverty (i.e. lack of ICT goods and services) has been deployed to show the conditions upon which ICT can make a difference in the life of the poor. This concept integrates three dimensions that reduce ICT access and use amongst the poor, namely: affordability, capability and infrastructure deficiencies. Each dimension identifies a constraint to ICT access and use and creates a sort of divide amongst those that do not have access to ICT, those that have access to an ICT tool but use only the simplest functions, and those that have the resources and knowledge to use information technologies as a pathway out of poverty (Barrantes, 2007).

2.5.4 Contested issues

The large amount of case studiesfd shows that there is abundant evidence that mobile phone technology can help alleviate poverty, by providing services that were previously unavailable to poor and remote communities. However, there is less evidence that this technology can be used as a way to go out of poverty and especially as a driver for reducing inequality. Nigeria for instance is one of the Sub-Saharan African countries with the highest mobile phone penetration rate, yet the proportion of the population living below the poverty line has increased from 1980 to 2010 and changes in the Gini coefficient (i.e. a measure of statistical dispersion of income) from 2004 to 2010 also indicates that inequality is rising (Abiodun, 2013). This does not establish a correlation between ICT and income distribution, but shows that the mobile revolution in DCs face context-specific constraints that limit its systemic impact.

In particular, the greater potential for ICTs to reduce poverty and inequality rests on internet use which is however limited in LMICs by its access costs and skill barriers. The large arrays of activities that can be quickly processed through a smartphone and a broadband connection, are not possible with a simple featured mobile phone (Mascarenhas, 2010). The evidence provided in the section below suggests that there are still some relevant technical, financial and policy constraints for a more effective and widespread use of the internet in LMICs.

2.6 Constraints in the use of ICT in LMICs

As far as the mobile phone revolution keeps growing in LMICs, more and lower costs services are being developed. However, the further spread of ICTs in LMICs depends upon three interlinked factors (African Partnership forum 2008). First, an enabling environment, including general policy framework

and more specific frameworks that address the standardization gap and competition rules. Second, infrastructure endowment, including the building of new infrastructure and the maintenance of the existing ones and reliable electricity supply. Most ICT infrastructure are concentrated in urban settings and countries' interconnectivity is low (e.g. in Africa most internet exchange points are located outside the continent). The 2009 Africa Economic Outlook reports that Africa needs laptops, PCs, optic-fibre cables and mobile phones to fuel a communications revolution. Third, access, in terms of improving public access facilities and improving IT skills.

2.6.1 Policy and regulatory constraints

In LMICs, at the ICT policy and strategy levels, many shortfalls still remain. An assessment of the existing e-strategies shows important limits in the existing documents. For instance, SSA countries score high in the analysis of the linkages with overall development goals, but low in both providing implementation arrangements and setting adequate targets and monitoring framework (World Bank, 2006).

In developed countries, the impressive development of ICT infrastructure and services has been driven by increased liberalization and market competition, along with increasing private investments (World Bank, 2006). An econometric analysis covering 165 countries in the period 2001-2011, shows that competitive telecommunication markets have above the average penetration rate up to 1.4% and 26.5% increases in fixed and mobile broadband services respectively (ITU, 2013). Clear regulation and strong property rights, limited restrictions to market entry and infrastructure ownership, effective national regulatory authorities, governmental support to universal access to telecommunications services have all been instrumental to lay down the conditions for a digital revolution of business and society. However, evidence in developed economies also shows that competitive market alone are rarely providing the 'last mile' access to every subscriber, because of the high marginal cost. In this context, governments are having a key role in granting universal access to the internet through complementary actions including public investments or special price regulations (World Bank, 2009).

LMICs are still setting up national regulatory frameworks for telecommunications services. Most would benefit from encouraging competition in terms of both cheaper and better quality telecommunication services. There are many examples of regulatory constraints that reduce the opportunities for a more widespread and effective use of ICTs. For instance, restrictions on infrastructure competition are reported to limit the development of high-capacity backbone networks, high political and commercial risks hamper investment in wired infrastructure (World Bank, 2009). In order to allow extended e-commerce and e-banking activities, most LMICs still have to overcome the lack of trust in online business, remove legal impediments and develop regulations for proper protection of personal data (ITU, 2013). Other areas that are yet to be improved include the licensing and the taxation schemes.

In terms of ICT-related political and regulatory environment, Africa has the largest number of worst performing countries. According to the 2010 World Economic Forum and INSEAD's annual Networked Readiness Index (a composite index made of 54 indicators including the following themes: political and regulatory environment, business and innovation environment, Infrastructure and digital content, affordability, skills, individual usage, business usage, government usage, economic impacts, social impacts), 64% of African countries are ranked at the bottom quintile (Table 2). Countries at the bottom of the ranking suffer from similar dysfunctions, such as overregulated markets, inefficient political frameworks, poor educational and research systems, and low mobile and internet penetration rates (GSMA, 2011).

An example of a key regulatory bottleneck for increased mobile technologies use in Africa is the limited spectrum availability allocated to mobile services. As the volume of data traffic increase over the continent, the existing spectrum licenses are close to reach the network capacity and cannot allow for an expansion of services. Private operators are in need of better spectrum planning, licensing, pricing and

re-framing (GSMA, 2011). Last, but not least, widespread corruption is also hindering or making more costly the use of ICTs for businesses, as firms are asked to pay bribes for service licenses or telephone connections (World Bank, 2006). Process for granting licenses are also reported to lack transparency and to be excessively lengthy (GSMA, 2011).

Table 2. Network Readiness Index ranking for selected African countries (2013)

Country	Africa Rank	Global Rank	Country	Africa Rank	Global Rank
Mauritius	1	48	Tanzania	20	125
Seychelles	2	66	Swaziland	21	126
South Africa	3	70	Mali	22	127
Rwanda	4	85	Gabon	23	128
Tunisia	5	87	Algeria	24	129
Cape Verde	6	89	Ethiopia	25	130
Egypt	7	91	Cameroon	26	131
Kenya	8	92	Malawi	27	132
Ghana	9	96	Lesotho	28	133
Morocco	10	99	Sierra Leone	29	134
Botswana	11	103	Benin	30	135
Namibia	12	105	Burkina Faso	31	136
Gambia,	13	107	Mozambique	32	137
Zambia	14	110	Libya	33	138
Senegal	15	114	Madagascar	34	139
Uganda	16	115	Mauritania	35	142
Zimbabwe	17	117	Angola	36	144
Liberia	18	121	Guinea	37	145
Côte d'Ivoire	19	122	Burundi	38	147

Source: World Economic Forum, 2014

2.6.2 Insufficient infrastructure endowment

Another important obstacle to ICT uptake in low income countries is related to the general weaknesses of public infrastructure, especially unreliable and costly electricity supply. Because of limited electricity supply, costly diesel generators are used to power base stations. In Nigeria for instance the cost to run a base station can be up to USD 2,000 per month compared to USD 429 per month in India (GSMA, 2011).

As the number of mobile internet subscribers keeps growing in LMICs, there will be more need for broadband networks, both fixed and mobile, to support ICT services that require high-speed internet connection and high rates of transmission data, such as cable TV or enterprise or hospital data transfer. The quality of the network coverage is critical for access to mobile internet and differences between income country groups are striking (Figure 6).

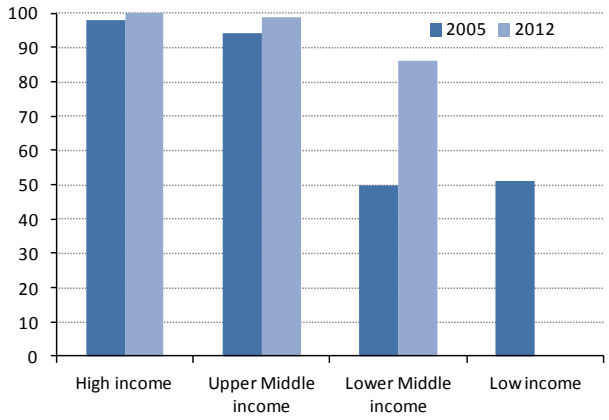
For instance, slow, unreliable, insufficient and expensive telecommunication services in most African countries prevents the region from better capitalizing on innovative applications and reap the full

benefits of a highly functional ICT sector. As an example, in the e-health sector, the transmission of a magnetic resonance imaging scan needs a large fixed-broadband connection with tens of Mb/sec, as the size of the file is so large that a mobile cellular network cannot be used, not even a 4G. Actually, even having a scan on a smartphone or a tablet would be useless, because the screen size and resolution would not be good enough. To be fully exploited, innovative applications and services need the appropriate infrastructure endowment, which is context- and scope-specific.

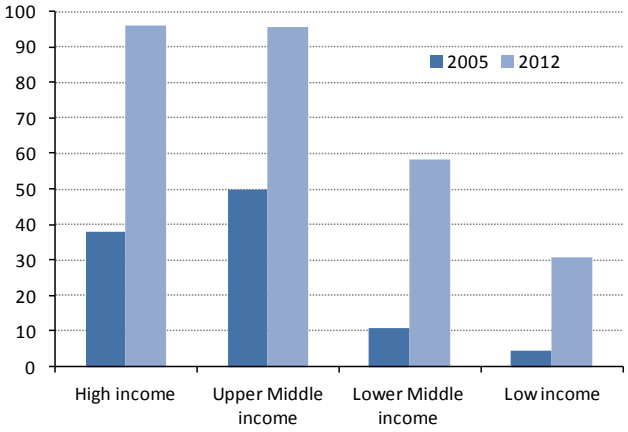
The commercial viability of broadband depends largely on the cost of backbone networks that have high fixed costs, but low variable costs. Investments are thus profitable when traffic volumes are large as in urban areas. According to GSMA, there are currently 707 mobile broadband (3G & 4G) networks worldwide, of which 422 are in the developing world. At present, 2G signal coverage exceeds 70% for all countries, whereas faster mobile broadband 3G/4G technology are developing mainly in potentially profitable areas, such as large cities and intercity corridors. In remote rural areas private mobile operators are highly concerned by the cost of maintaining and powering cell towers in remote off-grid locations, along with identifying appropriate solutions for powering off-grid cell towers with renewable energy (GSMA, 2014).

Figure 6. Quality of infrastructure among countries with different income (2012)

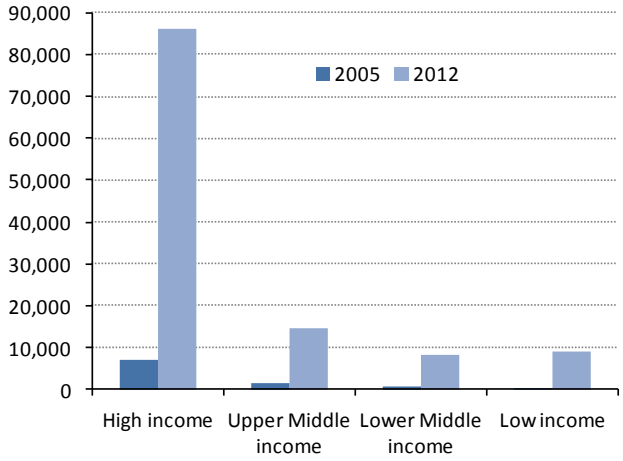
Population covered by a mobile-cellular network (%)



Fixed (wired)-broadband subscriptions (% of total internet)



International Internet bandwidth (bit/s per Internet user)



As of 1 July 2014, low-income economies are defined as those with a GNI per capita (calculated using the *World Bank Atlas* method), of $1,045 or less in 2013; middle-income economies are those with a GNI per capita of more than $1,045 but less than $12,746; high-income economies are those with a GNI per capita of $12,746 or more. Lower-middle-income and upper-middle-income economies are separated at a GNI per capita of $4,125. Note that low- and middle-income economies are sometimes referred to as developing economies. (Source: Word Bank website)

Source: World Bank, 2014

Contrary to common assumptions, there is extensive backbone network coverage in SSA, but its capacity has remained low due to the predominance of wireless technologies that were designed to carry voice traffic and are inadequate for high speed internet traffic. Fibre-optic backbone networks have mainly been developed in and between major urban areas and on international routes (World Bank, 2009). In SSA, it is estimated that the existing terrestrial backbone infrastructure can serve approximately three-quarters of the region's communications users, while the other one-quarter of the region's users utilize satellite technologies (UNECA, 2013). There are still countries which exclusively rely on satellite communication services for broadband connectivity (e.g. Chad, Sierra Leone, Liberia, Eritrea) and in most countries the international traffic is still carried out through more expensive satellite services even between neighbouring countries (ITU, 2013). Most importantly, there is a large geographical divide in terms of usage of the exiting bandwidth with 60% being consumed by five countries of Northern Africa.

2.6.3 Consumer constraints: skill shortage and affordability issues

WB pictured the demographic profile of the offline population across 20 countries and found out that 64% of the unconnected population lives in rural areas where people typically have poor communication and power infrastructure, lower incomes, and high illiteracy rates (World Bank, 2009). Youth, seniors and women are reported to be less connected than adult men. In particular, women account for 53% of the non-internet users versus 41% of the on-line population, and the gender gap can be up to 45% in certain parts of SSA. Illiteracy is also very common amongst offline population and accounts for nearly 28% of the unconnected groups (GSMA, 2014).

In low income countries, education shortages work at two levels to reduce the uptake of ICTs. Whereas the user-friendly technology of mobile phones has made them the most used ICTs amongst the poor, the widespread use of the internet remains a challenge. Internet users would need to master different skills such as technical, structural and strategic skills to be able to fully benefit from internet access (Mascarenhas, 2010). According to Torero and Von Braun (2006), technical skills refers to the ability to manipulate a technology, such as using a keyboard. Structural skills are linked to the capacity to understand contents and formats, while strategic skills implies to ability to select and prioritize the large volume of information available through the internet.

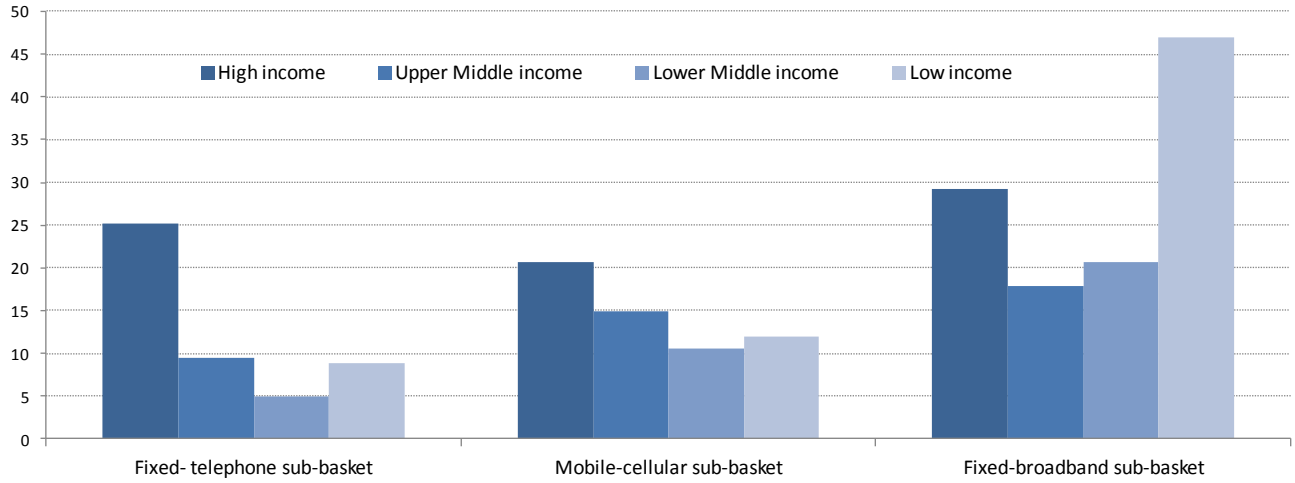
As the UNESCO Broadband Commission's Working Group on Education noted in 2013, education can no longer be separated from technology and technology literacy has to become an integral part of schools programmes from primary to tertiary education (UNESCO, 2013). Inadequate teachers' education in IT skills, lack of infrastructure, digital learning materials and access to networks are important obstacles to diffusing ICT literacy. This is even more relevant in LMICs, especially in mass primary and secondary education. Moreover, because in some LMICs, men are more likely to access to the internet than women, there is also the risk to create a digital skill gender gap that adds up to other forms of discrimination. Intel Corporation reports that in LMICs women have a reduced internet access by up to 25% as compared to men and 45% less in some regions of SSA (Intel, 2012).

Countries that most benefited from the internet revolution are those that managed to export goods in the IT sector and invented or produced innovative services (Kenny, 2003). Thanks to a large number of well-educated IT professionals, countries in Eastern and Southern Asia succeeded in becoming top exporters of IT products and services. Differently, sub-Saharan African countries are still plagued by low literacy rate and people with advanced technical and language skills are still too few. Countries with scarce IT-skilled labour force are confined to be ICT users rather than ICT producers. Another negative consequence of the ICT skill shortage is the limited capacity to assess returns and costs of using ICTs and the inability to retain ICT-skilled labour, especially for small businesses (World Bank, 2009).

Evidence shows that telecommunications services are highly valued in developed and LMICs alike. Both price elasticity of demand and income elasticity are high. As an example, a study of Indian household shows that a 1% increase in household income would double the demand for telecommunication

services (Waverman, 2005). Yet, affordability is still a key issue especially when considering that prices for the most advanced mobile and fixed telecommunication services are higher in LMICs than in developed countries (Figure 7).

Figure 7. Cost of access to ICT devices in developed and LMICs (2012)



Source: World Bank, 2014

The increased use of prepaid services led to high penetration rate of mobile phones in poor and rural areas, as these cards allow low-income consumers to make payments in small amounts. Increased competition amongst private mobile operators has also reduced the cost of calls. But pricing for internet access is still too high as compared to the average disposable income in most LMICs. In 2006 the internet price basket (e.i. the cheapest available tariff for accessing the internet) for SSA was about 62% of the average monthly per capita income, it was nearly 12% in South Asia, less than 9% in all other developing regions and only 1% in high income economies (World Bank, 2009).

2.7 Opportunities in the use of ICT in LMICs

Whereas some benefits of the mobile revolution have already materialized in the LMICs and succeeded in changing the life of people, most of the ICT potential remains to be fully exploited, especially for the lowest income groups.

Beside benefiting from the direct use of ICTs in a variety of services, LMICs also have the opportunity for developing their own ICT local industries and driving innovation in areas that are more relevant for reducing poverty and its consequences. Despite many LMICs are still at an earlier stage of widely adopting ICT in government, business and social services, by focusing on physical implementation of IT systems and networks, there are also opportunities for developing new and innovative ICT applications. As compared to other sectors, financial constraints for start-ups are less binding given the lower requirement for the initial capital investment. Human capital, and in particular IT skills, is much more relevant.

Countries with good ICT infrastructure, a well IT-trained and cheap labour force is likely to attract more offshoring, outsourcing, and foreign investment (World Bank, 2006). There are several examples of LMICs that have been very successful in IT services and ITES. India is a well know example of a middle income country that managed to build a competitive advantage in exporting ICT goods and services.

Other examples are the Mauritius and the Philippines that both prospered in specific market niches (UNCTAD, 2008).

The software industry in Africa is just emerging and is clustered in a limited number of countries including South Africa, Morocco, Egypt, Mauritius, Kenya and Tunisia. As an example, in 2010 Tunisia had already nearly 600 software firms with constantly increasing export turnover. Differently, the mobile revolution has opened a wider window of opportunities for African enterprises that developed applications that changed the delivery of financial, education and health services (UNECA, 2013).

The development of African content, produced by Africa for Africans is a good measure of the degree of appropriation of ICTs, and especially of its potential to influence societal and cultural changes (Dobra, 2012). The success of the Kenyan Safaricom's M-PESA in developing mobile money and mobile insurance is well reported, and inspired similar applications in other African countries (GSMA, 2011). Altough unbanked, clients of the mobile operator Safaricom, have been able to send and receive money through their mobile phone and to use it as an electronic wallet. As of March 2013, there were already 17.1 million Safaricom subscribers that were using the M-PESA services, making it one of the most impressive success stories in financial inclusion of the poor (Safaricom, 2013).

Similarly, a number of African private firms and not-for-profit organizations are supporting or developing software for various business and social services (Box 2). These ICT innovations are expected to revolutionize the African financial, agriculture and health sector. A study commissioned by the WHO revealed that about 75% of African countries are involved in m-health activities (UNECA, 2013). In agriculture, mobile technologies have enabled farmers to access real-time information on inputs, prices, market, reducing thus price dispersion and volatility (Aker, 2008).

Box 2. Examples of mobile value added services developed by African entrepreneurs

Finance: Pesa Pata by Paddy Micro Investment (Pesa Pata means 'get money' in Swahili): this is a mobile micro-loan facility that can be purchased in small shops or kiosk and allows to credit small amounts in the users' Safaricom M-Pesa account. These short term micro loans can be accessed in a few minutes and open many possibilities for micro-entrepreneurs.

Healthcare: Teleradiology by Medisoft East Africa Ltd: these are a set of technologies that allows radiologist to read medical images remotely saving time from scan to diagnosis and ensuring that a licensed radiologist interpret images. MedAfrica by Shimba Technologies: this is a vast, virtual library of medical information available on a smartphone. It can be used to validate doctors' credentials, identified specialized clinics, assist with identifying possible diagnoses and providing information on diet and drug related material. Cardiopad by Himore Medical: it is a computer tablet that enables to conduct remotely heart examinations such as electrocardiograms. Given the low number of cardiologists in Africa, this innovation has the potential to allow heart patient in rural areas to receive a prompt diagnosis.

Agriculture. AgriManagr by Virtual City Group: this is a mobile app that assists farmers and middlemen by automating produce purchasing transactions. It generates real-time information about purchases in the field including a complete report of the transaction (e.g. quantity, quality of the produce, the farmer's details, collection point, and the payment due).

Source: Africamentor.com

Furthermore, the growth of social media is providing many opportunities for reshaping the democratic landscape of most LMICs, promising to improve accountability and transparency of governmental actions. ICTs can be used as an instrument for citizens to retrieve information and monitor public

authorities in many different ways that include monitoring tools (e.g. Bunge SMS in Kenya, Mzalendo in Zanzibar), crowdsourcing tools (e.g. BongoHive in Zambia, Ushahidi in Kenya), participatory media (e.g. AFTIDEV, Global Voices), and platforms for debate in local languages (e.g. JamiiForums in Tanzania) (Dobra, 2012).

As compared to traditional media, such as the radio that has been extensively used as a tool for awareness raising about citizen rights, ICT applications for democracy offer a wider spectrum of possibilities where users move from a passive to a participatory stage. The role played by Facebook and Twitter in the Arab Spring in Tunisia and Egypt in mobilizing and organizing the public is very well reported (UNECA, 2013). Ushahidi, a web site initially developed to map reports of violence in Kenya after the post-election fallout at the beginning of 2008, has evolved into a global non-profit technology company aiming at using information flows to empower people.

2.8 Conclusions

In recent years, thanks to mobile telecommunication, LMICs have reduced their digital isolation, even if high rates of internet use and broadband services penetration remain a distinctive feature of developed economies. ITU reports that in 2014 the lion's share of mobile growth took place in LMICs, including SSA. Thanks to the mobile revolution, an unprecedented number of people gained access to information, became able to freely express their opinion to a large audience and managed to create new source of income and employment. In view of these unexpected developments, there has recently been renewed interest in supporting research that looks at the contribution of ICT for economic growth and poverty reduction.

This literature review confirms that the economic and social returns of ICTs in developed and LMICs alike are high, as telecommunications allow mitigating the negative effects of dysfunctional markets. When telecommunications services are used, markets are reported to work better, transaction costs are reduced and productivity increased. Countries with good IT infrastructures, an abundant IT-skilled labour force and business-friendly regulations, are those that most prospered from the ICT revolution in terms of increased national production, export, domestic and foreign investment, and new employment opportunities.

However, the evidence that explores the linkages between ICTs and poverty reduction is less developed. Most of the development discourse on ICTs is skewed towards assessing ICTs impact on growth and productivity. Even if ICTs contribute to economic growth it remains an open question how and if this ICT-enabled growth is going to be distributed at the micro level. In particular, whereas there is supporting evidence that by gaining access to ICs the poor can improve their living standards (e.g. gaining access to cheaper communication tools to stay in touch with distant relatives), there is scant evidence about the mechanisms that underpin the relationship between ICTs and poverty reduction.

As a matter of fact, the impact of ICTs on the life of the poor rests on a combination of technical, political and cultural factors. Mobile phones have become vital instruments in the life of the poor, but, as long as their use is limited to providing communication services, they will be less effective in moving people out of poverty. In this respect, access to the mobile internet would make a greater difference, as evidence shows that high penetration of modern ICTs can be a more effective driver of socio-economic development. Furthermore, the availability of ICT services reaches first the urban, better off and educated groups, while the urban poor and rural areas are less involved in the ICT revolution.

The number of LMICs that have been succesful in developing IT services and ITES and managed to get larger economic benefits is limited, and only a few is located in Africa (e.g. Tunisia, South Africa). Africa has the largest number of worst performing countries in terms of establishing a regulatory framework for ICTs. It also has slow, unreliable, insufficient and expensive telecommunication services that depend

on an inappropriate infrastructure endowment. This increases the cost of access to ICT for the poor and limit the possibility to develop IT-based services.

While rapid innovations in technology are making ICTs both less expensive and easier to use, limited capabilities and awareness reduce the potential of ICTs amongst the poor. Basic computer literacy is still not part of the primary education curriculum in most LMICs. The development of local contents and of applications designed to address the needs of the poor has also progressed more slowly. The degree of ownership of ICTs is also relevant to make LMICs less passive in introducing technologies that are not tailored on the needs of their populations. As far as ICTs remain a developed countries' domain, the benefits of it are limited because this creates a divide between producers and users of technologies to the advantage of the former. Most of the ICT potential remains thus to be fully exploited, especially for the advantage of the lowest income groups. However, the ICT landscape in LMICs is changing fast, and an increasing number of ICT applications, especially those based on the mobile phone technology, is being developed in these countries to meet specific local needs. The success of the Kenyan Safaricom's M-PESA in developing mobile money and mobile insurance is well reported, and inspired similar applications in other African countries. Finance, health and agriculture are the sectors where most applications are being developed in LMICs. At the same time, penetration of social media is providing an unprecedented opportunity for reshaping the democratic landscape of most LMICs, promising to improve accountability and transparency of governmental actions, and to increase participation in political decisions.

3. ICTs and health in LMICs

3.1 Introduction

Because LMICs are still facing the triple challenge of providing affordable, universal and quality health services, there is high interest in testing and applying on a large scale innovative approaches that might remove some of the constraints that plague already vulnerable countries (Lewis, 2012). The relevance of e-health for improving healthcare delivery, public health and health research is acknowledged among governments and international organizations (UN Foundation, 2010). In May 2005, the Fifty-eighth World Health Assembly adopted a resolution establishing an e-health strategy for the WHO and urged member countries to adopt appropriate plans and measures for integrating e-health services in their country health systems. However, a robust body of evidence on the effectiveness of e-health interventions on the large scale is still not available (Tomlinson, 2013).

This report looks at the recent trends in the use of ICT in healthcare in LMICs. It also identifies and summarizes the existing evidence of applying e-health initiatives in LMICs contexts for the purpose of identifying issues of interest for development policy-makers, including what works and what can be sustainably implemented at the national level.

The chapter is organised as follows: section 2 illustrates the methodology to identify the relevant source of evidence. Section 3 provides a description of healthcare needs in LMICs. Section 4 provides a definition of e-health and its sub-sectors: HISs, m-health, telemedicine and e-learning. Section 5 focuses on the state and trend of e-health; section 6 illustrates the impact of applications of ICTs in healthcare in LMICs. Section 7 focuses on the main challenges and barriers for furthering ICT use in healthcare in LMICs. Finally, section 8 summarizes the conclusive remarks.

3.2 Methodology

The literature analysed for this report includes both policy-relevant studies commissioned by donors or international organizations, scientific literature identified through an electronic systematic search using open access archives such as PubMed and GoogleScholar, and academic journals available under subscription. Priority was given to systematic reviews of peer-reviewed articles that already summarize a vast array of impact evaluation studies of e-health use. However, when deemed relevant, single case studies, especially when related to donor interventions, were reported to learn lessons from past practices.

The research strategy in PubMed was based on key words that combine e-health relevant terms, such as telemedicine, EHR, HIS, m-health with words that limit the research to the geographical scope of the present study (e.g. LMICs, DCs, Africa, limited resource settings, poor countries). The word review was also added to identify review studies. A snowball technique was also used to search additional and relevant scientific literature that could not be identified through the key word search. Some evidence from developed or upper middle income countries was also included to document specific issues related to constraints to implementing ICT in healthcare when information was not available in LMICs contexts. A separate key word search was then performed to focus on articles that address constraints to introducing ICTs in the healthcare system of LMICs. In particular, the combination of words limitations, constraints, obstacles, e-health, telemedicine, m-health and LMICs was used.

Using similar key words, a search strategy for grey literature was performed to retrieve information from relevant sources, such as the WHO and other donor publications. Whenever possible, the search was limited to the most recent published articles, given the fast changing landscape of the e-health sector. The search for articles was limited to literature published in English.

As the present review does not have a specific focus, in terms of e-health technology used or health problems addressed, it cannot be comprehensive. Therefore the research strategy was set to identifying a sufficient body of evidence that can underpin policy recommendations for donors once combined with other more general research and discussion papers related to the introduction of ICT in the healthcare systems of LMICs.

Different data sources had to be used to document recent trends in the uptake of ICT within the healthcare sector of LMICs, because there is no single repository of information on e-health statistics. The Global Observatory for e-health of the WHO (available on line at http://www.who.int/goe/en/) is the main source of data and information used in this report. This source has the advantage of providing comparable standards and definitions across developed and LMICs, and of presenting data per income groups. It also has nearly global geographical coverage. Because most of the innovation in the e-health sector is generated in the private sector, WHO data were integrated with other sources such as the Center for Health Market Innovation Database that collects information on innovative health programmes in LMICs, and reports prepared by market research consultancy companies, such as IDC or PwC (Piai, 2014; PwC, 2012).

3.3 Healthcare needs in LMICs

Most of the attention of the international community to health issues in LMICs has been driven by three health-related MDGs to be achieved between 1990 and 2015. These are: i) reduce child mortality by two thirds, ii) reduce by three quarters the maternal mortality ratio and iii) halt and begun to reverse the spread of HIV/AIDS and the incidence of malaria and other major infectious diseases. These objectives are then articulated into sub-targets and have the merit of having channelled resources into three of the most important threats to life in LMICs.

The UN, reporting progress on the MDGs, indicates that none of the health-related MDGs has yet been attained, but remarkable progress has been made in certain areas, resulting higher life expectancy indicators. Between 2000 and 2013, nearly 3.3 million deaths from malaria were averted and 90% of those were amongst children under the age of five living in SSA. About 22 million lives were saved fighting tuberculosis worldwide. Child mortality has been halved and the maternal mortality ratio dropped by 45% (UN, 2014).

However, progress has been uneven across developing nations and many dire conditions still threaten public health. As an example, four out of every five deaths of children under age five occurs in SSA and Southern Asia, the majority of deaths having been caused by infectious diseases (malaria, diarrhoea and pneumonia) and malnutrition. Maternal mortality in developing regions is still fourteen time higher than in developed nations. Although most maternal deaths are preventable, access to skilled health workers for antenatal check-ups is still a challenge in some regions being 50% in SSA and only 36% in Southern Asia.

While most of donors and governments efforts went in the direction to prevent communicable diseases, an increased incidence of chronic diseases has been reported in LMICs. The World Diabetes Foundation predicts 80% of all new diabetes cases will originate from LMICs by 2025 (UN Foundation, 2010). The combined effect of communicable and chronic diseases is often reported as double burden for LMICs (Kahn, 2010). Finally, unpredictable events, such as flooding or earthquake, and social unrest, overburden LMICs even further (World Bank, 2011). In the lack of a safety net and prompt emergency response, people are more vulnerable to the spreading of infections and inappropriate hygiene conditions. Neglected tropical diseases, such as rabies and leprosy, also plague the health systems of LMICs (UN Foundation, 2010).

Confronted with such challenges, the health systems of LMICs proved inadequate to provide an effective response. Lacking financial and human resources, LMICs health systems have many limitations in terms

of universal access, treatment quality and affordability, behavioural norms, access to medical information and high quality research, and bridging the sanitation gap. The shortage of healthcare workers, exacerbated by the brain drain to industrialized countries, is often mentioned as a key obstacle to develop national health systems. As an example, with a majority of population residing in rural areas and too few health workers, Africa countries, with the exception of Egypt and South Africa, have less than two physicians per 10,000 inhabitants (PwC, 2012). It is in such a context that e-health has brought about many expectations concerning the possibility to overcome the constraints of geography, limited human and financial resources, along with an increased burden of chronic diseases (World Bank, 2011).

3.4 A definition of e-health and its sub-sectors

There are many different definitions of e-health and of its sub-categories. The WHO simply defines e-health as 'the use of information and communication technologies for health' (WHO, 2015). However, a systematic review of literature of used definitions of e-health identified 51 different definitions created out of a different balance of the concept of health, technology and commerce. Interestingly, all definitions bear a positive attitude towards e-health describing it with efficiency, enabling and enhancing functions, whereas none of the published definitions suggests that e-health might be disadvantageous (Rizo, 2005). Most definitions place e-health as a category of medical informatics, characterized by a predominant use of networked information and a lesser use of hard technologies, such as equipment and robotics (Pagliari, 2005).

Table 3. Definitions of Health information system, m-health, telemedicine, and e-learning

Name	Definition	Main categories	Ref.
Health Information System	All technologies that apply electronic patient information systems to collect, store and share information about patients.	1) Electronic medical records; 2) Electronic health records; 3) Personal health records.	WHO, 2012
m-health	An emerging term for medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, PDAs, and other wireless devices.	1) Education and awareness; 2) Health conditions remote monitoring; 3) Remote data collection for HIS; 4) Communication and training for healthcare workers; 5) Disease and epidemic outbreak tracking; 6) Diagnostic and treatment support.	WHO, 2011b; UN Foundation, 2010
Telemedicine	The delivery of health care services by all health care professionals using ICTs for the exchange of valid information for prevention, diagnosis and treatment of diseases, for research and evaluation and for the continuing education of health care providers.	1) Teleradiology to transmit digital radiological images; 2) Telepathology for transmission of digitized pathological results; 3) Teledermatology; 4) Telepsychiatry.	WHO, 2011c
e-Learning	The use of ICTs in education to remove barriers to distance.	In relation to the healthcare sector: 1) development of digital libraries and repositories offering medical information; 2) provision of medical education at the undergraduate and graduate level and for upgrading medical competencies.	Al Huneiti, 2014

The development literature on e-health does not either provide a clear indication of what is meant by e-health, but is similarly focused on the internet and mobile technologies as instruments to improve health care delivery. These technologies are meant to exchange medically relevant information using different forms: audio, coded data, text, images and video. They are generally used to support health education and clinical decision making, put in place health management information systems and health surveillance systems, foster public health related behavioural changes, and provide remote diagnostics and disease management (Piette, 2012). There is a vast array of e-health services that can be classified following different categories of users, technologies (i.e. platforms), mechanisms for data transmission and expected benefits, and no commonly agreed definitions. Furthermore, as the convergence of mobile and internet technologies increases, there are also less clear-cut boundaries between the different uses of ICT in healthcare (World Bank, 2011). For instance, mobile technologies are increasingly becoming more relevant for registering patient data in HISs (WHO, 2012).

Four macro-categories are consistently used throughout this report, and summarised in Table 3.

3.5 State and trend of e-health

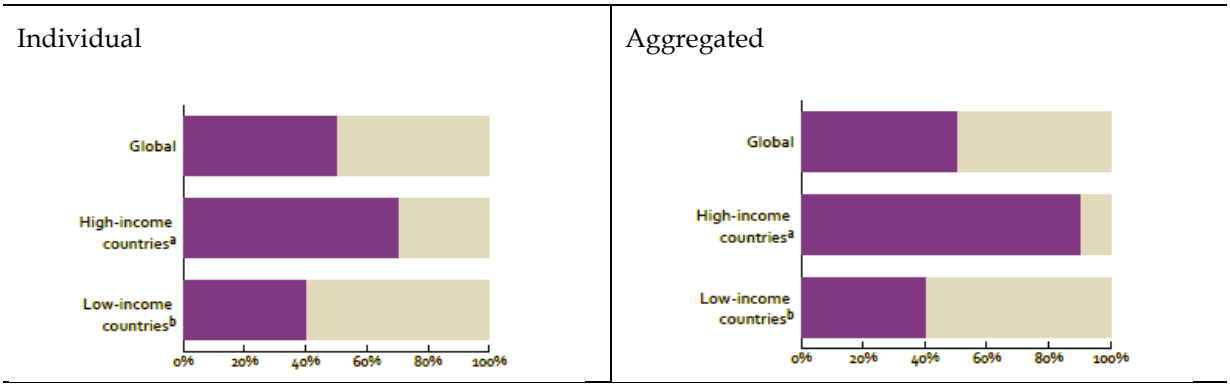
As in most ICT sectors of application, e-health has been displaying an impressively dynamic landscape in both developing and developed countries. In developed countries e-health services are driven by three factors: i) the shortage of healthcare professional in front of ageing populations; ii) rising healthcare costs and iii) increased burden of chronic illnesses. Conversely, the most important advantage of e-health in LMICs, and especially telemedicine and m-health, is the improved access to healthcare (Wootton, 2010). Because e-health includes different technologies and services, and its definition is contested, comprehensive and geographically comparable empirical information of e-health is hard to find. Comparison across different studies on the use of specific e-health services and technologies is also hard to make, as the category of use or purpose of the targeted e-health service is differently defined. The use of e-health applications varies following countries' economic development. In LMICs most projects were driven by the MDGs goals. For instance, in these countries, m-health has been largely deployed in maternal and child health, HIV/AIDS, malaria, and tuberculosis (WHO, 2011a).

Looking at Center for Health Market Innovations' database (a digital platform storing information about health projects in LMICs), Lewis identified 176 ICT-enabled projects out of 657 programmes in LMICs. The researchers found that the percentage of programmes using ICT increased from 8% in 1991-1995 up to 43% in 2006-2011. In relative terms the five health areas with the highest percentage of ICT-enabled programmes were in order: emergencies, tuberculosis, mental health, malaria, and primary care. In terms of purpose behind the use of the ICT, removing geographical barriers to healthcare access was by far reported as the main driver to change. About 47% of the programmes included in the sample relied on donor support (Lewis, 2012). The following sections provide more in-depth analysis about the current use of ICT in specific e-health services: HIS, m-health, telemedicine and e-learning.

3.5.1 Health information systems

The transition from paper-based systems for collecting medical information to an electronic one is globally progressing. However, high-income countries that have more advanced ICT infrastructure are reported to have well advanced in the transition from a paper-based system for medical data collection and storage to an electronic system (Figure 1). With the exception of Brazil, India and China, LMICs struggle to find the necessary financial and human resources to scale up HIS at the national level. However, some low income countries managed to implement local patient information system (WHO, 2012).

Figure 8. Use of paper and electronic formats for individual and aggregate patient data at the national level by income group



Source: WHO, 2012 "Management of patient information, trends and challenges in Member States. Based on the findings of the second global survey on e-health "Global Observatory for e-health series" v.6
Note: World Bank Income Group High Income includes both high income and upper middle income countries.
Purple: adoption of electronic system; Grey: paper-based.

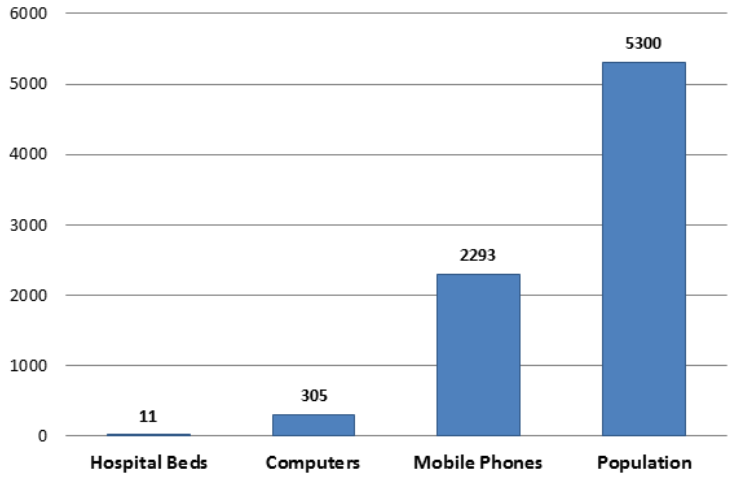
Globally, collection of patient information at first point of care is still overwhelmingly done on paper (i.e. 90% of countries surveyed by the WHO Global Observatory on e-health) (WHO, 2012). However, there is a large variability across countries depending on their income. Nearly 50% of high income countries report a very high or medium use of electronic information systems, while the same figure for low income countries is a mere 4%. Geographically, the African Region and the South-East Asia Region are reported to be the most dependent on paper-based medical reporting (WHO, 2012). Generally, the use of HIS for aggregated data is larger, as these are considered more valuable data at the institutional and policy level for disease monitoring and management of interventions (WHO, 2012).

In an analysis of the HIS landscape in 19 LMICs focusing on efforts to create national HIS that integrate different critical health-related data, a number of common features of these systems were identified. These include the relevant fragmentation and duplication in data collection, the low interoperability across systems, and the large administrative workload generated by the introduction of electronic records. Moreover at the early stage of implementation of HIS, these are more oriented towards informing policy rather than improving care at the point of service (Vital Wave Consulting, 2009).

3.5.2 M-health

This is the e-health application that has recently seen the most impressive growth, especially in LMICs thanks to high penetration rate of mobile telecommunication technologies that in many LMICs reach further than other infrastructure, such as hospital beds or computer (Figure 9).

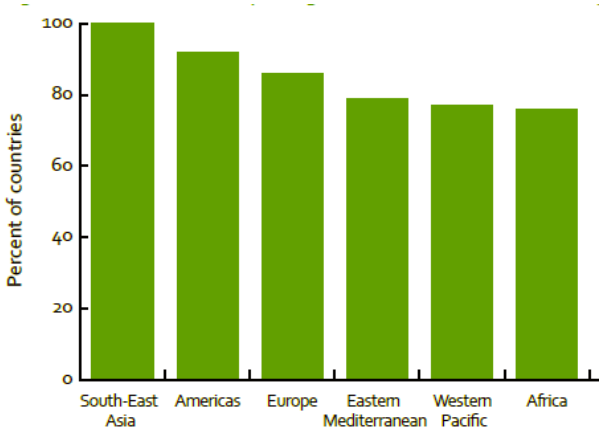
Figure 9. Comparison between access to ICT and access to hospital beds in LMICs (millions)



Source: United Nations Foundation and Vodafone Foundation, 2010

In spite of country differences in deploying m-health services, these can be considered a global phenomenon. More than 80% of the countries taking part to the Global Survey on e-health launched by the WHO in 2009, reported to have at least one type of m-health service (Figure 10). Of these, three quarters reported four or more types of m-health initiatives. That figure might well underestimate the number of actual m-health initiatives, given that local and informal projects might not have been registered at the national level (WHO, 2011b).

Figure 10. Percentage of countries reporting at least one m-health project, 2009

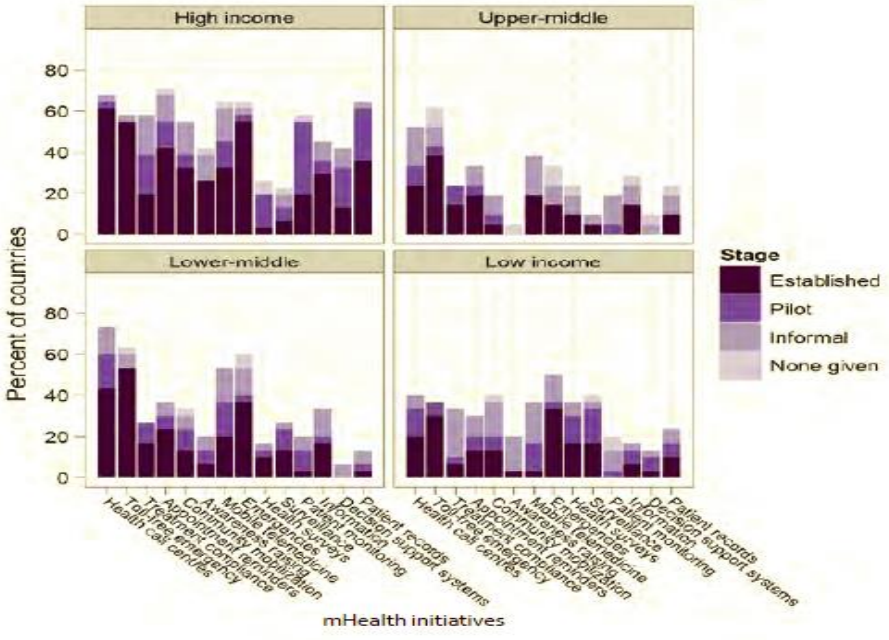


Note: WHO regions

Overall, the most frequently reported initiatives were those based on the core voice functionality of mobile phones, such as health call centres/healthcare telephone help lines (59%), emergency toll-free telephone services (55%), and emergencies (54%). Mobile telemedicine follows with 49% of reported initiatives, whereas health surveys (26%), surveillance (26%), awareness raising (23%), and decision support systems (19%) were the last frequently reported programmes. Some important differences across income country groups were noticed (Figure 11). In particular, low income countries have a higher use of

m-health technologies for the purpose of health survey, community mobilization and surveillance. (WHO, 2011b).

Figure 11. Use of e-mobile services by income group, 2009

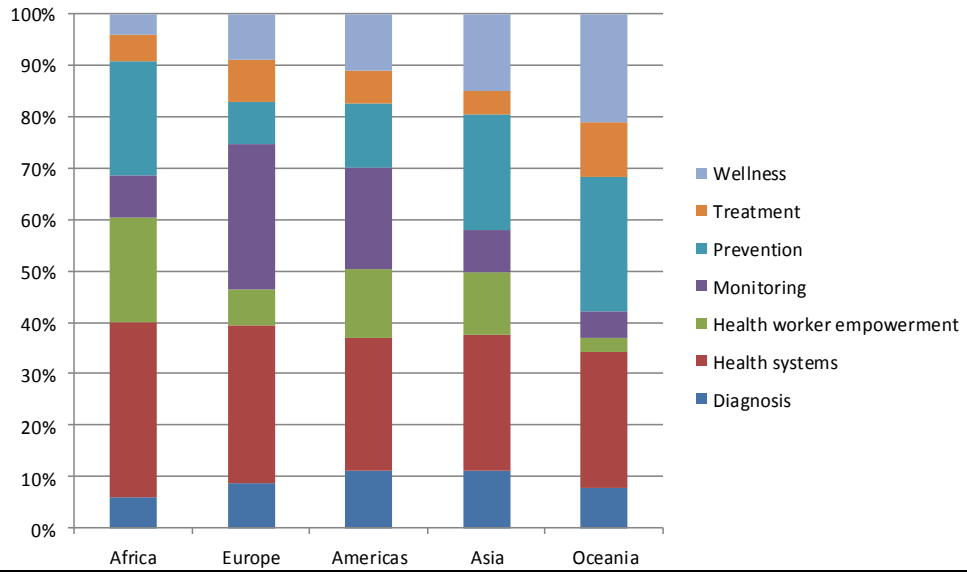


Source: WHO Global e-health survey, 2009. Note: World Bank income group

Using the GSMA Connected Living Tracker (a digital platform that maps mobile-enabled products and services), it is possible to extrapolate different categories of m-health deployment by region (Figure 12). Interestingly, at the end of 2014, the African region has the highest number of m-health initiatives recorded (436), followed by the Americas (315) and Asia (251). Data confirms a higher prevalence in the use of m-health for monitoring purposes in developed regions, whereas in developing regions m-health solutions are most used in prevention and strengthening of health systems.

In terms of future market development, Europe (30%) and Asia-Pacific (30%) are estimated to be the largest market for m-health services, followed by North America (28%), Latina America (7%) and Africa (5%) (PwC, 2012). In LMICs, the m-health landscape is highly fragmented, and most of the programmes terminate at the end of the pilot phase. For instance, between 2008 and 2009 there were 23 m-health initiatives in Uganda that could not be scaled up, and 30 m-health programmes in India that proved to be unsustainable beyond the pilot phase (Lemaire, 2011). Whereas in LMICs m-health applications are mostly provided through donor or governmental support, in developed countries the m-health application market has already started the commercialization phase (Research2guidance, 2014).

Figure 12. Deployment of m-health solutions by different regions, 2015



Source: Author's elaboration from GSMA Connected Living Tracker (http://www.gsma.com/connectedliving/tracker/)

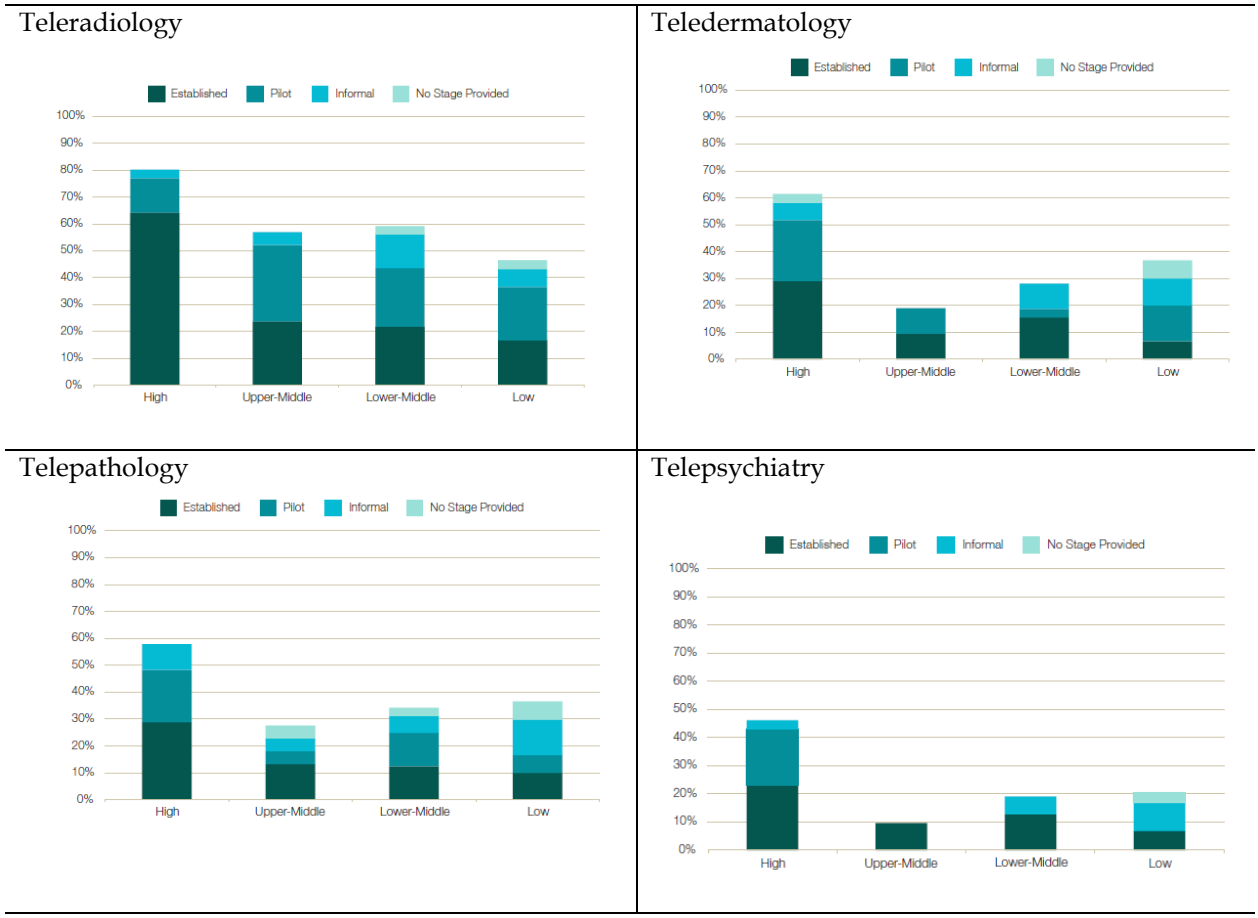
Globally, monitoring services, that are those offered to elder and chronically ill people, are expected to growth at the highest pace (PwC, 2012). Diagnosis services are expected to expand fasted in LMICs, to meet the paucity of health workers (Figure 13) (PwC, 2012).

Figure 13. Estimated expenditures by e-health service categories in various regions of the world, 2017

3.5.3 Telemedicine

Telemedicine applications can be divided into two types, depending on the way information is transmitted. These are: synchronous (i.e. real time), and asynchronous (i.e. store-and-forward). (Delaigue, 2014). Globally, the use of telemedicine has recently seen a remarkable increase. A recent study of IHS, a private market research company, predicts that the global number of patients treated trough telehealth, actually a sub-category of telemedicine, is set to growth ten times from 2012 to 2018 (IHS, 2014). Technological progress, such as the decreasing costs of ICT and the increasing penetration of mobile internet, has made the expansion of telemedicine in LMICs more promising. Moreover, basic store-and-forward e-mail-based telemedicine requires minimal hardware and software investments and can be implemented even with low bandwidth service availability (WHO, 2011c).

Figure 14. Use of telemedicine services by income groups, 2009 survey data



Source: Global Observatory for e-health, 2011; Note: World Bank income groups

In developed countries most telemedicine services focus on diagnosis and clinical management and have been integrated in the health systems. Progress is also being made towards an introduction of biometric measuring devices to monitor chronically ill patients. Differently, telemedicine applications were primarily introduced in LMICs to link healthcare facilities to connect local care centers with referral hospitals (WHO, 2011c). Given the limited availability of suitable telecommunication network in LMICs, clinical telemedicine has remained limited to the use of email or web messaging and little use of video conferencing has been made (Wootton, 2011).

Telemedicine is being applied in many medical areas, but is globally more common and recognized in four areas: teleradiology, teledermatology, telepsychiatry and telepathology. A survey administered by

the WHO in 2009 found out that telemedicine services tend to be more established in industrialized countries as compared to LMICs, with teleradiology being the most integrated practice (Figure 14).

Geographically, South-East Asia is the leading region in all four areas of telemedicine explored by the survey. Europe and the Americas are the two other regions with the highest percentage of established telemedicine services. The survey's report also estimates that high income countries are more likely to have a more rapid expansion of telemedicine due to the high number of countries piloting new telemedicine services (WHO, 2011c). Besides the four above mentioned services, other telemedicine services were also reported to be offered within countries. These include cardiology and electrocardiography, ultrasonography, mammography, and surgery (WHO, 2011c).

3.5.4 e-learning

Thanks to the increased diffusion of Internet, the number of online resources has kept increasing, including repositories and libraries for medical education (e.g. MedEdPortal, the Health Education Assets Library) (Masic, 2008). However, scant evidence is available on the general trends of e-learning in medical education in LMIC context. Available references focus on specific cases with a local relevance, that makes them not informative of general trends. This is however a quite promising area of development given that LMICs face the two-fold challenge of a shortage of faculty and the need to increase substantially medical doctor graduation rates. A review of articles addressing the use of e-learning in LMICs, shows that e-learning is being used by a variety of e-health workers with a predominance of physicians (58%), followed by nurses (24%), pharmacists and dentists. Most articles reported the examples of middle income countries, such as Brazil, India, Egypt and South Africa (Frehywot, 2013). E-learning initiatives are underway in Africa and mostly concern the tertiary sector, but most African countries lack of a policy and legal framework that rules the use of ICT in education. As a consequence most e-learning initiatives remain scattered and disparate. Initiatives also concentrate in urban areas where most tertiary institutions are located, and are severely constrained by accessibility to fast speed internet (ICWE, 2015).

3.6 Impact of applications of ICTs in healthcare in LMICs

3.6.1 Evidence from Health Information Systems

Evidence on the implementation of HIS in LMICs is scarce and fragmented. Three systematic reviews of HIS in LMICs for different functions were identified (Tomasi, 2004; Oluoch, 2012; Blaya, 2010), along with a study documenting the use of HIS in ten SSA countries (Foster, 2012). A summary of major outcomes of these articles is illustrated in the Table 4. Comparability of HIS studies is severely limited by different interpretation of sector definitions. Some reviews have a limited focus (such as on primary care or HIV treatment), whereas others attempt to provide a more general overview of using HIS in healthcare systems.

Foster analysed the HIS development in ten SSA countries (Angola, Botswana, Ethiopia, Ghana, Kenya, Nigeria, Tanzania, Uganda, Zambia and Zimbabwe), with a mix of literature review and communications with ICTs experts. All of the countries show at least some evidence of implementation in HISs, even if it is fragmented. There is limited evidence of electronic health records used to support patient care and the implementation effort in this category is largely in public health, disease surveillance and vital registration. Support of patient care appears to be largely program-specific (e.g. for the care of HIV patients) (Foster, 2012).

Tomasi *et al.,* reviewed the use of HIS in primary health care. With regard to EPR the main conclusions are related to the maintenance of privacy and confidentiality. The interconnection between different systems is another relevant issue. The finding of a low level of adhesion among physicians to protocols for computerization is almost ubiquitous. A substantial number of the articles reviewed stressed the

need for continued motivation and training for all team members as an important requisite for the success in this area. Another common conclusion was the difficulty of finding adequate methods for evaluation (given the variety of applications and contexts in which IT is used). The results of specific evaluations lack external validation, because health services are extremely variable (in terms of population seen, specific activities, etc) and this hampers comparability. In the consideration of CDSS in particular, emphasis has been placed on quality and safety concerns. The main problems of such systems include the difficulty in addressing complex conditions, the profusion of different systems with different formats, and the need for training and support (Tomasi, 2004).

Table 4. Summary of the articles reported about HIS use in LMICs

Ref.	Objectives	Conclusions
Tomasi, 2004	Use of HIS in primary health care. Period: 1992-2002. Studies included: 52 (10 on EPR, 22 on PPAEM, 20 on CDSS)	When compared to paper–based registration systems, EPR delivered greater accuracy, reduced errors, quick access to the patient's data. PPAEM systems were reported to offer advantages in terms of reliability, speed and optimization of resources. The most reported advantage of CDSS was the adherence to standardized protocols. Too many differentiated evaluated methods due to the enormous variety of applications and contexts in which ICTs is used
Blaya, 2010	Implementation of HIS in different functions. Period: 1991-2009. Studies included: 15 qualitative and 40 quantitative studies.	The following functions were reported to bring positive effects: the possibility to reduce errors in laboratory and medication data, the ability to track patient throughout the treatment period, the possibility to collect clinical and research data and to label and register samples and patients, and the reduction in communication time within and between institutions support system. Studies identified were mostly qualitative and descriptive. The number of randomized trails is still limited, but increasing in recent years.
Foster, 2012	HIS development in ten SSA countries. Period: 2008-2012. Review based on country assessment.	There is limited evidence about the use of EHR to support patient care, while most systems are built for public health, diseases surveillance or vital registration purposes.
Oluoch, 2012	Use of EMR for CDSS in HIV care and treatment. Period: 1995-2011. Studies included: 10 in SSA, 2 in the Caribbean	Mixed evidence about the effectiveness of EMR-based CDSS. General reported benefits were the increase in time spent with patient, reduction in data errors and decreased patients' waiting time. Technical infrastructure problems and clinicians' limited computer skills are key impediments to the implementation and effective use of CDSS. None of the papers described a strong (randomized controlled) evaluation design.

Oluoch *et al.,* reviewed the use of EMR for CDSS in HIV care and treatment. Studies reported reduction in data errors, reduction in missed appointments, reduction in missed CD4 results and reduction in patient waiting time. Technical infrastructure problems such as unreliable electric power and erratic Internet connectivity, clinicians' limited computer skills and failure by providers to comply with the reminders are key impediments to the implementation and effective use of CDSS. Benefits of EMR-based CDSS in resource poor settings cannot be generalized due to limitations of few studies conducted. Barriers to implementation of EMR-based CDSS should be addressed before their impact on quality of

care can be realized. The review concluded that rigorous evaluations are needed to draw conclusions on the impact of CDSS on clinical process and outcome measures (Oluoch, 2012).

Blaya *et al.,* evaluated the implementation of HIS in different health functions. Benefits were shown in systems that track patients through treatment initiation, monitor adherence, and detect those at risk for loss to follow-up; tools to decrease information communication times within and between institutions, as well as errors in reporting laboratory data; barcoding for patient identification cards and laboratory samples; handheld devices for collecting and accessing data; and the ordering and management of medications. Because of the lack of infrastructure and backup systems in LMICs, better designed e-health solutions may have a much larger impact. The review concluded that as e-health becomes widespread in LMICs, impact will need to be identified by more rigorous independent follow-up evaluations (Blaya, 2010).

In spite of the great variability of the systems in use and of the evaluation methodologies employed, there seems to be convergence in the literature about the advantages of adopting HIS in limited-resource country settings, in terms of improving the speed and accuracy of some regular processes within health centers. However, the literature also shows a lack of studies that rigorously evaluate the impact of the use of these systems on quality of care, and also emphasizes the lack of proper economic assessment. These systems are also reported to have a limited outcome in areas where data quality is notoriously poor. The small scale of implementation is another limitation given that these systems are not designed to integrate the community-level information with other regional or national information system (Piette, 2012).

3.6.2 Evidence from m-health

The use of m-health in LMICs was triggered by two key factors: the high penetration rate of mobile phones amongst all income groups, and the reliability and easiness of use of simple featured mobile phones. Furthermore the growing ubiquity of mobile phone makes it a suitable technology for reaching out patients living in remote areas poorly connected to healthcare infrastructure (UN Foundation, 2010). Generally, in LMICs, m-health initiatives are reported to bring about benefits in terms of increased access to healthcare and health-related information, increased awareness on public health issue, improved ability to diagnose and disease surveillance, increased access to medical education and training (UN Foundation, 2010). In spite of rapid introduction and proliferation of m-health pilot initiatives in LMICs, there are few reviews of the outcomes of mobile phones in healthcare in LMICs (Tomlinson, 2013; Beratarrechea, 2014). This study report a number of them, summarised in Table 5.

Peiris *et al.,* examined the ability of m-health interventions to improve health care quality in LMIC settings for non-communicable diseases. The review included 24 studies, the majority from middle-income country settings. The most common disease areas were either diabetes or cardiovascular diseases. Thirteen studies tested specific m-health interventions, but only seven used a RCT design with the remainder using quasi-experimental designs. A number of key findings were observed from this review: i) m-health for non-communicable diseases remains an under-explored area, with a limited number of quality studies; ii) despite m-health having a wide variety of applications, studies so far are dominated by behaviour change interventions through use of text messaging systems. Few studies have applied m-health tools as a means of strengthening health systems; iii) although the studies that have reported effectiveness are encouraging, few have examined outcomes across multiple dimensions of health care quality, and none have looked at equity and safety issues. Finally, iv) there is a shortage of process evaluations to understand the contextual factors that promote or hinder effectiveness of the interventions (Peiris, 2014). The review recommends four areas to improve the m-health research agenda: i) to do comparative studies examining m-health versus other health care strategies; ii) to implement multinational studies powered on clear clinical endpoints; iii) to make an economic evaluations of effective and failed interventions in m-health; iv) to examine policy-level barriers to

largescale adoption of promising m-health interventions. Related to this, the Authors suggests a greater engagement with policy makers in study design and implementation is order to ensure that interventions can be integrated with existing national and local initiatives (Peiris, 2014).

Hall *et al*., carried out a review study of the health impacts of m-health interventions. For the purposes of the review, health impacts were defined in terms of measurable changes in mortality, morbidity, disability adjusted life years, and improved disease detection rates. The results show that there is a growing evidence base for the efficacy of m-health interventions in LMICs, particularly in improving treatment adherence, appointment compliance, data gathering, and developing support networks for health workers. However, at present, there is very limited evidence on its effects within health systems. Such evidence concerns pilot studied and small-scale implementation projects (Hall 2014).

The report carried out by Zhenwei Qiang, is not a systematic review, but a large and interesting report which include extensive case studies of three countries, Haiti, India, and Kenya. The major conclusions are the following: i) health systems usually do not provide the impetus for the development of m-health interventions. Instead, their development is usually driven by people adept with technology, members of NGOs, and private enterprises; ii) many services are not built for scale but rather for small pilots intended to demonstrate proof of concept. Few m-health interventions have shown the capacity to serve millions of people because of fragmentation in financing, partnerships, and health systems; iii) in order to overcome barriers to sustainability will be important to replicate and expand successful models; iv) promoters of m-health services should create business models that can be replicated and expanded. M-health will grow faster if public and private stakeholders recognize the role of strategic financing and interventions; v) m-health services are much more powerful when organizations in the health sector make their health information systems interoperable. This can only happen through cooperative efforts to standardize and connect the systems of governments, other large funders, and private healthcare providers; iv) LMICs have to enhance literacy and training in ICTs and in health, and health workers will need new skills to use m-health services (Zhenwei Qiang, 2011).

Deglise *et al.,* examined SMS-supported interventions for prevention, surveillance, management and treatment compliance of communicable and non-communicable diseases in LMICs. The Authors assessed the use of SMS messages for disease prevention, surveillance, self-management and compliance. A total of 98 applications fulfilled the inclusion criteria: 33 prevention, 19 surveillance, 29 disease management and 17 patient compliance applications. Africa had the largest number of projects (53) followed by Asia (32). Interestingly, most African projects located in emerging mobile phone markets, including South Africa and the countries of the Great Lake region, Kenya, Tanzania and Uganda. The majority of applications focused on HIV/AIDS (29), while others focused on sexual and reproductive health (7), tuberculosis (6), malaria (6), and avian influenza (4) plus a wide range of others. Disease prevention interventions, were reported to be well accepted by the population, although the length of the campaign need to remain limited. Differences in utilization between man and women, rural and urban population were observed. Disease surveillance interventions showed that these projects resulted in reducing transmission delays and error rates and saving time. In disease management interventions, one RCT reported significant clinical improvement. Applications generally facilitated communication between remote health workers and specialists and to register and monitor patient. In one case it was shown that a HIS for HIV/AIDS was possible at the national level. Five patience compliance applications reported positive clinical outcomes. Improvements in treatement adherence and attendance rate was observed (Deglise, 2012).

In all applications the mobile network coverage and cost, along with unreliable electricity supply were reported as barriers. Other specific challenges include high personnel turnover, language differences, confidentiality and data protection. Three recommendations are drawn from this review: i) establish monitoring and evaluation of projects with assessment of clinical and economic outcomes; ii) promote high quality research to facilitate better-informed decision making; and encourage collaborative design

and implementation that involves the target population and stakeholders in the design of the programme (Deglise, 2012).

The review of Higgs *et al.,* summarizes evidence for m-health projects targeted at changing behaviour for reducing child mortality in LMICs. The review included 15 studies in the period 1990-early 2013 including the following interventions: i) provider behaviours, ii) patient medication compliance, iii) maternal education and behaviours, iv) patient compliance with health care appointments, and v) creating demand for health care services. Although availability of high-quality evidence of m-health interventions (primarily text message–based interventions) is limited, the review showed promising results regarding the positive impact of these interventions on child survival and development. M-health interventions have been effective in improving adherence to medication, uptake of service, education of caregivers, and clinical provider compliance with protocols. From the review emerge that investments in m-health can effectively improve child health by connecting caregivers to the health system, improving quality of services provided by health workers, and facilitating adherence to recommended treatments. However, studies demonstrating the efficacy of m-health on maternal behaviours (such as greater attendance at antenatal appointments, enhanced attended skilled deliveries, and enhanced compliance with their children's vaccination schedules, etc.) strongly support the need to implement RCTs to obtain sustainability evidence.

The review also provided policy recommendations and recommendations for future research. In brief: i) a government leadership is needed to facilitate m-health partnerships. Mobile and internet content is unregulated in most LMICs. Public-private partnerships may facilitate large-scale interventions bringing together different stakeholders (regulators, development organizations, commercial enterprises, beneficiaries, etc.); ii) policies should be adopted to protect the privacy of citizens using m-health services; iii) health programs should adopt an overarching strategy that integrates m-health into community and health system interventions; iv) future m-health research must use rigorous designs with validated outcome measures (Higgs, 2014).

The study carried out by Aranda-Jan and colleagues provide an overview of strengths, weaknesses, opportunities, and threats of m-health projects in Africa. Forty-four studies were included and classified as: patient follow-up and medication adherence (19), staff training, support and motivation (2), staff evaluation, monitoring and guidelines compliance (4), drug supply-chain and stock management (2), patient education and awareness (1), disease surveillance and intervention monitoring (4), data collection/transfer and reporting (10) and overview of m-health projects (2). M-health projects demonstrate positive health-related outcomes and their success is based on the accessibility, acceptance and low-cost of the technology, effective adaptation to local contexts, strong stakeholder collaboration, and government involvement. Threats such as dependency on funding, unclear healthcare system responsibilities, unreliable infrastructure and lack of evidence on cost-effectiveness challenge their implementation. M-health projects can potentially be scaled-up to help tackle problems faced by healthcare systems like poor management of drug stocks, weak surveillance and reporting systems or lack of resources. Research recommendations include assessing implications of scaling-up m-health projects, evaluating cost-effectiveness and impacts on the overall health system (Aranda-Jan, 2014).

Table 5. Summary of the articles reported about m-health use in LMICs

Ref.	Objectives	Conclusions
Peiris, 2014	The study assessed the use of m-health systems for non-communicable diseases. Period: current to May 2014. Studies included: 24	The review found few high-quality studies. Most studies narrowly focused on text messaging systems for patient behaviour change; few studies examined the health systems strengthening aspects of m-health. There were limited literature reporting clinical effectiveness, costs, and patient acceptability, and none reporting equity and safety issues.
Hall, 2014	The study reviewed the evidence on the specific impacts of m-health in LMICs, from the perspectives of various stakeholders. Period: 2009 - early 2014. Studies included: 76	There is a growing evidence base for the efficacy of m-health interventions in LMICs. There is the need to take small pilot studies to full scale, in order to strengthen the evidence base. The quantity and quality of the evidence is still limited in many respects.
Zhenwei Qiang, 2011	The study analysed m-health services in Haiti, India, and Kenya. Projects included: 60	The m-health initiatives analysed contributed in term of improving quality of care, access to health information, access to services and increasing operational efficiency. Barely 20% of the m-health services included in the study reported to have been deployed for at least five years.
Deglise, 2012	The study assessed the use of SMS for disease prevention, surveillance, management and treatment compliance. Period: January 1998 - July 2009. Studies included: 123 (98 applications).	Mobile phones are an appropriate tool for health communication and disease control in LMICs context. Areas where lay most of the opportunities for using SMS include mass awareness campaigns, tailored behavioural change communication, enhanced diseases surveillance, support for remote health workers and patient treatment compliance. The review highlights the need for more reaserch on actual needs, applicability and cost-effectiveness. Most outcomes reported were related to process and satisfaction rather than to measuring clinical outcomes.
Higgs, 2014	The study assessed m-health projects targeted at changing behavior for reducing child mortality. Period: 1990-early 2013. Studies included: 15	Overall, this review found efficacy of m-health interventions for improving adherence to medication, uptake of service, education of caregivers, and clinical provider compliance with protocols. Some m-health interventions have sufficient evidence to make topic-specific recommendations for broader implementation, scaling, and next research steps. Evidence of sustainability is weaker. Limited number of high quality studies that fulfil the criteria for being included in the review.
Aranda, 2014	The review evaluated the implementation of m-health projects in Africa. Period: 2003-2013. Studies included: 44.	Overall positive health-related outcomes. Success depends upon accessibility, low-cost of the mobile phone technology, adaptation to local contexts, strong stakeholder collaboration, and government involvement. Weaknesses are related to excessive dependency from external funding, unclear healthcare system responsibilities, unreliable infrastructure and lack of evidence on cost-effectiveness. All evaluation study designs included limit comparability.
Brinkel, 2014	The review assessed mobile phone-based interventions for public health surveillance in SSA. Period: 2009-2013. Studies included: 9.	Mobile phone-based surveillance projects in the SSA countries are on small scale, fragmented and not well documented.

The review carried out by Brinkel el al., examined mobile phone-based m-health interventions for public health surveillance in SSA. A total of 9 studies were included which focused on infectious disease surveillance of malaria (3), tuberculosis (1) and influenza-like illnesses (1) as well as on non-infectious disease surveillance of child malnutrition (2), maternal health (1) and routine surveillance of various diseases and symptoms (1). The review revealed that mobile phone-based surveillance projects in the SSA countries are on small scale, fragmented and not well documented.) The article concluded with some recommendations: i) before adopting any ICT technology, it should carefully be ensured that the implementation of services is driven by the needs of national health sectors rather than by the intense technology market pressure; ii) ICTs are based and dependent on technology infrastructure which is inadequately available or weak in many SSA countries; iii) partnerships between policy makers throughout the study design and implementation process as well as a reliable flow of information between stakeholders are crucial for a successful implementation, program sustainability and national scalability; iv) more research in the applied field as well as a better reporting of lessons learned is needed, in order to build a more evidence-based field of practice in m-health surveillance (Brinkel, 2014).

The studies reviewed in this section show that m-health services can have a direct or indirect impact on improving individual or public health outcomes. However, most evaluation of impact of m-health projects in LMICs focus on the projects' outcomes and processes (such as improved treatment adherence or improved access to information) rather than providing evidence of clinical impacts. Most studies illustrate how the use of m-health can improve the efficiency and the outreach of healthcare service delivery and attach great attention to the advantage of the mobile technology in optimizing the use of the scarce resources available. Moreover, in LMICs context, besides the use of the SMS technology, there is scant evidence of health outcomes or cost-effectiveness improvements for all the other possible use of m-health services (Bastawrous, 2013). An excessive reliance on SMS limits a more effective use of the m-heath technologies because text messages have a limited number of characters and cannot be used to transfer images or interactive content that is so important for making diagnoses. If 3G phones were more widespread and connection to the internet more affordable, then more complex services related to direct to patient healthcare could be more sustainably implemented (Zhenwei Qiang, 2011). Another important limitation is that all the m-health initiatives reported have a micro scale and their sustainability is rarely investigated.

3.6.3 Evidence from telemedicine

Impact reviews of telemedicine use are mostly in industrialized country settings. Most evidence in LMICs is descriptive and is not based on rigorous quantitative analysis of clinical and economic outcomes. The existing evidence is based upon few reviews, case studies or internal evaluation of telemedicine programmes that mostly focus on process improvement. This study identifies two systematic reviews concerning the implementation of telemedicine initiatives in LMICs, and three reports that summarize the experience of telemedicine networks.

The systematic review carried out by Khanal *et al.,* aimed to identify organizational, technological, and financial features of successful telemedicine programs providing direct clinical care in LMICs. The review identified 46 articles (reporting 36 programs) between 2000-June 2014. Technological modalities included synchronous technology, real-time teleconsultations, and asynchronous technology. The study identified key factors associated with telemedicine program success: i) program integration with existing systems, ii) twinning of international institutions; iii) simple and easy-to-use technology; iv) ability to reduce the burden on healthcare professionals, and v) technology able to maintain functionality in challenging environmental circumstances. However, as reported by other reviews, inconsistencies in reporting of outcomes from telemedicine programs represent an obstacle to establishment of successful programs in LMICs by limiting the application of previous experiences (Khanal, 2015).

Wootton and Bonnardot carried out a review on telemedicine in LMICs. Thirty-eight relevant papers were identified: 34 (89%) reported clinical experience and 14 (37%) reported the use of telemedicine for educational purposes. Fifteen articles (39%) reported the use of real-time telemedicine and 25 (66%) reported the use of asynchronous, or store-and-forward, telemedicine. Email was the most commonly reported modality (half of all studies). The review suggests that great potential exists for telemedicine in LMICs. However, the quality of the studies reported was rather weak and concerns remain on the potential use of telemedicine in the absence of robust evidence for cost-effectiveness. The review also provided several recommendations for a better implementation of telemedicine projects in LMICs: i) to avoid large and expensive projects; ii) to ensure close collaboration with local health workers and national health services; iii) to take into account the published experience of others; iv) to publish the evaluation results, whether positive or negative; and vi) to scale up only on the basis of clear success (Wootton, 2010).

Wootton *et al.*, summarized the experience, performance and scientific output of long-running telemedicine networks delivering humanitarian services. Seven long-running networks (those operating for five years or more) were included. All networks provided clinical tele-consultations using store-and-forward methods. Five were also involved in some form of education. The study concluded that although the overall quality of the scientific output is rather weak, the networks appear to offer sustainable and clinically useful services, encouraging ministries of health in LMICs to establish, support or join similar telemedicine networks (Wootton, 2012).

Similarly, Lipoff *et al.*, retrospectively examined the activity of the Africa Teledermatology Project, a store-and-forward teledermatology consultation network, established in 2007 in order to assist in providing dermatology care to 12 countries in SSA. All consultations were examined submitted between 2007-2013. During the period studied, a total of 1229 consultations were submitted. The submitting clinician rendered a suspected diagnosis in 63% of cases and a differential in 30%. The responding clinician agreed with the submitting clinician's diagnosis (or first listed diagnosis in differential) in 60% of cases. The findings demonstrate the utility of the Africa Teledermatology Project in improving the delivery of care to a highly underserved population (Lipoff, 2015).

Zolfo reported the experience of the ITM in Antwerp that in 2003 set up an internet-based decision support service to assist health-care workers in the management of difficult HIV/AIDS cases. Between 2003-2009 the service received 1,058 queries (by email or internet), from more than 40 countries, mostly LMICs. A user satisfaction survey reported that the services has been helpful for defining the diagnosis (75%), referring clinicians' education (55%) and providing reassurance (39%) (Zolfo, 2011).

Table 6. Summary of the articles reported about telemedicine use in LMICs

Ref.	Objectives	Conclusions
Zolfo, 2011	Analysis of an internet-based support service to assist health-care workers in the management of HIV/AIDS cases	The response rate to a user questionnaire showed that telemedicine advice was valuable in the management of specific cases, and influenced the way that clinicians managed other similar cases subsequently. There was a declining trend in the rate of use of the service.
Lipoff, 2015	Retrospective examination of a teledermatology consultation network.	The submitting clinician rendered a suspected diagnosis in 63% of cases and a differential in 30%. The responding clinician agreed with the submitting clinician's diagnosis in 60% of cases. Teledermatology provided positive results in improving the delivery of care in LMICs.
Khanal , 2015	The review identified organizational, technological, and financial features of successful telemedicine programs	Program integration with existing systems and twinning of international institutions were identified as factors enabling program success. Studies describing effectiveness and cost were limited.
Wamala, 2013	The article assessed the telepathology services in different African countries	The study points to the lack of political support for telemedicine, together with poor ICTs infrastructure, for slow introduction of telemedicine in Africa.
Wootton, 2010	General review on telemedicine in LMICs. Thirty-eight relevant papers were identified: 34 reported clinical experience and 14 educational purposes.	The review suggests that great potential exists for telemedicine in LMICs. However, the quality of the studies reported was rather weak and concerns remain on the potential use of telemedicine in the absence of robust evidence for cost-effectiveness.
Wooton, 2012	The review summarized the experience of long-running telemedicine networks delivering humanitarian services: 7 long-running networks were included.	Although the overall quality of the scientific output was rather weak, the networks appear to offer sustainable and clinically useful services, encouraging ministries of health in LMICs to establish similar telemedicine networks.

Whereas real-time telemedicine is commonly employed in industrialized countries, less expensive and more practical, store and forward telemedicine generally set to get second opinion by general practitioners is used in LMICs. In spite of encouraging results, the scale of implementation in LMICs is yet low. As for other e-health services, there has been a mushrooming of telemedicine projects and little evaluations that could support a better use of these technologies in the healthcare systems of LMICs. Case studies illustrate that telemedicine in LMIC contexts can help improve patients' management and medical diagnosis, but concerns remain about the appropriateness of telemedicine to the health needs and skill availability of LMICs (Wooton, 2012; Wooton, 2010). A report of telemedicine in Africa in the field of telepathology shows how telemedicine has been applied to address chronic scarcity of doctors and health service providers. The study points to the lack of political support for telemedicine, because of its high technological content as compared to the many basic health needs of African people, as one of the key reason, together with poor ICTs infrastructure, for slow introduction of telemedicine in Africa (Wamala, 2013).

3.6.4 Evidence from e-Learning

Generally, the most relevant benefit of the increased use of e-learning tools in medical education has been the growing availability of e-learning resources for healthcare workers all over the world. This proved to be particularly relevant in LMICs where there is a large and unmet demand for medical information in rural areas, and where referral hospitals and academic institutions are mostly based in capital cities (Al-Shorbaji, 2015).

The most common strategy to assess the effectiveness of e-learning tools involves the comparison of students that get a traditional education with those that received the e-learning modality (Ruiz, 2006). In a high income country setting, a review of 49 studies of e-learning for undergraduate health professional including 4,955 students found out that, with respect to knowledge and skill acquisition, there is neutrality between traditional and web or computer-based learning (Al-Shorbaji, 2015).

Such quantitative impact analysis of e-learning tools for pre-service medical education are less common in LMIC contexts, where studies remain formative and process-oriented, looking at the perceived benefits of introducing e-learning for healthcare students and workers (Alexander, 2009). In a comprehensive review of published articles on the use of these tools in LMICs, it was found out that nearly 39% the 124 case studies selected occurred in four countries: Brazil, Egypt, India and South Africa. The review also reported that the e-learning methods identified produced favourable results in terms of student outcomes (with just one article providing evidence on the negative effects of e-learning technologies). Consistently with other studies (Al-Shorbaji, 2015), the positive outcomes proved stronger for blended e-learning approaches (Frehywot, 2013).

The evidence suggests that in LMICs it is the possibility to access to high quality and affordable medical education, along with reliable and updated medical information, that matter most. Removing geographical barriers to access to knowledge, bringing medical knowledge in areas where this is chronically lacking, and strengthening collaborations with medical schools in high income countries, are all reported benefits. …Improved retention of health workers and increased cost-effectives are also two relevant advantages associated to the use e-learning in medical education in resource constrained countries (Frehywot, 2013).

3.7 Challenges and constraints for furthering ICT use in healthcare in LMICs

At the most basic level, poor infrastructure development hampers a more widespread and efficient use of ICT in the health systems of LMICs. These include the instability of power supply, unreliable internet connectivity and limited broadband, internet congestion and lack of equipment in the local points of care. Financial cost of large scale e-health programmes is reported to be another key barrier. In spite of decreasing costs of some ICT devices, equipment, maintenance, and training costs of local staff can still be unaffordable in many LMICs (WHO Global Observatory for e-health, 2011). However, besides the more general challenges of introducing the use of ICTs in LMICs, integrating IT solutions in healthcare also face some specific constraints.

3.7.1 Uncertainty about the cost-effectiveness of ICT use in healthcare

Providing evidence about the benefits of ICT in healthcare is particularly relevant to scale up at the national level solutions that proved to be successful within micro-projects. Clearly this is a relevant issue in countries with emerging national healthcare systems, where priorities are often driven by more elementary health needs. Within this context, the use of IT solutions in healthcare is grounded on the expectations that these technologies can bring about better care at lower cost. However, as result of weak monitoring and evaluation, there is still uncertainty about the effectiveness of adopting IT solutions both in terms of financial and clinical outcomes (Giguashvili, 2014).

For instance, the WHO Global Report on m-health shows that uncertainty about the cost-effectiveness of m-health solutions is a key constraint for the further development of the sector. In the context of limited resource, the availability of cost-benefit studies is of paramount importance to provide sound evidence for governments about the value added of m-health and build thus a strong case for scaling up m-health services. From an investor perspective, it is also important to elaborate a return of investment of m-health that clearly establishes the cost saving of these technologies as compared to more traditional form of interventions (UN Foundation, 2010). Too many m-health initiatives in LMICs still have an experimental nature and rely on a business model that depends upon donor support (World Bank, 2011). Moreover, projects designed to work at the local level, have few possibilities of being the most-cost-effective solutions, as they are not created to be integrated in wider regional or national systems (WHO, 2011). More high quality clinical trials measuring clinical outcomes of m-health initiatives in LMIC settings are also needed to provide a stronger rationale for scaling up (Tomlinson, 2013).

Similarly, the same lack of evidence on cost-effectiveness is also reported as the most frequently cited barriers to implementing telemedicine solutions worldwide, as the dominant perception is that implementing telemedicine is too costly (WHO Global Observatory for e-health, 2011). Despite most of the literature on telemedicine seems biased towards presenting success stories, there have also been some remarkable and costly failure, especially when telemedicine solutions were attempted to be integrated into national health systems. As an example, South Africa has been trying to implement a national telemedicine system since the 1990s and the government of Malaysia had to withdraw its plan for implementing a similar programme (Wootton, 2010).

3.7.2 Policy issues and legal frameworks

While technological progress has been fast in the ICT for health sector, policies and regulations are still uncompleted. In Africa most countries have not adopted yet national policies, strategies or regulatory frameworks that are needed for establishing common technical infrastructure, interoperability and standardization protocols. Ownership, confidentiality, security of data and quality of information also remain major neglected areas (WHO Africa, 2010). Whereas the lack of a clear legal framework could accelerate implementation process, it also poses a number of ethical and security issues (Luna, 2014). To minimize the present fragmentation of services, governments should also design national standards for e-health services and healthcare providers (World Bank, 2011).

Policy support for some e-health technology is still limited. As an example, in terms of policy development to support introduction of telemedicine services, only 25% of the responding countries to the survey of the WHO Global Observatory for e-Health (2011) reported to have a national telemedicine policy or strategy. High income countries are reported to be more likely to put their national telemedicine policy into practice as compared to LMICs.

Finally, because most innovation in the e-health sector is driven by the private sector, there is also a need for stability and consistency of policies to encourage further investments. The regulatory framework for mobile service providers, in terms of price setting and spectrum use, is a key issue in many African countries (World Bank, 2011).

3.7.3 Skill shortage

The scarcity of digital skills is reported as a major inhibitor of e-health initiatives in developed and LMICs alike. The lack of IT skills for the heath sector affects all stakeholders, including policy-makers, service providers, end users and medical staff and has negative consequences along the entire e-health value chain (Giguashvili, 2014). Particularly critical is the low computer literacy amongst the medical staff, especially in rural settings. For instance, in a study on the determinant of the use of telemedicine in a sample of 501 physicians across Spain, Colombia and Bolivia, it was reported that the level of ICT use amongst physician was the variable with the highest explanatory power in the use of telemedicine (Saigí

Rubió, 2010). A review on the introduction of health information technology in primary health care in LMICs highlights the resistance of health care professional and the need for training as a limiting factor for using HIS in clinics (Tomasi, 2004).

Besides being a general deterrent to introducing IT solutions in traditional healthcare systems, the lack of IT skills amongst medical workers also has many negative implications. First of all, resistance to organizational change impedes integrating systematically e-health solutions in country's systems. Secondly, the value of electronic HISs depends upon the quality of the information recorded in terms of consistency, accuracy, and frequency of updating data. If the medical personnel are not committed to this task, then the final outcome might well be what in the IT jargon is called 'garbage- in garbage-out'. Thirdly, integrating e-health in traditional and still developing health systems requires a high degree of administrative and organizational skills, whereas the effective allocation of the scarce health workers is a priority issue (Piatte, 2012). Furthermore, the on-going brain drain amongst the most qualified health-care and ICT professional is jeopardizing efforts to putting in place modern and efficient health systems (World Bank, 2011).

3.7.4 Lack of leadership and coordination amongst different stakeholders

The development and maintenance of e-health infrastructure in LMICs is beyond the financial capacity of national governments. Because dependence on donor funding is a sort of rule that add a further complexity to the e-health ecosystem, lack of leadership and coordination is often reported as an impediment to developing large scale e-health initiatives (UN Foundation, 2010). Coordination and leadership at the national level is needed to integrate systematically ICT in the health system of LMICs and overcome the existing fragmentation and duplication of pilot initiatives.

Because implementation of e-health solutions is rarely driven by demand, a too weak leadership is not able to oppose a proliferation of many non-interoperable and technology driven responses. In the long run, LMICs health systems won't be able to sustainably support multiple models. Leadership is needed both to provide the appropriate inputs to the ICT industry and for creating e-health services that address health sector priorities in LMICs (World Bank, 2011). Finally, because many LMICs still lack standards for interoperability and incentives for connectivity between applications, variation in donor and government requirements creates further impediments to develop common standard for recording of medical information. For instance, Kenya has at least seven systems for electronic medical records (some of which are highly specialized) for patients undergoing antiretroviral therapy (Zhenwei, 2011).

3.7.5 Insufficient interoperability of health information systems

Generally, combining all type of healthcare information, including structured and unstructured data, is a complex challenge both from an architecture and a governance point of view. Patient data management models that are mostly used in the healthcare sector generates a fragmented environment that makes information sharing and point-to-point application integration difficult (Piai, 2014).

Health data that are not comparable and systematically collected are of little support to decision-making (Luna, 2014). Yet, a limited number of LMICs put in place adequate operability between their community-level systems of health information and other information systems at the regional and national level. In a review of the HIS of 10 sub- Saharan African countries, it was revealed that half of these countries were not dealing at all with issues related to standards, interoperability, national registries, health information exchanges and data warehouses (Foster, 2012). Similarly, unique identifiers for patients and open data coding and exchange are yet to be systematically applied (Piatte, 2012).

Specifically, with the increasing use of m-mobile services and in the absence of globally recognized standard and metrics, LMIC governments need to define standards for hardware and software platforms so that different mobile applications can connect with each other. As EMRs models are being adopted, in

integrated healthcare systems patients should have a unique identification number as a sort of mobile identity that can coordinate different services (World Bank, 2011). Moreover EMRs systems that are not based on commonly agreed definitions, including medical terminology, are of little use at the macro level (WHO, 2012).

3.8 Conclusions

The use of ICT in healthcare is becoming increasingly popular in both high income and LMICs. In the latter group, the fragility of the healthcare systems creates many opportunities for using e-health to increase access to healthcare and to improve the quality of the existing services. ICT is indeed set to remove time and distance barriers and to bring medical care, along with medical education, to under-served communities (WHO Africa, 2010). Profiling and mapping what e-health is in terms of technologies used and services provided is no easy task, as definitions vary across countries and international bodies. For the purpose of this study, four broad categories of e-health initiatives have been identified. These are m-health, telemedicine, HIS and e-learning. Driven by the lower cost and the user-friendliness of the technology, m-health appears to be the most dynamic e-health technology in LMICs. (Clara, 2012). HIS is more common in high income countries, whereas telemedicine development is severely constrained by poor telecommunication infrastructure that makes store and forward telemedicine the most common practice in LMICs.

Despite policy makers have become increasingly interest in integrating ICT in health care systems, and donors are more keen to finance e-health in LMICs, high quality impact evaluations in resource limited country settings are scarce (Piette, 2012). Most evaluations of e-health programmes, and especially those for LMICs, have a qualitative nature that focus on the impact on healthcare service delivery rather than on clinical outcomes (Blaya, 2010). When clinical outcomes are considered, specific challenges of the country contexts, such as reaching out to remote and poor communities are rarely investigated. The broader issues of poverty and the links between ICTs and improvement of health conditions of the poor is not adequately investigated (Piette, 2012). In addition to this, comparison of impact evaluation studies of e-health initiatives is also difficult because of differences in terminologies and heterogeneous study design (Oluoch, 2012). Finally, most studies, and especially those prepared by donor organizations, seem to have a strong publication bias that overemphasizes positive outcomes.

Regardless of the of e-health technology used, most e-health initiatives occurring in LMICs are still at the early stage of development and there has so far been little adoption for routine healthcare delivery. Most e-health initiatives in LMICs have a small scale, a pilot nature and a demonstration purpose that made these programmes mostly relevant for small groups (World Bank, 2011). Information about project sustainability is often not reported, while there is scant evidence about initiatives that integrate ICT systematically within the national healthcare system (WHO Africa, 2010).

The largest body of evidence relates to m-health initiatives. Areas that this review finds particularly successful include the use of mobile technologies in treatment and awareness raising of HIV/AIDS, malaria, tuberculosis and maternal health. SMS is the predominant technology and has a large acceptance both from patients and health staff (Clara, 2014). However, it also appeared that too many m-health initiatives are driven by technology. The increasing role of telecommunication industry in pushing for further use of m-health in LMICs is a cause of concern (Tomlinson, 2013; Brinkel, 2014).

The implementation of HIS (in particular the setting up of EMR), is the second most documented area by this review. The reviewed literature converges towards identifying the major advantages of adopting HIS in LMICs in terms of improving the speed and accuracy of some regular processes within health centers and the improved ability to track patient and collect clinical and research data. As for the m-health sector, the literature also shows a lack of studies that rigorously evaluate the impact of the use of these systems on quality of care, and also emphasizes the lack of proper economic assessment.

Where infrastructure constraints are higher, as in the case of SSA countries, telemedicine practice has progressed more slowly (Wooton, 2009). Education networks linking medical institutions in high income countries with hospitals in LMICs proved to be useful and well-received (Zolfo, 2011). Other store and forward telemedicine initiatives, such as the Africa Teledermatology Project, proved effective in improving the delivery of care to a highly underserved population (Lipoff, 2015). However, the appropriatness of telemedicine before the basic health needs of LMICs is still a debated issue (Wamala, 2013) (Wooton, 2012; Wooton, 2010). Success factors in telemedicine program relay on a simple and easy use of technology, integration with existing systems and twinning with international institutions (Khanal, 2015) (Wootton, 2010).

Whereas it is still controversial whether e-health projects are more cost-efficient or effective than traditional healthcare delivery modalities, there is agreement that in most LMIC settings e-health services might be the only available medical services. At present, the key challenge is to move projects beyond pilot phase to achieve scale and identify sustainable business models (Schwetzer, 2012). Concerns remain about the sustainability, reproducibility and scalability of these projects at the regional or national level. (Luna, 2014). Besides basic constraints that refer to poor telecommunication and electricity infrastructure and lack of finance, there are many other barriers that hold back a larger use of e-health in LMICs. Specific constraints relate to uncertainty about the cost-effectivness of e-health solutions, lack of policy support and uncomplete legal frameworks (e.g. ownership, confidentiality and security of data), skill shortage and insufficient interoperability of HIS at the local, regional and national level.

Implementation of e-health in LMICs, especially in low income countries, appears to be strongly donor driven. Because dependence on donor funding is common, lack of leadership and coordination is often reported as an impediment to developing large scale e-health initiatives (UN Foundation, 2010). At the policy level, little has been done to improve coordination amongst different stakeholders and issue legislation to avoid a too much fragmented development of e-health. Donor programmes also provide little help in terms of developing harmonized and compatible systems.

Finally, most studies included in this review concluded that more research is needed to build more evidence supporting the further development of e-health in LMICs, as compared to other traditional healthcare practices. The availability of cost-benefit studies is of paramount importance to provide sound evidence for governments about the value added of e-health and build thus a strong case for scaling up these projects.

4. The EU approach in promoting ICTs in LMICs

4.1 Introduction

In the first half of 2000, ICT issues were prominent in donor development agendas. Two UN World Summit of the Information Society took place in 2003 (in Geneva) and in 2005 (in Tunis), to draw attention on the potential of ICT for fostering economic growth and reducing poverty. The WSIS also urged the international community towards increasing efforts for reducing the digital divide amongst developed and developing nations. Most donors developed their first ICT strategic frameworks, started implementing a diversified ICT project portfolio, and some donors established ICT-specialised unit (e.g. the WBG, the UK, Sida) (Heeks, 2014).

Since then, relevant policy shifts have been observed that resulted in a partial disengagement from ICT4D initiatives. There was less emphasis on telecommunication infrastructure, as private sector emerged as important investor in LMICs. In parallel, attempts to mainstream ICT into development programs resulted sometimes in termination of ICT activities as a consequence of failing results (Danida, 2012). In particular, early ICT4D programs failed to effectively make a dent into the two pillars of the development agenda (i.e. poverty eradication and environmental sustainability). It has been only in recent years, thanks to the stunning growth of ICTs worldwide, and especially to the high penetration rate of mobile phone in LMICs, that a new momentum for ICT4D has emerged, bringing about a renewed discussion amongst the donor community (Heeks, 2014).

In particular, donors have been increasingly financing research that investigate the impact of ICT on poverty reduction and also started questioning whether traditional approaches to ICT4D are suitable for supporting local innovation (AFD, 2014). As a matter of fact, the first wave of donor approaches towards promoting ICTs in LMICs, were marked by an exogenous development model that paid little attention to how poor people would have used ICT in their everyday life. This approach was also directed at exporting knowledge rather than supporting local knowledge capacity on developing and using ICTs (Mansell, 2014). Most ICT4D strategies were geared towards achieving the largest possible connectivity, but neglected to consider that the technologies promoted could have not matched with the capacities and needs of the end users (Mansell, 2006).

The purpose of this chapter is to provide an overview of the EU approach in the area of improving ICT access in LMICs. The review focuses on ICT4D policy and strategic frameworks, but it also illustrates specific examples of the EU ICT project portfolio. An assessment of the EU policy contribution to ICT health programmes in also included. In a comparative perspective, other donor approaches in ICT4D were also assessed. To this end, two multilateral organisations, the WB and the AfDB, were selected because of their leading role in promoting ICTs, including in the healthcare sector. Bilateral donors were selected amongst EU Member States considering the relevance of their ICT project portfolio.

Chapter 4 is organised as follows: the next section present the methodology applied of this literature review. Section 3 analyses how and to which extent ICTs are included in the EU aid strategy and policy framework. Section 4 describes the EU approach in the use of ICTs in healthcare sector in LMICs. Section 5 focuses on the approaches of other donors to promoting ICTs. Finally, section 6 summarises the conclusive remarks.

4.2 Methodology

The sections about the EU ICT4D policies and the EU approach towards promoting the use of ICT in healthcare, are based on an analysis of official documents released by EU institutions and available on the web sites of the concerned DGs of the EC, namely DG DEVCO, DG Research and DG Connect. These are complemented with preliminary interviews with eight staff members from the same DGs. Because EU Institutions do not have a central database for identifying ICT4D projects, and information on EU

support for ICT in LMICs is fragmented and not systematically reported, interviews were necessary to focus the documentary search as well as to gaining a better understanding of EU actions in this area.

The review has been enriched by a benchmarking exercise with other donors. The assessment of other donors' policy for promoting ICTs in LMICs is based on official document available on the Internet and on the OECD statistical data on aid for the ICT sector. To identify the relevance of ICT4D within donor aid policy frameworks, a word search was conducted across different policy and strategy documents using key words such as 'ICT', 'digital', 'information', 'telecommunication', and 'e-health'.

Similarly to the EU, ICT4D has increasingly become a horizontal theme for donors and information (especially about programmes and projects), is often fragmented and not comprehensive. This was even more problematic for the e-health theme. The projects mentioned in this chapter do not provide a comprehensive picture of donor's ICT4D programmes, but are rather meant to provide non-exhaustive but illustrative examples of donor interventions that are somehow representative of their approach towards ICT4D. As a matter of fact, a comprehensive benchmarking exercise is also limited by the methodological approach of the present review that is based on a review of literature. For a more complete benchmarking of policies and programmes for ICT4D, that also includes figures on budgets and results, an ad hoc survey and interviews with development agencies would have been needed.

Academic and independent literature was also included in the review using a sort of 'snowball technique'. However, only a limited number of papers was found that critically address the role of donors, and specifically of the EU, in promoting ICT in LMICs. The OECD DAC evaluation resource center was also investigated to identify independent evaluations of donor ICT4D programmes. Finally, this review is also built on the conclusions of the two studies commissioned by the STOA Panel on the role of ICT for development (EP, 2001) and the use of ICT in healthcare in LMICs (EP, 2004).

4.3 ICT within the EU aid policy framework

4.3.1 General principles of the EU development cooperation

The common values, principles, objectives and instruments of the EU Institutions and Member States on development cooperation are set out in the European Consensus on Development, endorsed in 2005. Poverty reduction is the overarching goal of the EU development cooperation. Policy coherence for development and partnership are central pillars in the EU fight against poverty, and, in this respect, the EU undertakes to consider the potential impact of all its policies on development issues (European Parliament, Council, Commission, 2006).

In 2011, two important reforms were adopted with the aim to make the EU development policy more strategically focused. These include: i) the establishment of the Agenda for Change and ii) a new policy and rules for providing budget support to LMICs. Better targeting and concentration are to be achieved through assisting countries most in need of aid, which translates in a stronger focus on SSA countries, and by channelling aid into the two priority areas of human rights and democracy, along with inclusive and sustainable growth. Whereas the overarching objective of the EU development cooperation remains unchanged, the 2011 revised approach gives a higher profile to governance and economic growth. The stronger emphasis on pursuing a country differentiated approach requires a larger use of innovative financial instruments that blends grants and loans and an increased use of joint programming with Member States (EC, 2011b).

While the UNs are shaping the post-2015 global development agenda that will be based on sustainable development goals to be pursued by all countries, the EU is also elaborating its vision for the EU development agenda beyond 2015. In this respect the EC has released a number of communications that support the balanced integration of sustainable development across its three dimensions of social, economic and environmental development (EC, 2013a; EC, 2014a).

Currently, the EU development cooperation strategy and policies, which are designed and implemented by DG DEVCO, are structured in the EU Agenda for Change along nine priority sectors, namely: human rights and governance, food and agriculture, economic growth, infrastructure that includes ICT as a sub-sector, human development, environment, energy, health and education, migration and asylum.

4.3.2 ICT relevant policies and strategies

The most relevant EU policy documents on ICT4D are presented in Table 7. In 2000 a resolution of the EP on ICTs and LMICs identified the potential impacts of ICTs in the development process in different areas. These were: i) democratisation, ii) poverty reduction through an increasing use of ICTs in health, education, rural development and environment, iii) job creation in IT-related industries. The resolution also warned of the possible marginalizing effect of ICTs as a result of an increasing digital divide amongst and within countries, and urged EU and Member States actions for broadening access to ICTs in LMICs. The resolution called the EC for formulating a single and coherent policy for ICTs within the EU development policy and to update it frequently. It envisaged an increase in the quantity and quality of ICT programmes, and suggested to integrate ICTs in country strategy papers (EP, 2000).

Building on the EP resolution, the role of ICTs in the EU development policy was later established in a communication issued by the EC in 2001. The communication considers the relevance of ICTs as enablers of socio-economic progress and laid out a number of actions to support the use of ICTs in the priority sectors of the EU development cooperation. A more systematic use of ICTs to enhance development projects was encouraged, especially when these are included in the development strategies of aid recipient countries. While acknowledging the increasingly important role of ICTs in economic development, the communication warned of the possible conflicts between promoting ICT and addressing other more pressing priorities of LMICs that have a more direct impact on poverty reduction (EC, 2001b). It is important to note that, at the time the 2001 communication was prepared, ICTs, and especially mobile phones, were far less ubiquitous in LMICs than they are today. The linkages between economic growth, poverty reduction and ICTs in LMICs were also not yet fully explored. The 2001 communication did not thus properly address the potential role of ICTs in poverty reduction and remained rather focused on the general issues of ICTs access in LMICs.

However, since 2001, the EC has not released a revised approach for promoting ICTs in within the EU development cooperation. The 2005 European Consensus on Development mentions an increased use of ICTs to bridge the digital divide, but do not further elaborate on this subject and kept it limited to an infrastructure issue. It is only with the 2011 Agenda for Change that ICTs are identified as powerful drivers for change with respect to job creation, economic growth, and poverty reduction. ICTs, generally referred as new technologies, acquire thus more prominence within the EU aid policy framework (EC, 2011b).

Within the communications released by the EC to shape a new global partnership for development between 2013 and 2014 (EC 2013a; EC 2014a) digitalisation is mentioned as an important driver of change. The communication 'Global partnership for poverty eradication and sustainable development after', released in 2015, also addresses the potential impact of ICTs in LMICs. It also acknowledges that technical progress does not automatically benefit the poor. To this end, development partners are called to use innovation as an instrument that meets the needs of the most vulnerable people (EC, 2015).

Table 7. Major EU policy documents related to ICT4D

Title	EU institution and year	Key messages
EP resolution on ICT and LMICs	EP, 2000	Identifies the potential impacts of ICTs in development process.
EC Communication ICTs in Development	EC, 2001	Strategy based on reducing the digital divide and access to ICTs in LMICs. Establishes that ICT is not to be considered a focal sector.
European Consensus on Development	EP, EC, Council, 2005	Emphasises the importance of addressing the digital divide.
Agenda for Change	EC, 2011	Better acknowledges the role of ICTs for economic growth, job creation and poverty reduction.
EP resolution Digital Freedom Strategy in EU Foreign Policy	EP, 2012	Explores the relationships between ICT and human rights (ICT as enabler of democracy and repressive instruments).
EC Global Partnership 4D	EC, 2015	Acknowledges that technical progress and innovation, including in the ICTs sector, do not automatically translate in poverty reduction.

The EP also continues to deliver its contribution for stimulating a debate about the role of ICTs in LMICs. In 2012, the EP adopted an important resolution on a Digital Freedom Strategy in EU Foreign Policy that emphasises how ICT can be used both as enabler of democracy and freedom and as repressive instruments under authoritarian regimes. Recognizing that human rights should also be protected through ICTs, the resolution calls for mainstreaming ICTs in all EU external programmes, and especially within the European neighborhood policy. It also calls the EC to propose new regulatory frameworks in the areas of Internet governance and trade (EP, 2012/2094 INI).

As for other sectors, the EU support to ICTs sector projects is built upon a regional approach. Especially, but not exclusively, in Africa, interconnection is considered instrumental to achieve higher regional integration, trade and growth. High priority is given to regional ICTs infrastructures, along with harmonization of regulatory frameworks amongst countries of the same region.

For instance, the Joint Africa-EU Strategy, that provides a framework for Africa-EU relations, aims, amongst other development objectives, at bridging the digital divide by addressing obstacles that limit access to mobile communications and the Internet (EU-Africa Partnership, 2014). Since 2008 ICTs was identified as a priority action. In the following roadmap 2014-2017 of the Joint Africa-EU Strategy, the EU strategy framework in the area of ICTs is further broadened to embed a more inclusive use of ICTs by citizens, businesses and public authorities that was missing in the previous documents (i.e. the First Action Plan 2008-2010 for the Implementation of the Africa-EU Strategic Partnership and Joint Africa EU Strategy Action Plan 2011-2013). To this purpose a three-pronged 'Connecting Africa' strategy has been planned. This aims at: i) increasing harmonisation and alignment of e-communication policies and regulatory frameworks, ii) strengthening interconnection of research and education networks through e-infrastructure, and iii) the enhancement of ICT capacity for all (Fourth EU Africa Summit 2014). More specifically, the EU–Africa Partnership on the Information Society, Science and Space Technologies is an integral part of the EU– Africa Joint Strategy and is the EU response to the African Regional Action Plan on the Knowledge Economy. The I3S supports the development of an inclusive information society in Africa as a key priority action aiming at a more inclusive and widespread use of ICTs in SSA.

While some regional strategies and policies of the EU development cooperation include explicitly ICTs, these are often not well integrated in sector strategies. As an example, the EU communication 'A Stronger role of the private sector in achieving inclusive and sustainable growth in LMICs', that was adopted in 2014 to lay out the role of the private sector in development, mentions the use of ICTs only in relation to achieving financial inclusion of the poor (EC, 2014d). The EU policy framework for the agriculture sector adopted in 2010 to set out EU priorities for promoting sustainable agriculture and improve food availability, does not integrate ICTs (EC, 2010b).

4.3.3 EC support to ICTs

Within the EC, support to ICTs in development cooperation is mainly delivered through the external aid provided under the supervision of DG DEVCO that also establishes the general and ICT-specific direction of the EU development cooperation. A unit within the infrastructure Division of DG DEVCO is in charge of coordinating ICTs for development issues, whereas programme design and implementation is carried out in the field offices of the EU Delegations. When capacity on specific ICT issues is not available internally, project development and implementation is contracted out to other organizations. For instance the programmes that address the ICTs policy and regulatory frameworks are developed in partnership with ITU. Development and implementation of e-Infrastructure initiatives have been entrusted to DG Connect.

Other EC Directorates are involved in supporting the development of research partnership and infrastructures in the ICT sector. DG Research has increased its funding for ICT research and innovation initiatives in LMICs. A general delay and difficulty in spreading the content of ICT4D relevant researches within the DG DEVCO was reported. This is also consistent with the finding of the last Development Assistance Committee Peer Review of the EU external assistance that reported that EU institutions could create better links with DG Research to tap into its vast knowledge base, thus improving knowledge transfer to other DGs (OECD-DAC, 2012).

DG Connect is in charge for managing the implementation of the EU Digital Agenda. Because it is the EC knowledge center on ICTs issues, it also provides advisory services to DG DEVCO on these issues. DG Connect does not have internal funds for engaging in IC4D activities, but it rather provides expertise and tap into the financial resources of other EC directorates. For instance, with funding from the EU FP7, DG Connect managed a number of initiatives aiming at establishing ICT research and policy links between Africa and Europe (e.g. EuroAfrica ICT Initiative, eI4Africa – African Grid Science Gateway).

Within the EC services dealing with ICT4D, the channels of communication are not structured and systematic but are rather based on programme specific needs and rely on personal networks.

4.3.4 Implementation of ICTs relevant programmes

In 2001, the STOA Panel of the EP promoted a study concerning the diffusion of ICTs in LMICs. The study identified two major weaknesses in the EU ICT4D approach, namely: the lack of a clearly focused strategy and the excessive use of a top-down approach. The study suggested that a combination of top-down interventions (e.g. policy and regulatory support for ICTs) and bottom-up activities (e.g. direct support to ICTs projects), would make the EU development cooperation more effective. At the micro level, it recommended to build local capacity and empower local entities, while at the macro level it suggested to focus on increasing awareness of ICTs advantages amongst donors and LMICs' governments, provide regulatory and policy support, promote the use of the technologies that have the most promising development outcomes, and contribute to reducing telecommunication costs for the end-users (STOA, 2001).

Since then, progress has been mixed, although the EU has elaborated an articulated response to the challenges of using ICTs in development process. The ICTs sector is not a focal sector of the EU

development cooperation, but is rather a sub-category of the infrastructure priority area. Geographically, most ICT initiatives target ACP countries. Because of its cross-cutting relevance, ICT components can be found in other priority sectors such as education or governance.

Table 8. Aid commitment in the ICTs sector for the EU and other selected donors.

Donors	2009	2010	2011	2012	2013
EU Institutions					
Amount	13.0	13.8	169.2	108.0	377.1
% total aid	0.1%	0.1%	1.2%	0.6%	2.0%
Finland					
Amount	36.5	9.0	4.4	6.2	2.4
% total aid	4.0%	1.1%	0.5%	1.0%	0.4%
France					
Amount	0.6	0.7	0.2	0.3	59.0
% total aid	0.0%	0.0%	0.0%	0.0%	0.9%
Germany					
Amount	8.3	17.8	8.0	8.8	24.0
% total aid	0.1%	0.2%	0.1%	0.1%	0.2%
Sweden					
Amount	0.1	0.9	0.1	15.7	3.2
% total aid	0.0%	0.0%	0.0%	0.6%	0.1%
United Kingdom					
Amount	52.2	73.6	29.1	23.9	18.9
% total aid	0.7%	1.9%	1.0%	0.5%	0.4%
AfDB					
Amount	0.0	0.0	0.0	0.0	0.1
% total aid	0.0%	0.0%	0.0%	0.0%	0.1%

Source: OECD Development Statistics
Notes: Value in million euros and % of total ODA. Data are not available for the World Bank Group. The OECD sectors considered are: ICTs, Radio/television/print media and Telecommunications (all are subsectors of the Communication sector, which in turn is a subgroup of the Economic Infrastructure and Services activities).

Between 2007 and 2013 the average annual disbursement for the ICT sector in LMICs has been 33.39 million euros, whereas the total amount spent for the ICT sector was up to 233.73 million euros (DEVCO Annual Reports 2009, 2010, 2011, 2012, 2013c). Within the macro sector of economic infrastructure and services, ICT had the lowest share of funding, together with banking and financial services (see Annex 1). However, these figures likely underestimate EU expenditures for the ICTs sector, as ICTs components of large programme are not often identified as a separate budget items. Budget support, which represents nearly a quarter of the EU external assistance for development, can include sector specific programmes that have an impact to the ICTs sector. As an example, two major sector budget support programmes for private sector development in South Africa contributed, amongst other initiatives, to establishing ICTs business centers (DEVCO Annual Report, 2008).

Data from the OECD development statistics database reveals much higher contributions from the EU to the ICTs sector. This is because a different and broader definition is applied. According to the OECD data, EU commitments for the so-called communication sector went from 13.0 million euros in 2009 up to 377.1 million euros in 2013 (Table 8). EU interventions in support of ICT4Dwere grouped in four main areas. A list of examples of projects for each category is illustrated in Table 9.

Table 9. Examples of EU interventions in support of ICT4D.

Area	Project name	Years	Region	EU aid*
I) Development of ICT infrastructure	EASSy Submarine Cable	2007-2010	East Africa	2.6
	Mauritania Submarine Cable Connection West Africa	2013-ongoing	Western Africa	5.5
	Seychelles Submarine Cable Southern Africa & Indian Ocean	2010-2012	SSA	4
	Satellite eMedicine for Africa	2010-ongoing	Western Africa (pilot)	4
	African Internet Exchange System	2010-ongoing	Africa	5.1
	Study for the West Africa implementation of UMOJANET	2010-ongoing	Western Africa	1.3
	Global Monitoring for Environment and Security in African, Caribbean and Pacific countries	2006-ongoing	ACP countries	-
II) Harmonisation of ICT policy and regulatory frameworks	Support for the establishment of harmonised policies for the ICT market in the ACP states (HIPSSA, HIPCAR, ICB4PIS)	2008-2013	ACP countries	-
	ALICE2	2008-2013	Latin America	22
III) Research and education networks of EU and LMICs	EUMEDCONNECT3	2011-2014	Mediterranean countries	3.2
	RedCLARA (part of ALICE2, previously of ALICE)	2004-2013	Latin America	-
	CAREN	2009-2013	Asia	5
	TEIN4	010-2012	Asia	8
	C@ribnet	2012-2013	Caribbean region	10
	AfricaConnect	2011-2014	Africa	11.8
	African Virtual	-	Africa	-
IV) ICT capacity building initiatives	ACP-Information and Communication Technologies Programme	2008-2013	ACP countries	20
	Capacity Building Programme and Community Development in Internet Governance and ICT Policy for Intra-ACP regional and sub-regional institutions	2010-2012	ACP countries	-
	Support to ICT Strategic Planning in the SADC Parliaments	2009-2012	Southern Africa	-
	Support to ICT Strategic Planning in Caribbean Parliaments	2009-2012	Caribbean region	-
	ICT Research & Innovation Partnership (LEADERSHIP initiative)	2013-ongoing	Latin America	-

Sources: Annual Report on the European Union's Development and external assistance policies and their implementation from 2008 -2013; the EU Policy Coherence Report (2013); ITF Annual Report (2013); Projects' web sites. EU contribution reported when available. *: in million Euros.

4.3.4.1 Support to the development of ICT infrastructure

Since 2007, thanks to the establishment of blending mechanisms that put together grants and loans (such as the EU-Africa Infrastructure Trust Fund or the Caribbean Investment Facility and the IFP), the EU has increased its support to infrastructure projects, including in the telecommunication sector. So far, it is mostly the ITF that has been used to support ICT infrastructure development. Within the framework of the EU–Africa Partnership on Infrastructure, ITF financing for ICT is set to develop connections with the continental and regional networks and to help lower the costs of broadband and high-speed internet connectivity.

The development of space technologies and satellite navigation systems in Africa are also receiving increasing support from the EU. Space applications supported by the EU with a relevant impact on development include, amongst others, disaster early warning and damage assessment, land mapping, and monitoring of climate change. In particular, the EC is supporting the extension of the services of Galileo and EGNOS, the first European satellite navigation systems, to Africa (Capacity4dev.eu, 2012)

4.3.4.2 Harmonisation and alignment of ICT relevant policy and regulatory frameworks

In this area the EU provides support for establishing modern and harmonized policy and regulatory frameworks for the telecommunication sector. Technical assistances are provided to relevant ministers and regulatory agencies in Latin America, ACP, Mediterranean and Eastern neighborhood countries. These interventions focus on ICTs policies, development of national legislation and compliance procedures.

BEREC is a recently EU created body which contributes to the development of the internal market for electronic communications networks and services in the EU. Furthermore, BEREC assists the Commission and the national regulatory authorities in implementing the EU regulatory framework for electronic communications (BEREC, 2015). In the context of ICTs and LMICs, the EC encourages cooperation between BEREC and its counterparts in other regions of the world with the purpose of promoting transparency, respect of human rights and freedom of expression (EC, 2013b).

4.3.4.3 Establishing national research and education networks of EU and LMICs

Two different instruments are used to achieve this purpose. The first is based on creating e-infrastructures (i.e. ICT-based infrastructure for research and innovation). Géant, the pan-European high-capacity and high-performance research and education network, is already interconnected, thanks to EU funding, with southern Mediterranean countries (Eumedconnect3), Latin America (Alice2 with Redclara), Asia (Tein4 and Caren) and the Caribbean (C@ribnet). A similar high–capacity internet network, that facilitates information exchange between research and education institutes, is being developed in SSA ('Africa Connect' project). The project has already connected Southern and Eastern African countries into a regional network using terrestrial facilities. Building on the development of e-infrastructure, the EU also supports the African Virtual Campus project that aims at developing a network of fully operational e-learning national centres across Africa. This Internet-based network is going to be used for training on a large scale for both teachers and students.

The second type of interventions consists in fostering collaboration with third country on research and innovation. Globally, this is achieved through the Horizon 2020 programme that has an ICT component. Because participation in the EU research framework programmes is often challenging for LMICs, support measures have been employed, such as the Esastap Plus initiative in South Africa or the EuroAfrica-ICT.org, to encourage Africa participation in EU-funded research programmes with and ICT theme. Under the FP7 (2007-2013) Cooperation programme, the EU financial contribution to third country participants (non-EU 28 countries) to the ICTs sector was divided as follows: industrialized

countries 32%, Eastern Europe and Central Asia countries 20%, Latin-American countries 17%, Asian countries 16% and 10% to ACP countries (EC, 2014e).

4.3.4.4 ICT capacity building initiatives

These are mostly technical assistance activities for public authorities or grants to civil society organisations to promote an inclusive use of ICTs across different sectors of society. These interventions often target national experts or ICT organizations for the purpose of increasing local capacity for benefiting from ICT use. For instance, training to national experts is provided in the key areas of regulatory tools, including universal service, cyber-security, data protection, electronic, transactions and regional statistics. A flagship initiative in this area is the 'ACP-information and communication technologies (@CP-ICT) programme'. With an overall financing of 20 million euros, it aims at supporting ACP governments and institutions in designing, implementing, monitoring and evaluating their ICT national, regional and continental policies (DEVCO Annual Report, 2013).

Besides providing support to country and regional ICT programmes, EU institutions also engage at the international level to promote dialogue on ICT global policy issues. This includes participation in global ICT bodies such as the WSIS, the Internet Governance Forum, and the Global Alliance for Information and Communication Technologies and Development. Since 1996 the EU is a member of ITU and is particularly active in ITU development politics in relation to bridging the digital divide (Oberthür, 2013). Participation of the EU in ITU has been recently declining, but remained strong for issues related to the global internet governance and ITU's development politics. On other ICT related issues EU participation in ITU's debates is channelled through the CEPT that works for the development of an EU common position (Shahin, 2013).

4.4 The EU approach in the use of ICT in healthcare sector in LMICs

In 2004 the STOA promoted a study on the subject of health and ICTs in LMICs, to identify actions that could encourage a wider use of ICTs in the delivery of healthcare services. The study emphasised that there was little use of ICTs in the EU aid for the health sector. The report's recommendations suggested donors to overcome traditional concepts of health cooperation towards a gradual use of ICT innovations, to improve coordination of health programmes and to help LMICs introducing ICTs into their health strategies (STOA, 2004).

A 2010 communication from the EC on the role of the EU on global health recognises that ICT can have a key role in improving health service provision and urges the EU to promote the use of ICTs in the health sector. The communication also urges the EU to better streamline its work with other international bodies, including the OECD, the WHO and the Health Metrics Network for promoting the development of health information systems that allow the collection of comparable health statistics (EC, 2010c).

Whereas other donors have recently started being more active in promoting e-health in LMICs, the EU development cooperation has made little progress in this area. At present, DG DEVCO does not have a specific document or guidelines that guide the use of ICTs within the priority sector of health. A relevant strategy context is provided by the EU eHealth Action Plan 2012-2020, which is however directed to EU Member States. Amongst the operational objectives of the Action Plan, the EU undertakes to promote policy dialogue and international cooperation on e-health at global level. The purpose of this action is to remove obstacles to a wider use of e-health solutions, including lack of interoperability and international standards. It is however unclear to what extent this action is going to engage LMICs (EC, 2012b).

Within the Horizon 2020 programme, the "Health, demographic change and wellbeing" challenge addresses health related issues. The role of ICTs features prominently within the foreseen actions that are however targeted to respond to health challenges for European healthcare systems (Smolders, 2014).

In the lack of a strategic framework that supports the development of e-health programmes within the EU development cooperation, an *ad hoc* project/programme approach prevails (Table 10). For instance, the First Action Plan (2008-2010) for the implementation of the Africa-EU Strategic Partnership identifies telemedicine and early warning systems for epidemics as strategic actions within the ICTs priority area (Africa-EU Ministerial Troika, 2007). Visibility of EU e-health initiatives for LMICs of is also very low, as these are sometimes integrated as small components of larger programmes. Overall, e-health appears to be a relatively unexplored area for the EU development cooperation, being pilot telemedicine projects the only e-health technology that has so far been promoted. The new European strategy on Global Health recognises the potential use of ICTs in improving health service provision, but this has not translated yet in a more systematic use of ICTs in health development projects (EC, 2010c).

Table 10. Examples of EU interventions promoting the use of ICTs in healthcare

Project name	Region	Project description	Reference
T@lemed	Latin America	E-health model to the provision of health services in strongly underserved regions in Colombia and Brazil.	Delazari Binotto, 2006
Hispano American Health Link (EHAS) projects	Latin America	Improving health-care services in isolated rural areas.	Prieto-Egido, 2014
Tackling Aids and Tuberculosis through ICT (TACIT)	Southern and Eastern Africa	Tackling AIDS and tuberculosis through ICT.	ISTAfrica, 2014
Satellite-enhanced eHealth for SSA (eHSA)	SSA	Multi-year programme aimed at establishing sustainable e-health services.	European Space Agency, 2014
Seminar on e-health	Mediterranean countries	Seminar on e-health benefits and cooperation in the Southern Mediterranean region.	Eastern Mediterranean Public Health Network, 2014

4.5 Overview of other donors approaches to promoting ICT

4.5.1 Multilateral organizations

World Bank

The WBG has been leading the global ICT4D agenda. Since 2001 it has an ICTs sector strategy to guide its ICTs activities in LMICs. The WBG supported the ICT in broad terms engaging in both the ICT sector, including networks, infrastructure, policy and regulatory frameworks and ICTs applications, such as the use of ICTs in other sectors (e.g. m-banking, m-health). The rationale for the WBG activities in the ICTs sector is based on the exponential growth of mobile technologies, in both developed and LMICs, and on the importance of ICTs connectivity for economic growth (World Bank, 2012). From 2003 to 2010 the WBG ICTs project portfolio was delivered through a mix of lending, policy advice, investments, advisory services, and political risk guarantees instruments. Most of the WBG funding went to fostering private sector investment in ICT. Worldwide, the WBG provided nearly 1% of private investment in telecommunications and was the largest multilateral financier in telecommunications in Africa.

IFC, a member of the WBG, is the largest global development institution focused exclusively on the private sector in LMICs. It provides advisory, investment and asset management services to the private

sector (IFC, 2015). MIGA, another member of the WBG, promote foreign direct investment into LMICs to help support economic growth and reduce poverty. It provides insurance against political risks and credit guarantee for investors (MIGA, 2015).

Within the WBG the following division of labor is applied: the WB supported telecommunication sector policy and regulatory reforms, including privatisation, while the IFC and the MIGA supported private investments for telecommunication infrastructure and IT companies. More than 1,300 active WBG investment projects, which corresponded to 74% of the WBG project portfolio and amounted to $4.2 billion, were reported to have an ICT component. The sectors that had the highest number of projects with an ICT component were: agriculture and rural development (258 projects), health nutrition and population (144 projects), transport (144 projects), and education (140) (World Bank, 2012). In spite of these achievements, only a few of the WBG sector strategies systematically integrate ICTs in support of development objectives (IEG, 2012).

Building on the results of implementing the 2001 strategy, the WBG adopted a new ICT4D strategy, that was approved in 2012, and that is based upon three pillars: I) the 'Transform pillar' is set to leverage ICTs to promote open and accountable governments and to improve delivery of public services; ii) the 'Innovate pillar' is set to foster IT-based industries. Finally, iii) the 'Connect pillar' aims at bridging the digital divide in terms of national or regional broad band infrastructure. As compared to the past strategy, the new approach marked a shift from supporting voice telecommunication to broad band and high speed internet services, while connectivity infrastructure remains the top priority. The new strategy is also supported by a more structured division of labor amongst IFC and MIGA (World Bank, 2012).

A recent evaluation of the WBG interventions in the ICTs sector found out that the most effective contributions of the WBG have been in advancing sector reform and supporting private investments, especially for the mobile telephony market segment. Differently, targeted interventions, that aimed at granting access to the poor through subsidised and non-commercially viable initiatives, proved to be less successful and were is some cases left uncompleted. In this respect, the evaluators noted that reforms that enabled a more competitive business environment were more effective in cutting costs of communication than other instruments (IEG, 2012).

The development of knowledge products to inform or stimulate public debates on ICT4D is also an area were the WBG has made substantial contributions. The IEG reports states that between 2003 and 2010, the WBG completed 410 analytic and advisory activities for ICTs in 91 countries. Most of these products (51%) were prepared to address ICTs policy, regulatory and competition issues. Another relevant share (40%) of this analytic work went to build capacity of ICTs regulators and other institutions (IEG, 2012).

At the global level, the WBG launched two notable initiatives that have the value of creating platforms for donor coordination in the area of ICT4D. These are the Development Gateway, also supported by the EU, which provides software for improving aid management and procurement of donor supplies and services, and the InfoDev, a multi-donor trust-funded global program that supports innovative entrepreneurs in LMICs through grants and advice. Established in 1995 as an ICT-for-development research leader, InfoDev now assists start-up entrepreneurs through its Mobile Innovation Programme that supports a global network of Mobile Application Laboratories (mLabs) and a Mobile Social Networking Hubs (mHubs) across eleven countries (ITAD & Universalia, 2013).

In the healthcare sector, 78% of projects implemented between 2003 and 2010 included an ICTs component. The experience of the IFC in implementing e-health application projects delivered mixed results. Projects were generally unsuccessful because of the high risk nature of IT projects, but also because of problems encountered in relation to regulatory uncertainties, technological risks, poor quality of the sponsor and competition from other providers. (IEG, 2012)

The 2012 WBG ICT4D strategy includes several examples of how ICTs can be used to improve the delivery of health services, and e-health is a specific priority for IFC focus on IT applications. It also

illustrates a number of suggestions on how ICTs can be integrated into the WBG health specific interventions, such as building global framework of ICTs tools for health care, building capacity of health care workers in basic ICTs skills, improving access to healthcare in rural areas, establishing a more systematised used of clinical data (World Bank, 2012). However, the existing WBG strategy for the health sector released in 2007, does not address the use of ICTs in healthcare (World Bank, 2007).

African Development Bank

The AfDB is a major contributor to promoting ICTs in Africa. The ICT operations strategy of the AfDB has two main goals, namely: i) support the development of regional and national broadband infrastructure, and ii) create an enabling policy and regulatory environment. It also includes cross-cutting areas related to capacity building, coordination, and knowledge management and sharing. An internal review of the existing strategy urges the AfDB to adopt a holistic approach that influences the entire ICTs ecosystem and recommends thus the AfDB to broader its strategic goals to include the development of ICTs applications in government services (AfDB, 2012).

Historically, the AfDB has not engaged in supporting policy and regulatory reforms of the telecommunication sectors. Its comparative advantages rest rather on financing feasibility studies for ICTs infrastructure, investing through its private sector operations in ICTs infrastructure, support ICTs skill development through the establishment of ICTs centre of excellence, and supporting the development of e-applications in various sectors, including health, education and agriculture (AfDB, 2013). As part of its global corporate strategy, the AfDB is also increasing its contribution to developing knowledge products. This is also reflected in the ICT sector, where together with the WBG and the ITU, the AfDB documents the evolution of the ICT landscape in Africa with a number of sector and thematic reports that show the transformational impact of ICTs on African citizens, public sector and businesses (eTrasform Africa Initiative).

Inadequate staffing and skill mix is reported to be a major limitation for expanding the AfDB ICT project portfolio. This also resulted in a still too limited use of ICT applications in sector such as governance, health, agriculture, trade and regional integration (AfDB, 2012).

In the healthcare sector, the AfDB is increasingly promoting the use of ICTs. To this purpose it has set a number of ambitious targets, including: i) promoting the use of ICT in all its current and new health operations; ii) promoting a new model of ICT-based hospitals; iii) supporting its member countries in developing and implementing e-health policies; iv) supporting knowledge production on e-health; v) providing capacity-building programs for increased use of new technologies in healthcare service delivery; and vi) promoting public–private partnerships between African governments and private ICT providers to pilot and scale up e-health and m-health innovations (AfDB, 2014). Table 11 below summarise the ICT4D approaches of the WB and the AfDB.

Summary of the ICT4D approaches of the WB and the AfDB

Topic	World Bank	African Development Bank
Strategic approach	Target and mainstream	Target and mainstream
Major contribution to ICT4D	Infrastructure, ICTs policy and regulatory frameworks, ICTs for development research, IT-based industries	Infrastructure, knowledge products, ICTs capacity building, policy and regulatory framework
Actions in the health sector	Focus on m-health	Broad spectrum of interventions from policies to capacity building and development of e-health applications
Challenges	Further promote a competitive business environment for ICTs; developing viable e-health application	Inadequate staff and skill mix Broaden approach to the ICTs sector development to include It applications in services and public administration

4.5.2 European bilateral donors

United Kingdom

ICT is not a focal sector of the British development cooperation, but it is rather mainstreamed in different priority sectors. Generally, DFID, that leads UK's aid work, has a strong focus on promoting access to knowledge and information and for collecting evidence on the potential role of ICTs in fighting poverty.

DFID supports a large number of ICTs related initiatives in LMICs. A search performed in April 2015 on DFID Research for Development database (R4D), an on-line portal keeping information about research funded by DFID, reveals that there are 345 records related to ICTs. These include analytic or research works (297 records), or projects (3 current and 45 completed projects). The large majority of documents and projects are developed in partnership with other organisations. Most documents target the mobile communication sector, the internet or ICTs capacity building issues. Together with the IDRC, (a public corporation created by the Canadian government to help communities in the developing world), DFID is a co-founder of the ICTs for Development Research and Capacity Development Programme, targeting the region of Asia and Africa for a better use of ICT for the poor. The programme has also been sponsoring research on the use of ICT in healthcare, especially with reference to the use on mobile phone in maternal health (Department for International Development, 2011).

In 2012, DFID released a new digital strategy to integrate a digital culture into all aspects of aid policy making and delivery. The strategy does not set the objectives of British aid with respect to ICT4D, but it rather foster the use of ICTs within DFID departments to improve transparency, internal efficiency, external and internal communication flows and aid policy development (DFID, 2012).

Sweden

SIDA, a government agency working on developing and implementing Swedish aid programmes, has a long history of supporting the use of ICTs in LMICs. As early as 1999, SIDA adopted an ICT4D strategy and in 2002 established an ICTs for Development Secretariat within its Infrastructure Department. SPIDER, the Swedish Programme for Developing ICTs in Developing Regions, is the most notable ICTs initiative in the Swedish development cooperation. This multi-year program mobilised ICTs experts to

help LMICs use ICTs effectively for poverty reduction. It also served as an advisor for SIDA ICT4D projects (Greenberg, 2008).

The ICT4D Secretariat had the challenging task of mainstreaming ICTs within SIDA's aid programs. However, two independent evaluations of SIDA's ICT initiatives carried out in 2008 and 2009, noted that ICT mainstreaming efforts were not successful. This was due to a number of reasons, including the moderately developed IT competencies of most SIDA staff, the lack of decentralised ICT focal points, and the existence of pre-conceived ideas about the use of ICT4D and poverty reduction. The current SIDA aid policy framework still considers ICT is a major contributor towards economic growth and poverty reduction. It addresses the digital divide in terms of granting the broader possible access to an open and free Internet to the poor and of improving capacity and infrastructure at country levels (SIDA, 2014).

Mainstreaming efforts of ICT were also directed at the health sector. Through the Internet it was possible to identify three recent health projects with an e-health component. The first, 'Research on climate change and health using e-health as a tool' targeted Indonesia, was concluded in 2013 and aimed at establishing a Swedish-Indonesian collaboration for increasing medical preparedness through eHealth. The second, 'Developing a multi-sectoral approach model for sustainable health and development' was conducted in India and had an e-health component promoting the use of e-health to improve access to care. The third, 'Improving maternal health through the Internet' created an online healthcare guide for pregnant women and parents of young children in China. All these projects were based upon a collaboration with Swedish universities that is a characteristic feature of Sweden's approach for promoting ICT.

Germany

For the German development cooperation ICT is both a cross-cutting issue and a development goal in its own right. The Federal Ministry for Economic Cooperation and Development has recently released guidelines to support dissemination and use of ICTs in LMICs. The strategy advocates the enabling function of ICT in reducing poverty and furthering progress towards the MDGs. While emphasizing the importance to continue supporting ICT initiatives within multilateral organisation, the strategy also sets the strategic priorities for German aid for ICT. These are to improve regulation of telecommunication market; to support the local ICT sector (e.g. by providing long-term financing to telecommunication infrastructure and service providers, capacity development for local IT firms); to increase the use of ICT in sector programmes (including governance, healthcare, education, financial system and private sector development), and to enhance cooperation with the private sector (BMZ, 2013).

The health sector strategy of the German development cooperation was issued in 2009 (BMZ, 2009). It does not address the theme of integrating ICTs into health bilateral programmes. However, through the Health Development portal, it was possible to identify a number of initiatives that promoted eHealth in LMICs. These include activities for supporting the development of health information system (BMZ, 2014a) or for promoting a wider use of ICTs in healthcare - e.g. the 2014 Manila conference on universal health coverage through ICTs, a joint initiative of the Asia eHealth Information Network, the WHO and the ADB meant to exchange knowledge on health system improvements using ICTs (BMZ, 2014b).

Finland

Since 2005, Finland has adopted a policy document to guide its ICT4D activities. The policy translates in a development context the principles of Finland's inclusive knowledge society, and attaches great importance to developing information societies in LMICs. Overall, the goals of Finland ICT4D policy are set to employ ICTs to alleviate poverty. To this end, Finland's ICT4D policy calls for mainstreaming ICTs in different development sectors, including education, governance, health and private sector development (Ministry of Foreign Affairs of Finland, 2005).

Finland approach towards ICT4D made an explicit depart from a technology-centered ICT development assistance and focused on integrating ICTs into development process in favour of larger society-wide impacts. This allowed Finland to pursue an innovative approach based on user-driven innovations that empowered local people and fostered local technologies. In this respect a relevant contribution came from a series of bilateral programmes in South Africa supporting ICTs and innovation systems (COFISA, INSPIRE, SAFIPA) (Halme K, 2014).

France

French aid for the ICT sector is structured along four axes: i) improving access to the Internet; ii) capacity building; iii) support for regulatory frameworks; and iv) development of ICT services and content. In parallel, the French Agency for Development (Agence Française de Développement) is supporting ICT infrastructure projects, whereas PROPARCO (a subsidiary of AFD), is providing financial support to private mobile telecommunication operators in different countries of Africa and Haiti. The French development cooperation has been actively supporting the ICT sector, especially in SSA.

Another relevant feature of France aid for ICT4D is the strong focus on education and health sector applications. Between 2007 and 2009, 68 ICT projects were implemented, mostly supplying ICT in the education sector. The 2010-2012 overall aid programming plan had a specific component addressing the digital divide (MAEE, 2011).

The French approach in the ICT sector is based on identifying and testing the most promising innovations in terms of feasibility and sustainability (AFD, 2014). With this respect, France contributed to advance knowledge about the use of ICT in economic development and poverty reduction. For instance, it sponsored a research project that looked at the emergence of innovative ICT business models in models in education, health, agriculture and financial services that impact on the life of the poor (Hystra, 2011).

France is promoting a larger use of ICT in the health sector of LMICs, especially in relation to distant learning for health workers and to the use of telemedicine for remote diagnosis. To further promote the use of ICTs in healthcare, France urges recipient countries to adopt national health policies that clarify the use of ICT in healthcare to scale-up sustainably of the existing initiatives (AFD, 2014). Table 12 below describe in brief the ICT4D approaches of a selected number of EU Member Stataes.

Table 11. Summary of the ICT4D approaches of a selected number of EU Member States

Topic	UK	Sweden	Germany	Finland	France
Strategic approach	Mainstream	Mainstream	Target sector and mainstream	Target sector	Target sector and mainstream
Budget*	18.9 – 73.6	0.1 – 15.7	8 - 24	2.4 – 36.5	0.2 - 59
Major contribution to ICT4D	Research ICT and poverty reduction	Knowledge transfer	Infrastructure, regulation of telecommunication market, support to the ICT sector	Knowledge transfer	Infrastructure, education, health
Actions in the health sector	Yes	Yes, telemedicine	Yes, HIS	N/A	Yes, telemedicine

Source: OECD; *: indicates the minimum and maximum yearly amounts of resources committed to LMICs aid (million euros, 2009-2013), within the following sectors: 'ICTs ', 'Telecommunications ', 'Radio-television-print media'.

4.6 Conclusions

EU approach

Within the EU's aid policy frameworks, ICTs are perceived as enablers of economic growth and poverty reduction and are thus advocated as relevant development instruments to be employed as much as possible across different areas of the EU development cooperation. The review identifies that the EU ICT4D initiatives can be grouped in four major areas of intervention: i) harmonisation of ICT policies and regulatory frameworks; ii) ICT infrastructure development; iii) ICT capacity building, and iv) collaboration in ICT research and innovation.

The lack of a central repository of initiatives related to ICT4D makes it difficult to reconstruct the contribution of EU institutions in promoting ICTs in LMICs. There are no independent evaluations of ICT4D initiatives supported by the EU, and only a limited number of information on ICT programme outputs can be found in the EU DEVCO annual reports. Low visibility and little dissemination of ICT4D programme outcomes were also observed. Identification of good practices of EU ICT4D projects was not possible because of the lack of documentary evidence specific to this sector.

The EU intervention in ICT4D is still characterized by a technology-centered approach. Two past STOA studies stressed an excessive use of a top-down approach, the need to strengthen the support for bottom-up initiatives and the lack of a clearly focused strategy. Since then, progress has been mixed. In spite of having a quite diversified ICT project portfolio, the EU is not a leading donor in this sector. As compared to other large multilateral donors, such as the WBG or the AfDB, the lack of a clearly focused ICT strategy resulted in a fragmented ICT portfolio. Mainstreaming of ICT in other focal sector of the EU development cooperation has also progressed slowly and unevely. This is due to the lack of an ICT4D coordinating unit in DG DEVCO.

A distinctive approach of the EU assistance for ICTs, that is also similar to other EU bilateral donors such as Sweden or Finland, is the prominence of initiatives fostering learning and innovation networks, and in establishing ICT research partnerships amongst European and LMICs institutions. As compared to other EU member state aid, the EU approach in promoting ICT is marked by a larger use of regional and continental initiatives, especially in relation to promoting harmonisation of ICT policy and regulatory framework.

At present, e-health does not emerge as an area of strong involvement for the EU development cooperation. The new European strategy on Global Health recognises the potential use of ICTs in improving health service provision, but this has not translated yet in a more systematic use of ICTs in health development projects (EC, 2010c). Besides the eHealth Action Plan 2012-2020, which is directed to EU Member States, DG DEVCO does not have specific guidelines to support a more systematic use of ICTs within the priority sector of health. The EU development approach for e-health mostly rests on pilot initiatives, especially focused on the use of telemedicine, and remains a largely unexplored areas.

Major trends and policies shift in ICT4D

This review highlights that there are different approaches in how to mobilise resources for ICTs in development cooperation. In recent years, donors support for the ICT sector has shifted from financing infrastructure to providing assistance for ICT policy and regulatory frameworks and IT capacity building. Driven by the mobile phone revolution in LMICs, the financing of applications for mobile phones in different sectors, such as health or finance, has become an increasingly are of interest for donors. Both the WB and the AfDB have been actively supporting development of applications for mobile phones.

Donors generally combine a two-pronged approach for promoting ICT in LMICs that is based on targeted intervention for the ICT sector (e.g. financing broadband infrastructure, support to IT-based

industries), and mainstreaming of ICTs in priority sectors. Mainstreaming of ICT across different focal sectors has been a dominant theme amongst donors. However, mainstreaming efforts, often led to a lack of focus on ICT, especially in the absence of a clearly focused ICT strategy or ICT internal units. The ICT mainstreaming issue has been approached differently across the donor included in this analysis. Some like the UK or Sweden sees ICT as a cross-cutting issue and increasingly integrate ICT into their programmes and aid delivery systems. Others like Germany or the WB, follows a two-fold approach where ICT is both gradually mainstreamed into priority sector programmes and is also targeted as a stand-alone sector with specific interventions. France, that is also adopting a two-fold approach, has a strategic focus towards promoting ICT in the two sectors of education and health, rather than applying a full mainstreamg approach.

The present review also highlights that there is scarce independent literature addressing donor approaches in the ICT4D sector. Many case studies have been financed, mostly by donors or international organization, but only three of the considered donors (e.i the WBG, Sida, and the AfDB) have recently conducted evaluation or internal reviews of their approaches towards ICT4D that allow to learn lessons from past interventions. This is certainly an area where more independent research is needed.

The wide use of ICT in health development cooperation has only recently emerged, thanks to the high penetration rate of mobile phones that opened new opportunities for universal health coverage. Whereas some donors, including the EU or France, have been focusing on pilot telemedicine projects, others, such as the WBG and the AfDB, have been supporting the use of mhealth applications. However, it emerged that in most cases e-health projects in LMICs still have a small scale and a pilot nature. In addition to this, the lack of donor coordination is leading to a plethora of non-interoperable applications that are hardly scalable at the national level.

5. Survey

5.1 Introduction

An online survey was designed to collect qualitative and quantitative data from a sample of experts in the fields of cooperation, ICTs and health, in order to investigate on the usage of ICTs in LMICs, and the effectiveness of EU Institutions policies and strategies concerning ICTs in LMICs. The ultimate aim of the survey was to discuss the policy options EU Institutions should embrace in this field of development cooperation.

This chapter is organised as follows: the next section present the methodology applied to the survey. Section 3 describes the sample of survey respondents. Section 4 describes respondents' opinion on basic issues concerning ICTs for development, as the areas in which ICTs are more relevant in LMICs' development and the main obstacles to ICT4D. Section 5 focuses on the survey results that provide indications on the role that ICTs can play in LMICs' healthcare. Section 6 is centred on EU Institutions' policies and strategies. It analyses respondents' assessments about EU Institutions' past and present initiatives in the field of ICT4D, the strategy and general approach they should follow, key areas of interventions and most effective instruments. Finally section 7 summarizes the conclusive remarks.

5.2 Methodology

The survey's (closed form) questions and their possible answers were drafted on the basis of the most relevant issues emerged from the three literature reviews carried out for this study. At the end of February 2015 a pilot test was launched, sending the questionnaire to 10 selected experts. The list of possible answers was modified for some questions, as well as some questions formulations, in light of suggestions gathered in the test phase. Invitations to the on-line survey were sent on 12th March 2015 via e-mail through an electronic system. A letter of introduction from the EP, encouraging the experts to contribute to the consultation, was attached to the invitation message. On the 30th of March a reminder was sent to the experts invited to the survey, and on the 3rd of April the survey was closed. Inspiration to draft the questionnaire has been taken after the analysis of the literature review (presented in chapters 2-4), interviews with experts of the field and previous surveys on the same subject (The eLearning Africa Report, 2015).

The questionnaire was structured in four sections (a draft questionnaire is included in Annex II):

- Section A entitled 'Personal information', aimed at collecting basic data about respondents, and in particular their type of job affiliation, job description, years of experience in relevant areas, countries they work in.

- Section B entitled 'Role of ICTs in Economic Development of LMICs', set to capture respondents' opinion on some basic issues concerning this topic. This section provides a general background for the two more specific issues analysed in the subsequent sections.

- Section C entitled 'ICTs for Health' investigates on benefits and limits of e-health programs and technologies in the LMICs, and on most effective policies in this area.

- Section D entitled 'EU Institutions policies in ICTs for Development' represents the core of the survey, collecting respondents' evaluations of past EU initiatives/strategies and their opinions on the type of intervention and approach EU Institutions should pursue in ICT4D policies.

Section B, C, and D ended with open questions, asking to leave any general comment. Comments were screened and selected on the basis on the "value added" of the information they contained, in order to avoid repeating ideas already emerged from closed-form responses.

The majority of questions asked the participants to select and rank 3 or 5 answers from a larger set. For these questions, for each possible answer two pieces of information have been extrapolated: i) the percentage of respondents that selected such answer (independently of its ranking); ii) a synthetic score measuring the average preference/ranking given to such answer. The latter measure was constructed as follows: for each question, a score of 5 (3) was assigned to each answer any time it was ranked in the first position. A score of 4 (2) was assigned any time it was ranked in the second position, and so on. Then a weighted average of all answers' scores was computed. The resulting indicator measures the average preference assigned to each answer by those selecting it. It is worth highlighting that the two indicators measure different things: the first one (the % of respondent selecting a certain answer) synthetizes the opinion of the majority of respondents about the relevance of an answer. The second one measures "how important" was on average that answer for those who selected it. Thus it can assume relatively high values even for answers selected by only few individuals, if they have all assigned a high ranking to them.

The methodology to identify the target respondents involved four main strategies: i) contacts collected from public lists and online databases; ii) contacts directly collected from database of the project's team, especially from the business sector; iii) contacts provided by STOA and the EC; and iv) formal request sent to consortiums and companies involved in ICT4D and ICT4Health as investor or donor. In addition, the survey also relied on the spontaneous circulation of the questionnaire through specific professional and social networks (e.g. LinkedIn, Google groups).

The target respondents have been searched both at a global, national and regional level. Efforts were made to select entities with a potential role in all the different phases of the ICT4D policies and programmes, such as director of specific areas and coordinators.

The survey was designed to collect different perspectives on the theme under analysis. Target respondents belong to six main categories:

- Independent experts in ICT4D, including e-Health (academia, think tank, research institute);

- Bilateral and multilateral donors (e.g. UN, WHO, SIDA and other development agencies);

- NGOs and other operators;

- Private for-profit sector (ICTs all-size firms, suppliers of ICTs structures and knowledge management);

- Public authorities, i.e. recipient countries' institutions/agencies/structures (e.g. Ministry of Health, national commissions, hospitals);

- European Union institutions.

A special effort was made to ensure a significant representation of experts from the academia, expected to express a more independent view on the topic. Several questionnaires were only partially completed by respondents, which is probably due to both the survey's not negligible length (29 questions) and the heterogeneity of respondents' expertise. As the survey was made of sections covering different topics, some respondents may have abandoned the survey when asked questions concerning issues outside their main area of expertise. In particular, the last section required some specific knowledge of EU policy that not all experts might have.

5.3 Respondents' information

5.3.1 Respondents' type of affiliation (Section A)

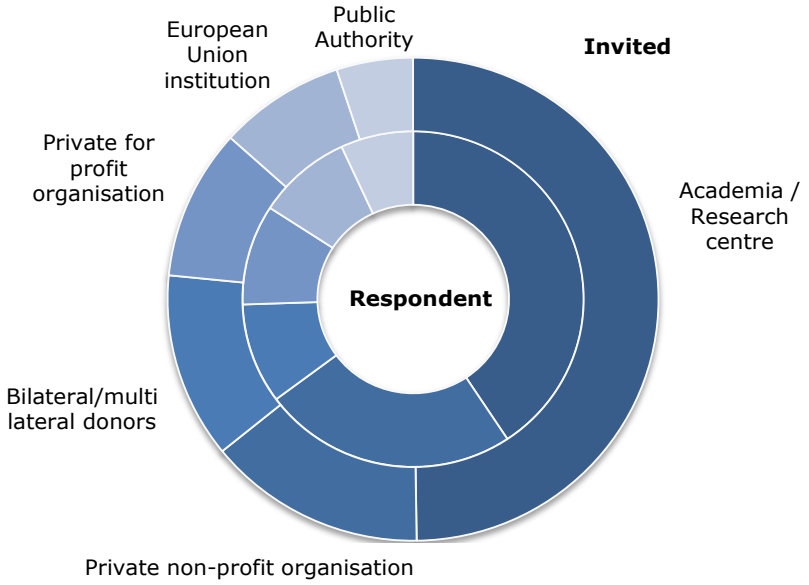
Overall the invitation was sent to 1,275 experts. Sixteen experts left the survey after having replied to section A, i.e. the one collecting only personal information. These respondents have been excluded from the analysis (including part A) as their contribution is null. Out of total expers invited to participate

(1,275), 145 (11%) replied to section B, 127 (88% of 145 participants) replied to section C and 121 (83% of participants) replied to section D. An analysis of the subsamples of individuals replying to each of the four sections showed that the sample composition did not change significantly, in terms of key personal characteristics (type affiliations and jobs). This indicates a good degree of homogeneity of respondents across different sections.

The sample of survey respondents (Fig. 15) is characterized by a significant presence of experts working in the academia/research centres/think tanks (59, 41%). This is partially due to the design of the survey, whose invitation was sent to a relatively high number of academia experts, and partially to the respondents' self-selection. In general the high representativeness of the academia should ensure a greater degree of independence among survey respondents. However, for some questions this could also entail some distortion: in these cases a breakdown by type of affiliation was carried out to control for this aspect. Experts employed in NGOs constitute the second largest pool of respondents (35, 24% of total sample). Within this category, the majority of experts are either project managers (11, 31%) or ICTs specialists (6, 17%).

The other typologies of affiliation are equally represented: bilateral/multilateral donors (14, 10%), private for-profit organizations (14, 10%), EU institutions (13, 9%), public authorities (10, 7%). The sample provides a good balance between private and institutional actors: private profit and no-profit organizations account for 34% of respondents' affiliations, whereas public authorities, public organizations and European Union institutions for 26%.

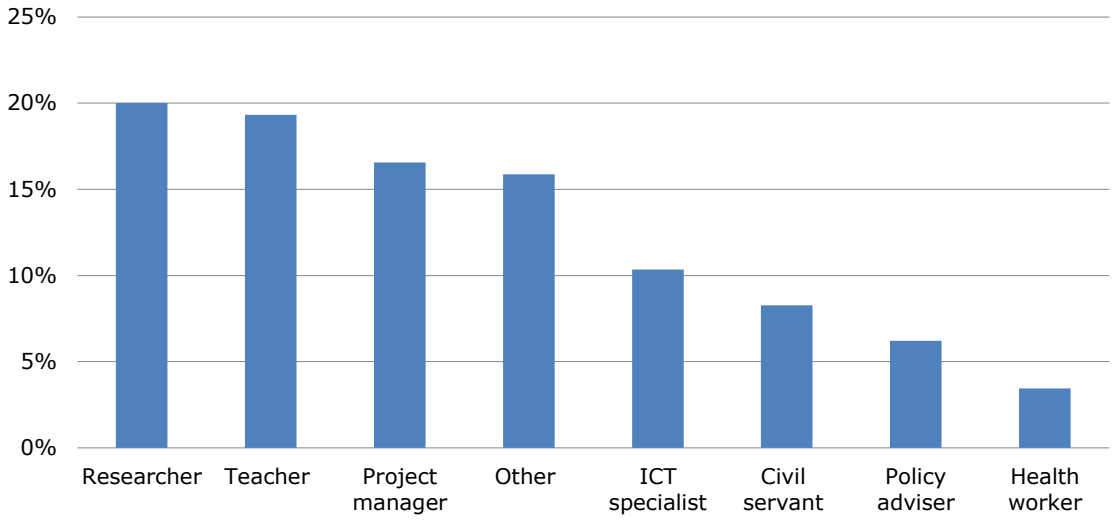
Figure 15. Breakdown of experts invited to the survey and survey participants by type of affiliation [145 respondents]



5.3.2 Respondents' type of job

Researchers, teachers and project managers are the most represented job positions, accounting respectively for 20%, 19% and 17% (Fig. 16). The percentage of participants choosing to select the 'Other' option and to write their position by their own is quite high (23, 16%): 14 out of these 23 respondents hold managerial roles (as 'CEO', 'Executive director', 'Programme manager').

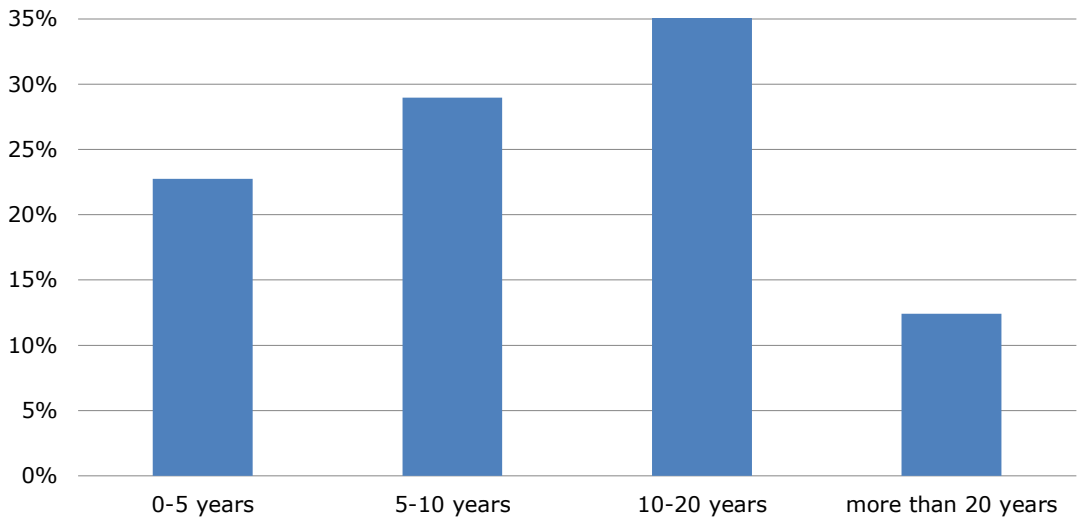
Figure 16. Breakdown of survey participants by type of job position [145 respondents]



5.3.3 Years of experience in relevant fields

The majority of survey participants (112, 77%) work in the field of ICT4D, development cooperation and/or health sectors in LMICs for more than 5 years (Fig. 17), which ensures that most of collected opinions have been formed during a significant professional path in the fields of interest. Of all, 65% of respondents report between 5 and 20 years of experience.

Figure 17. Breakdown of survey participants by years of experience in the ICT4D, development cooperation, health sectors in LMICs [145 respondents]

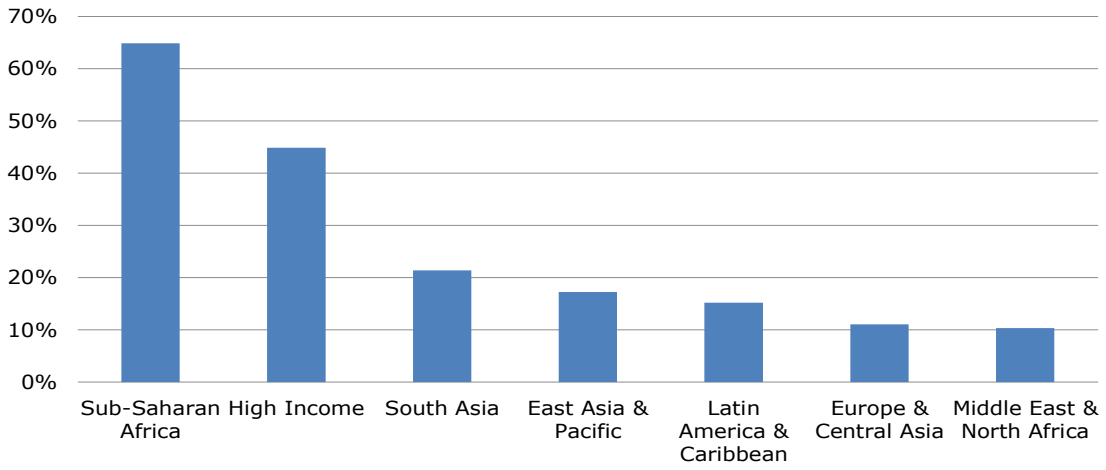


5.3.4 Geographical distribution

The survey included a question asking participants the 'country in which they work in'. In order to synthetize results countries have been grouped according to the January 2015 World Bank list of economies, which includes a categorization of low and middle income economies, whereas it considers high income countries apart (World Bank 2015). Only half of respondents (74, 51%) selected a single country, 6% selected 2 countries, 44% selected 3 or more countries. The majority of respondents (94, 65%) indicated to work in one or more countries in SSA, which is a particularly interesting area in the frame of

this survey. More than 40% of participants reported to work in high income countries, 1/3 working exclusively in such nations (Fig. 18).

Figure 18. Geographical coverage: percentage of survey respondents working in each of WB regions [145 respondents]



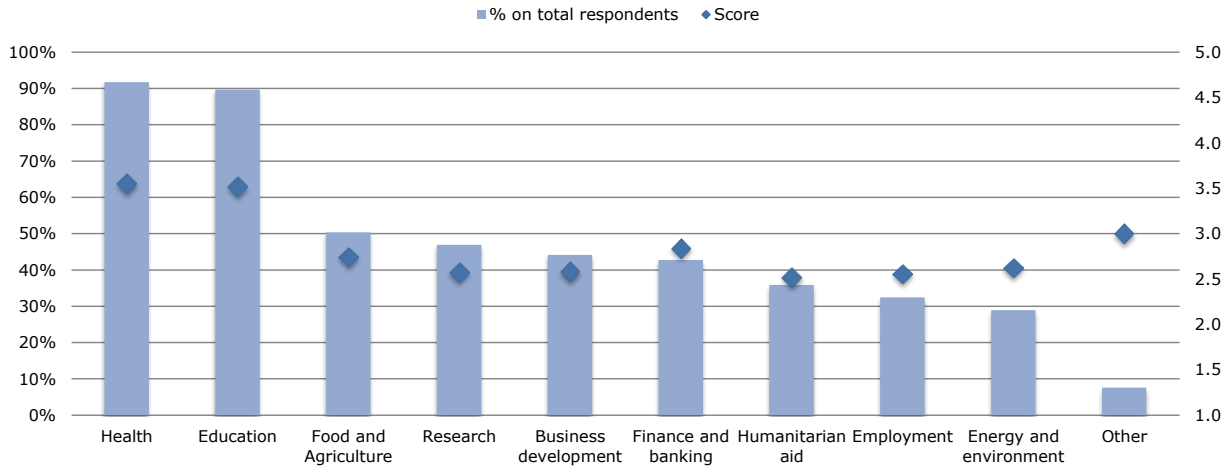
Note: January 2015 'World Bank list of economies' has been adopted to come up with a regional categorization of low and middle income economies. This categorization considers high income countries apart. As many respondents indicated to work in different countries, overall percentages sum up more than 100%.

5.4 Role of ICTs in the economic development of LMICs (Section B)

5.4.1 Areas where ICTs are more relevant for economic development

More than 90% of respondents clearly converged to highlight two main areas where ICTs are more relevant in the economic development process: health and education. In addition, such areas often ranked among respondents' first choices, as indicated by their high scores (Fig. 19).

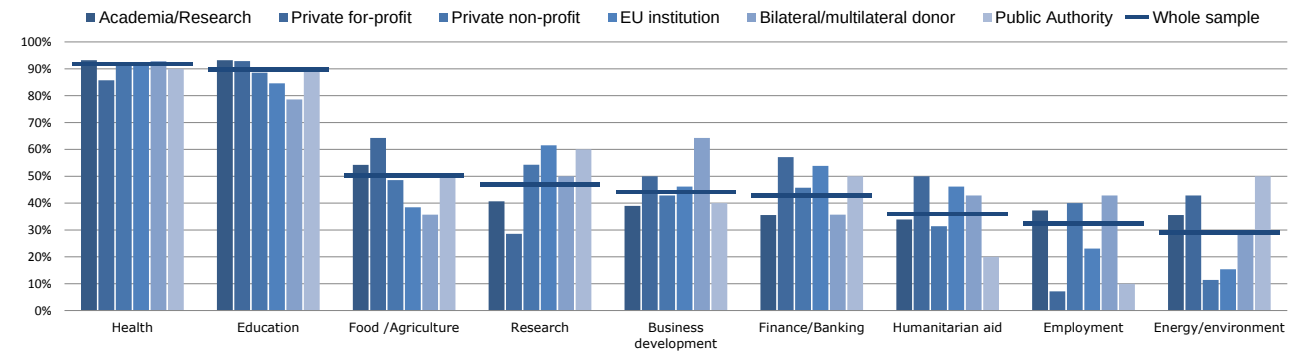
Figure 19. Question B1. Please rank the 5 policy areas where, in your opinion, ICTs are more relevant for economic development in LMICs (% of respondents and score). [145 respondents]



Note: the left axis refers to the percentage of respondents that selected each answer. The right axis indicates the score achieved by each answer.

Grouping respondents by type of affiliation, it emerges that the percentage of individuals selecting health and education is much similar across different groups (Fig. 20).

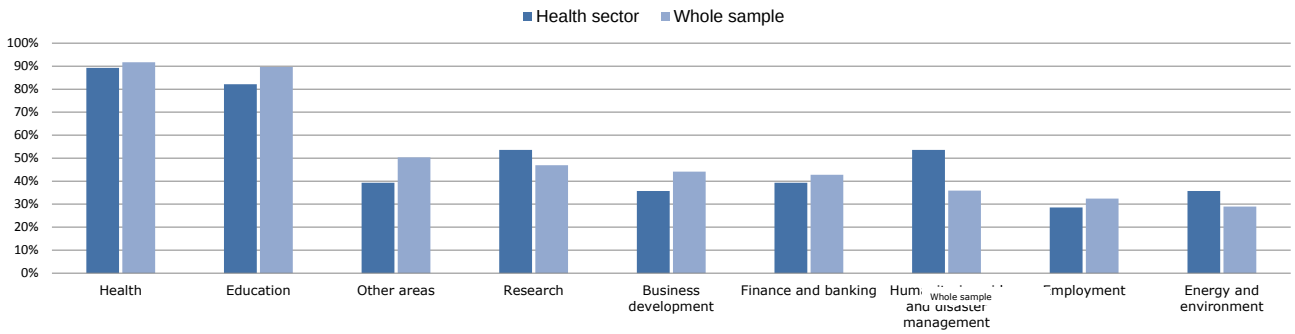
Figure 20. Question B1. Percentage of respondents by type of affiliation [145 respondents]



Note: the vertical axis refers to the percentage of respondents that selected each answer.

It may be interesting to check whether experts working in the field of health share the general view that ICTs are much relevant in this sector. Even though it was not always possible to determine the area of specialization of respondents' affiliations with the available information, a variable identifying affiliations that are surely engaged in the health sector has been constructed, isolating both well-known health organizations (e.g. WHO) and affiliations whose name undoubtedly indicates their focus on health. Of all 145, 27 (19%) have been considered engaged in the health sector. It can be seen that those working in the Health sector (identified in the way just mentioned) share the same opinion of others (Fig.21).

Figure 21. Question B1. Percentage of respondents with affiliation in the health sector [145 respondents]

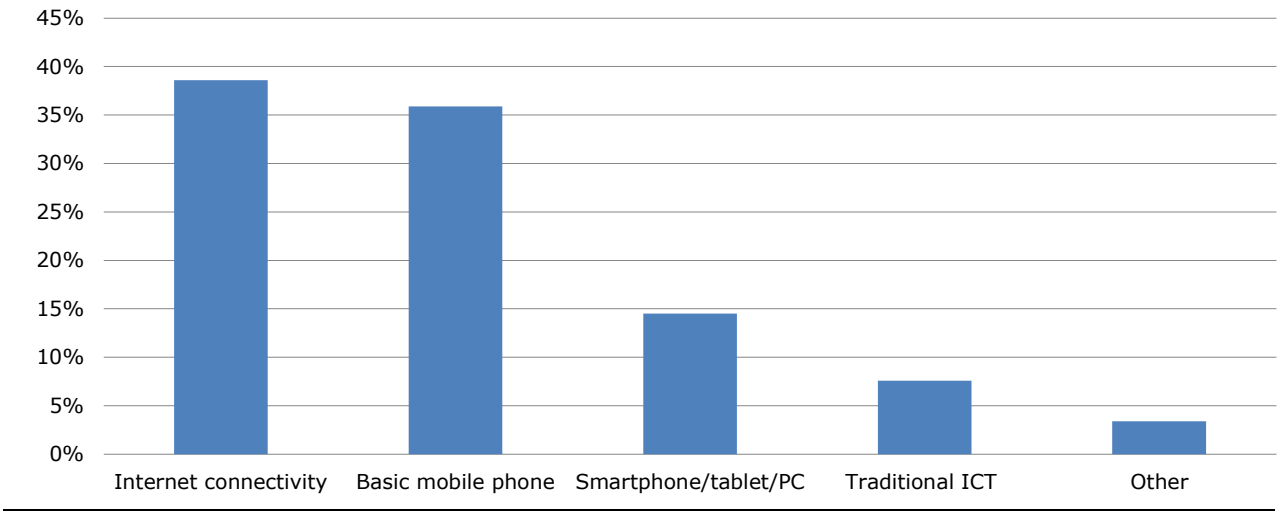


ICTs are thus perceived as being able to enhance development especially through these areas, and only secondarily within the scope of policies concerning economic activities (e.g. food and agriculture, finance and banking), notwithstanding there is some evidence of a positive impact of ICTs diffusion on growth and productivity, and the development of the ICTs sector entails the creation of new jobs.The importance attributed to the health and education sectors among respondents emerges also controlling for the geographical region they work in. In all cases these are the sectors chosen most frequently. Experts working in Latin America & the Carribean (22, 18%) are the only ones choosing the education sector (21, 95%) more frequently than health one (19, 86%).

5.4.2 Key ICTs for economic development

In general internet and basic mobile phone are the technologies considered as most important (Fig. 22).

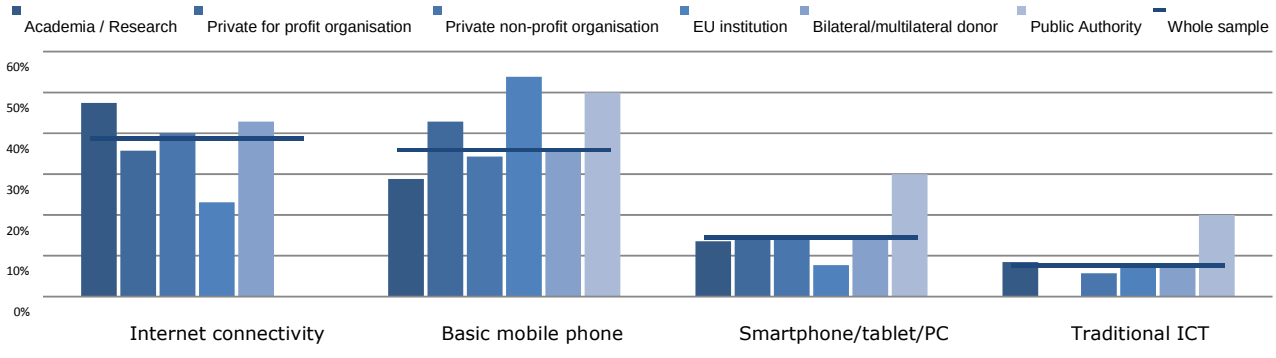
Figure 22. Question B2. According to your experience, which ICTs mostly impact economic development in LMICs? (% of respondents) [145 respondents]



As showed by ITU's data quoted in the literature review, the latter one is much more widespread in LMICs than internet and mobile-broadband, so that both the business related to mobile technology and the other potential externalities stemming from its diffusion can currently leverage a greater critical mass of users in these countries, with respect to internet. (ITU, 2014). Still, internet connectivity is considered by a slightly higher percentage of respondents as the most important technology. Internet wider functionalities may determine this result. In addition, internet diffusion can be seen as a necessary step for LMICs to avoid enlarging their digital divide, taking into account that the internet revolution in developed countries is still in progress.

Experts' opinions are heterogeneous across different groups when assessing which are the most important ICTs technologies for economic development (Fig. 23).

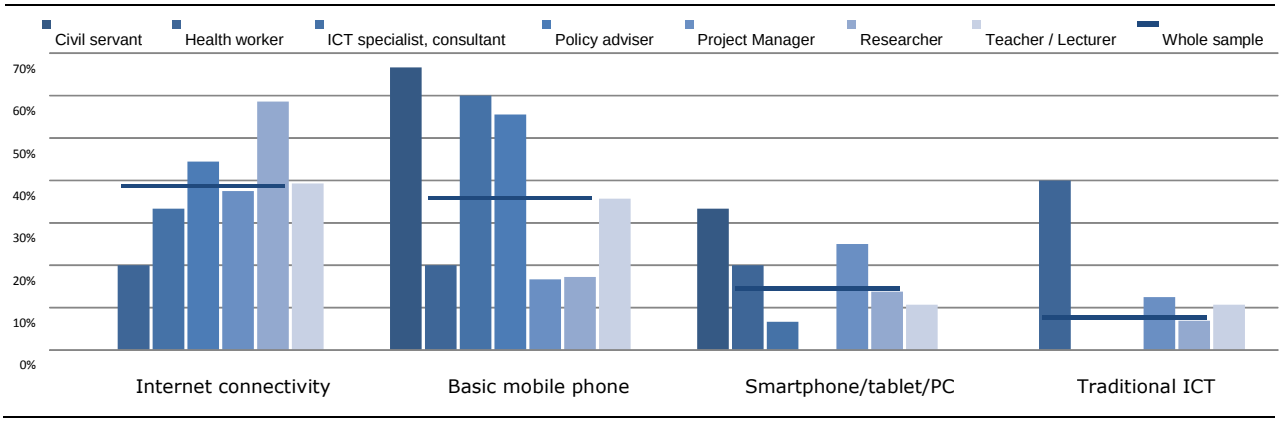
Figure 23. Question B2: percentage of respondents by type of affiliation [145 respondents]



Respondents working for bilateral/multilateral donors and the academia tend to stress more than others the importance of internet connectivity, whereas for those employed by European institutions and public authorities mobile technology is more essential.

A significant variation is found also across different job typologies (Fig. 24).

Figure 24. Question B2. Percentage of respondents by type of job [145 respondents]



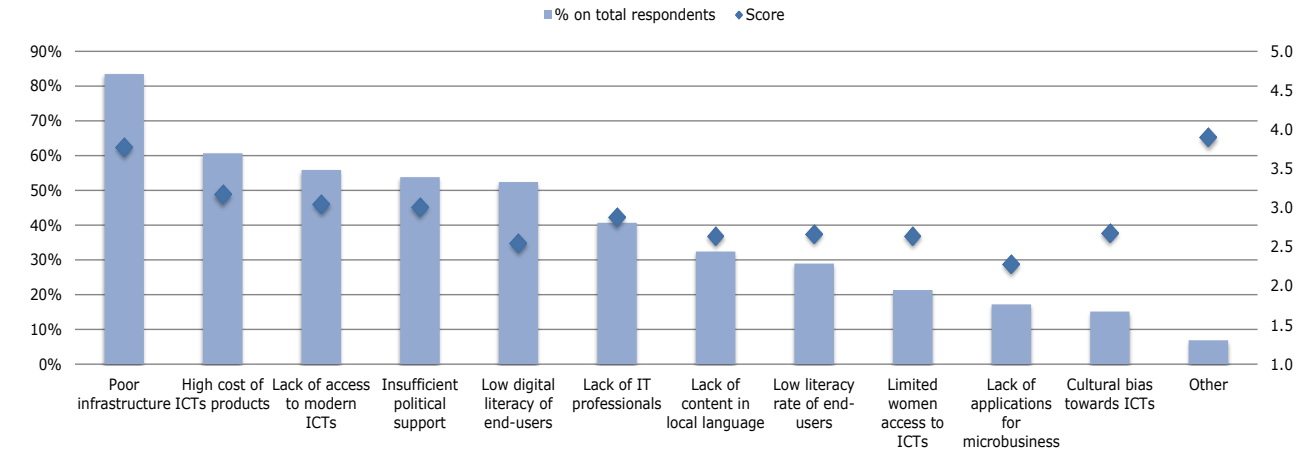
Available data do not allow to support specific explanations. It may be simply due to the fact that there is no mostly impact technology, but the impact of an ICTs depends on a variety of context conditions.

5.4.3 Obstacles to ICTs for economic development

For what concerns the obstacles to be tackled in order to unleash ICTs potential in LMICs, the survey primarily stresses the importance of the poor infrastructure endowment of these countries (Fig. 25).

This should not be referred only to ICTs-specific infrastructures, but also to more basic ones, whose poor performance can affect the latter. As noted by some respondents who left a written comment in this section, also the lack of a stable electricity supply is a major issue. Poor infrastructures determine a low coverage and low quality of service, which as noted in the literature review reduces the scope of ICTs potential benefits. This is a particularly harsh problem in rural areas, where sometimes commercial viability for investments is lacking.

Figure 25. Question B3. Please rank the 5 main obstacles that in your opinion mostly hamper the use of ICTs for economic development in LMICs (% of respondents and score) [145 respondents]



Other major obstacles can be grouped into three categories: affordability ("High cost of ICTs products", "Lack of access to modern ICTs") human capital ("Low digital literacy of end-users", "Lack of IT professionals"), and political support. The cultural bias towards ICTs is rarely seen as a major obstacle (22, 15%). In addition the low digital literacy of end-users, though being among most selected answers, shows a relatively low score (2.67), signalling this is not seen as a priority problem. Of note, literacy rate has been selected as potential obstacle more often by respondents employed in bilateral/multilateral

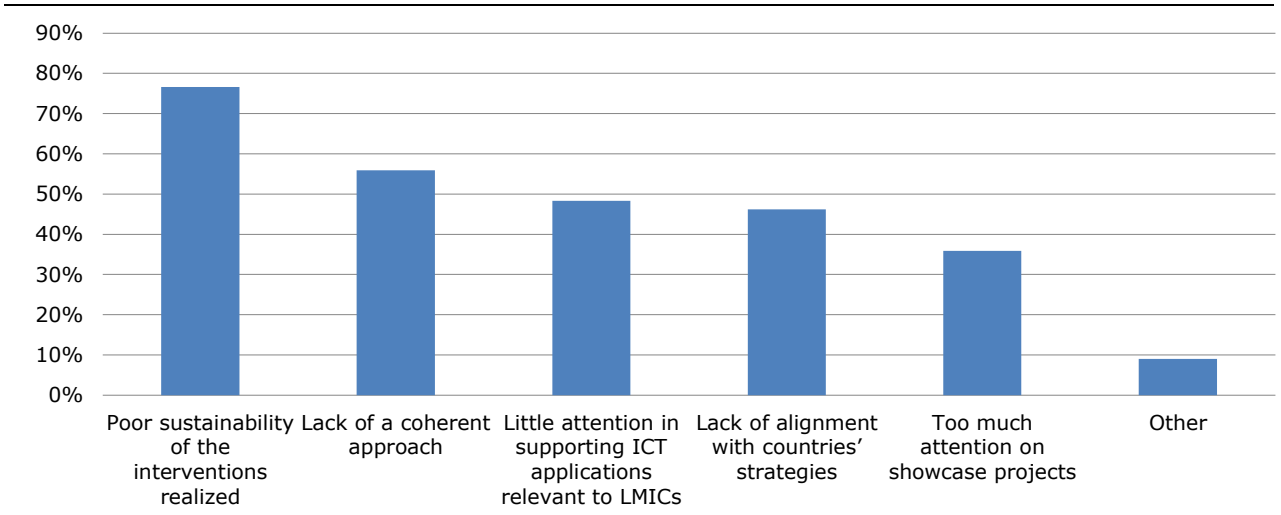
donors (57%) and European institutions (46%), with respect to all others and in particular to those employed in NGOs (17%).

5.4.4 Donors' shortcomings in donors' approaches in promoting ICT4D

At the end of this general overview on the role of ICTs in LMICs development, respondents were asked to assess which were donors' main shortcomings (Fig. 26). The sustainability of their interventions is the most critical issue. The literature provides many examples of initiatives that terminated at the end of the pilot phase. Also the other three most selected shortcomings are indirectly related to sustainability, as a coherent approach, an attention to support relevant technologies and an alignment with recipients' strategies clearly increases the probability to develop long-lasting projects.

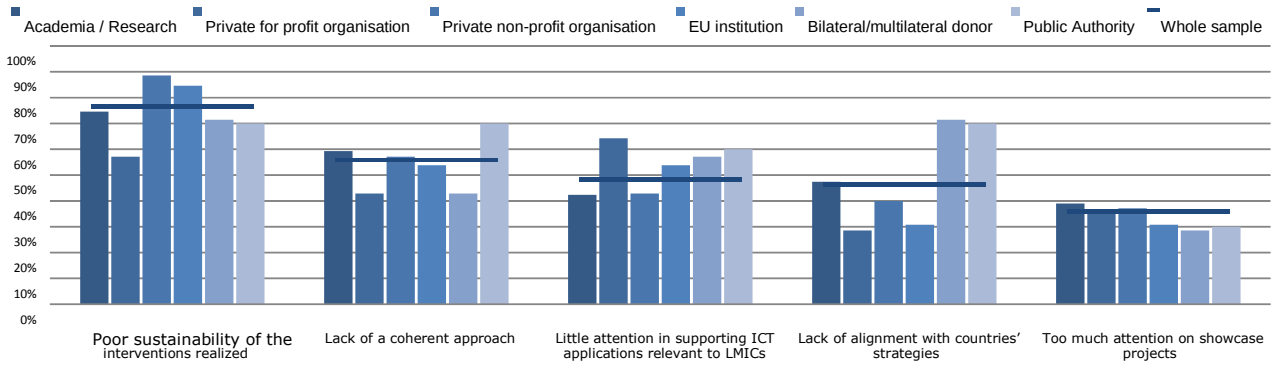
Experts working for private non-profit organizations are those more concerned about the sustainability of projects, which may signal a greater risk of scarce sustainability for projects carried out following a bottom-up approach (Fig. 27). However the issue of sustainability is the one most selected among all categories of affiliations, with the exception of experts working for private for-profit organizations, who instead highlight to a greater extent the importance of supporting ICTs that are relevant in the context in which policies are carried out. Among experts affiliated to bilateral/multilateral donors and public authorities the problem of sustainability is selected as much as the "lack of alignment with countries' strategies".

Figure 26. Question B4. Please indicate up to 3 of the main shortcomings in donors' approaches in promoting ICT4D (% of respondents) [145 respondents]



Interestingly respondents working for European institutions tended to select less frequently this latter answer (31% against 46% for the whole sample), as those employed in the for-profit (29%) sector.

Figure 27. Question B4. Percentage of respondents by type of affiliation [145 respondents]



5.4.5 General comments to section B (Question B5) [44 respondents]

Forty-four open comments were received in total for Section B. Comments presented here were screened and selected on the basis on the 'value added' of the information they contained, in order to avoid repeating ideas already emerged from closed-form responses. Nine out of 44 total comments underline that notwithstanding projects in the ICTs areas are 'proliferating', they are often marked by a short-term vision, lacking adequate maintenance provision and being too focused on technologies and not enough on skills transfer. Comments of this type are reported here below and divided by ty of affiliation.

Academia/think tank/research centers

1. Donors' approach is a key problem. Some major shortcomings include the shortness of projects, the excessive use of tied-aid, the too little real capacity building, and the adoption of a 'solution-looking-for-a-problem' approach.

2. The sustainability of ICTs infrastructure can be fostered reducing ICTs deployments and increasing efficiency through the correct design of ICTs infrastructure, the massification of roll outs, and systematic training. Revenue streams may come initially from government entities that already invest financial resources to reach people in disadvantaged areas through other channels.

3. The main barrier that mostly hampers the use of ICTs for economic development is the techno-centric approach in implementing ICTs. Implementers tend to focus more on technology than its users.

4. There is a "market saturation" of donors in this area that combined with short term cycles frequently leads to a "graveyard" of unfinished projects, the danger of which is an environment marked by high investment and low returns.

Private for-profit organizations

5. Donors' approaches lack a holistic sustainable approach, in terms of the economic, social and environmental dimensions of their initiatives.

6. Donors do not use systems that can be integrated (thus allowing for inter-operability). In addition there is limited skills transfer and poor sustainability planning once the pilot phase is over. The donors' investment is often limited to the pilot phase and once this is over projects lose usefulness after a few months.

Private non-profit organizations

7. In many donors' initiatives, ICTs is still seen as a mere instrument and budget goes mainly to hardware, instead of capacity building and integration within the beneficiary organizations.

8. Most donors' initiatives are output based, and hardly look at the medium-term impact, thus most ICTs projects turn out to be handouts that go unused immediately after the project period. Community ownership for ICTs project is a very important point, without which security becomes an issue.

9. A lot of attention is paid to hardware and internet connectivity, less for embedding ICTs in work practices, local relevant content and capacity building.

Another topic emerging from respondents' comments can be synthetized as the donors' poor efforts in understanding the needs of communities targeted by ICTs initiatives, which also undermines the initiatives' success (5 comments). Both these criticisms seem to hold in particular for small-scale projects, for which a long-lasting effectiveness appears as a hard objective.

Private for-profit organizations

1. The key issue of most ICT4D projects is that they do not take consumers' issues into account. Projects that succeed are those with an easy value proposition (i.e. those whose benefits can be understood by consumers very easily) that truly fit into people's habits (i.e. either provided through devices that are widespread among people, or provided via local agents trusted by the community, with a higher digital literacy

2. Replicating approaches that have been successful in one country in another one does not bring the same results. Each country is different ad needs to be addressed differently.

Private non-profit organization

3. Donors should consult people on the ground.

4. ICTs projects need to address practical problems that are relevant to communities in LMICs.

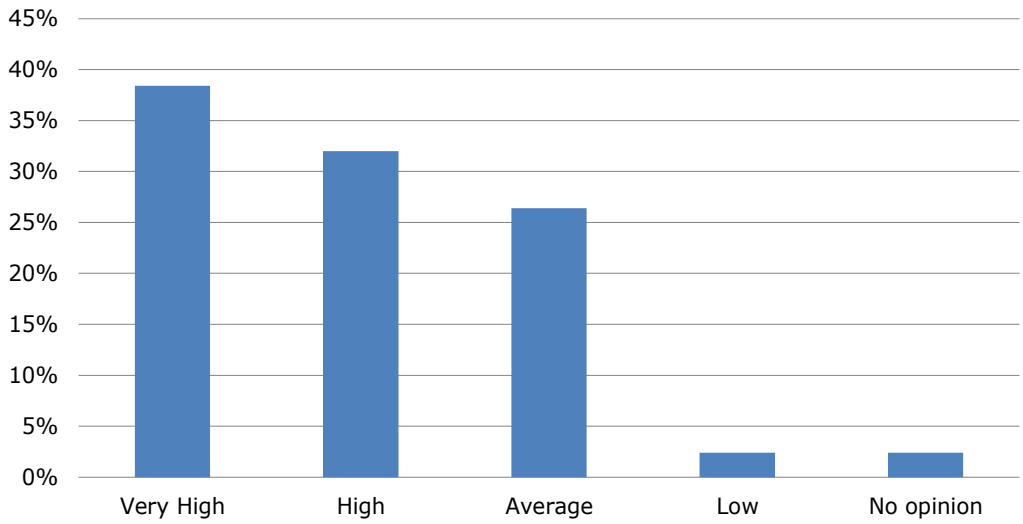
5. Donors' demands and restrictions not tied to the needs of the LMICs hamper all efforts made to ensure sustainability and scalability of the ICT4D innovations. Local input is needed at all levels to sustain such innovations.

5.5 ICTs and health in LMICs (Section C)

5.5.1 Relevance of ICTs for the health sector in LMICs

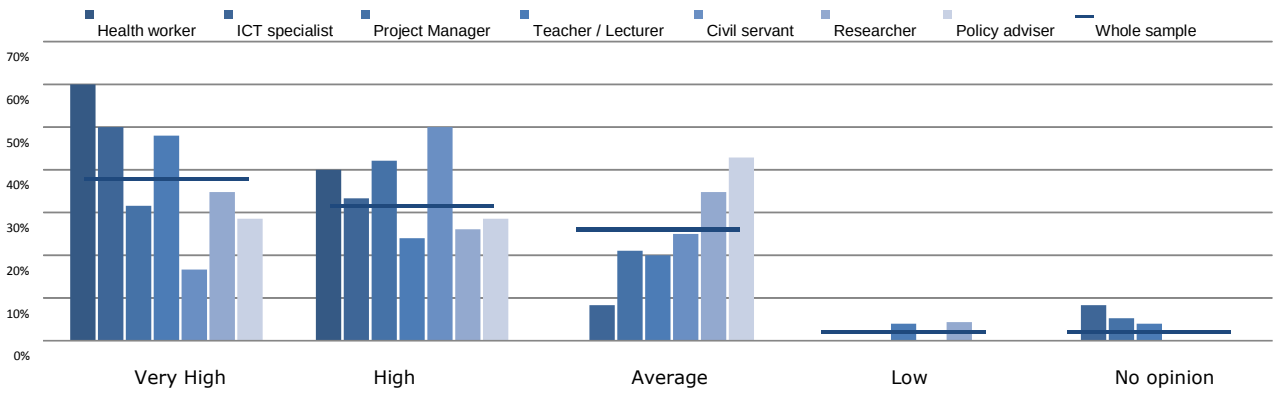
The opinion of respondents on the issue of ICTs role in LMICs' healthcare is clear: ICTs should have either a high (31%) or very high (38%) level of priority within the healthcare planning (Fig. 28).

Figure 28. Question C1. Please indicate which level of priority ICTs should have within healthcare planning as compared to other health priorities in LMICs (% of respondents) [127 respondents]



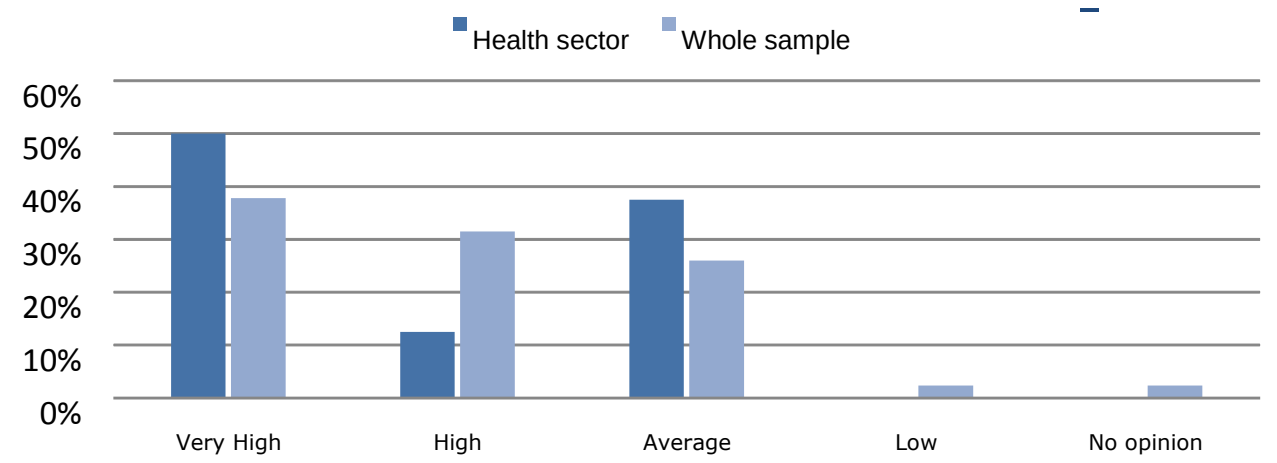
This evaluation is shared by all categories of professionals: the percentage of respondents indicating either a high or very high priority is greater than 50% across all groups, ranging from 57% for policy advisers to 100% for health workers (Fig. 29).

Figure 29. Question C1. Percentage of respondents by type of job [127 respondents]



Respondents working for affiliations operating in the area of health (identified as explained in the previous chapter) are more likely than others to think ICTs should have a "very high" level of priority. However, more than 50% of both them and the whole sample selected "very high" and "high" answers (Fig. 30).

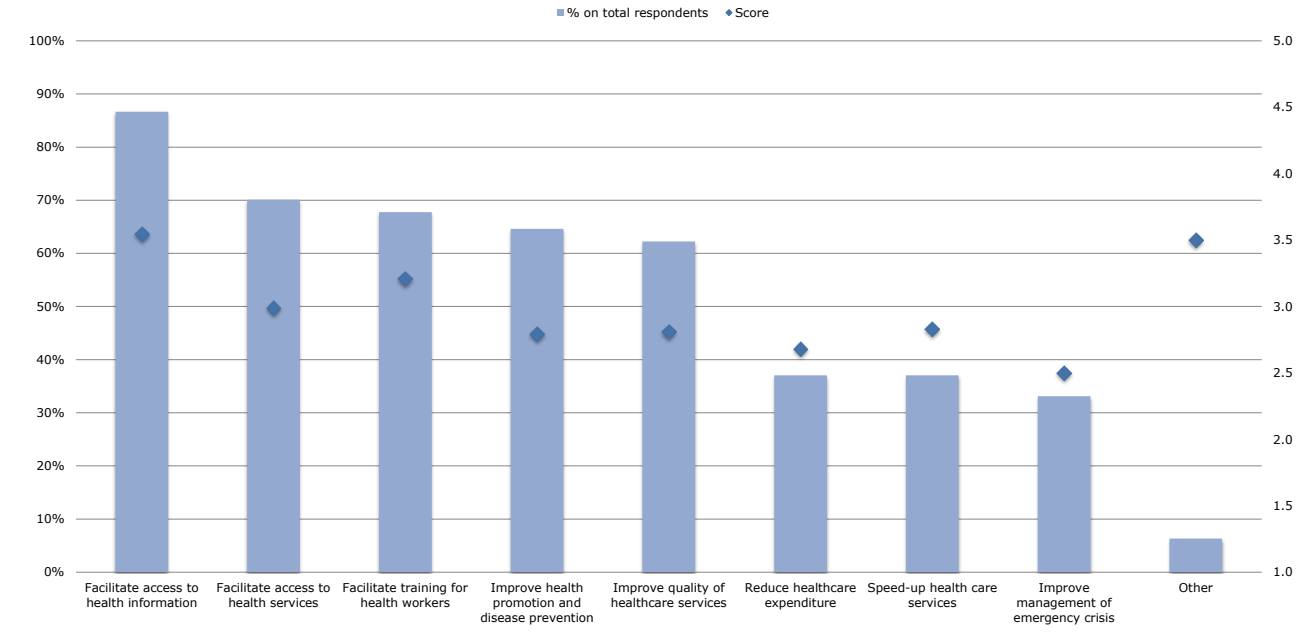
Figure 30. Question C1. Percentage of respondents with affiliation in the health sector [127 respondents]



5.5.2 Benefits of e-Health

E-health technologies can be used for a variety of purposes. The survey's results suggest that their ability to facilitate health information is the most important one in LMICs, followed by the fact that they can be leveraged to increase access to health care (as it is the case for telemedicine technologies), and used to provide health workers with training services (Fig. 31).

Figure 31. Question C2. Please rank the 5 main benefits of e-Health in a LMICs context (% of respondents and score). [127 respondents]



The opportunity to reduce healthcare costs was selected by relatively few respondents (47, 37%) - still with a peak of 60% among experts working for public authorities. The ability to improve the effectiveness of emergency crisis interventions is generally considered as a minor issue, even though this

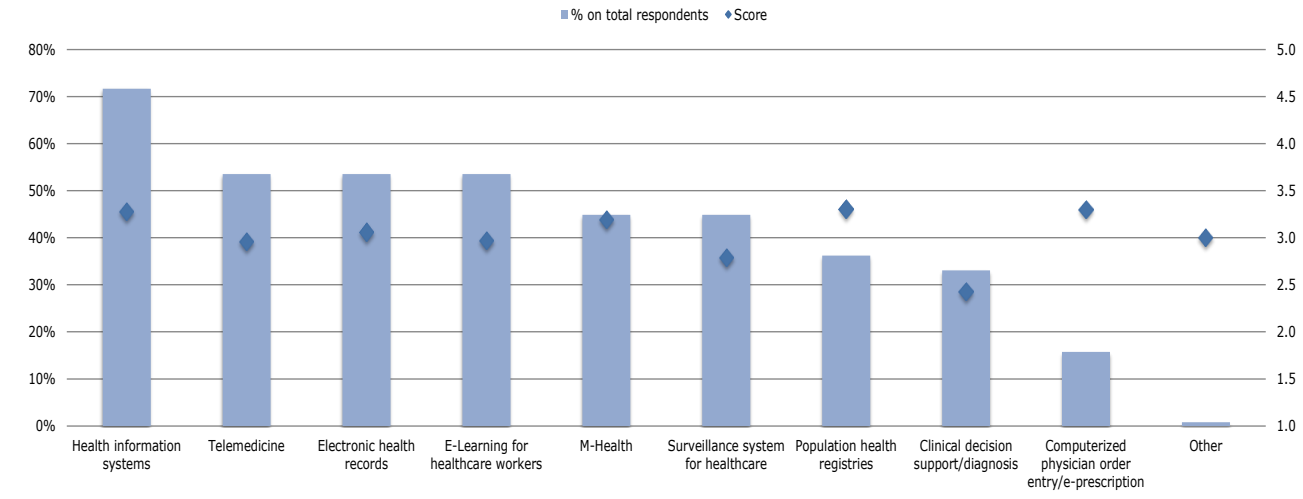
is a significant area for ICTs-enabled health projects in LMICs, as seen in the literature review. Also the score to this answer is low, meaning that even the few respondents selecting it averagely assigned a low ranking.

Even though some studies suggest that ICTs – and in particular HISs - can speed-up health care services, also this aspect has not been considered a major issue with respect to others. This aspect was selected more often only by ICTs specialists (67%), health workers (60%) and civil servants (50%). Of all, 3% of respondents did not express any opinion.

5.5.3 E-Health technologies

The preference given to the informational dimension of ICTs is mirrored in the fact that respondents mostly indicated HISs as the form of e-health technology mostly used. Among such systems electronic health records (i.e. comprehensive health record of patient health information) are those considered more important, rather than for example clinical decision support. HIS are followed by telemedicine and e-learning, whereas m-health has been selected less frequently, notwithstanding the current mushrooming of e-health projects based on mobile technology in LMICs (Fig. 32).

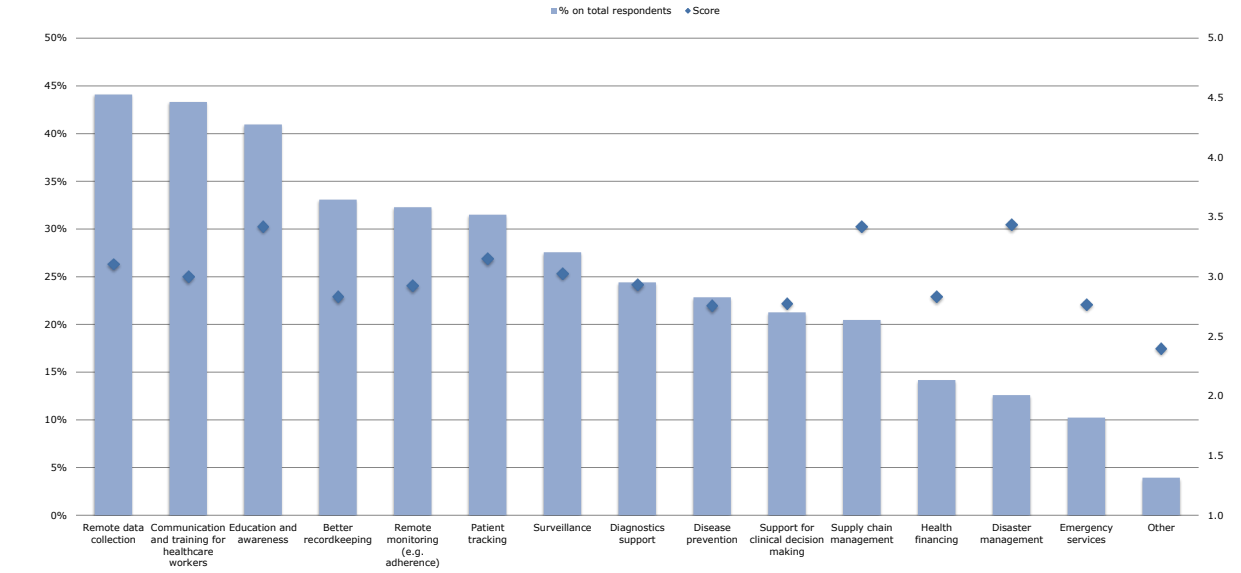
Figure 32. Question C3. According to your experience, which e-health technology is mostly used in LMICs? Please rank the most important 5 (% of respondents and score) [127 respondents]



It is worth noticing that answers selected by fewer respondents (e.g. 'Population Health Care Registries', 'Computerized Physician Order Entry') on average totalled relatively high scores, suggesting that the opinion of experts on this topic tend to diverge significantly. This may be due to both the difficulty to provide the assessment asked by these questions – as seen in the literature review there is a significant variation of e-health usage across different LMICs countries, also due to the different diffusion of LMICs - and of the heterogeneous terminology used in the field of e-health.

Focusing on m-health, remote monitoring emerges as the most effective application, which is in line with studies carried out in this field and discussed in the literature review (Fig. 33).

Figure 33. Question C4. According to your experience, please rank the 5 m-health applications that proved to be more successfully used in LMICs (% of respondents and score) [127 respondents]

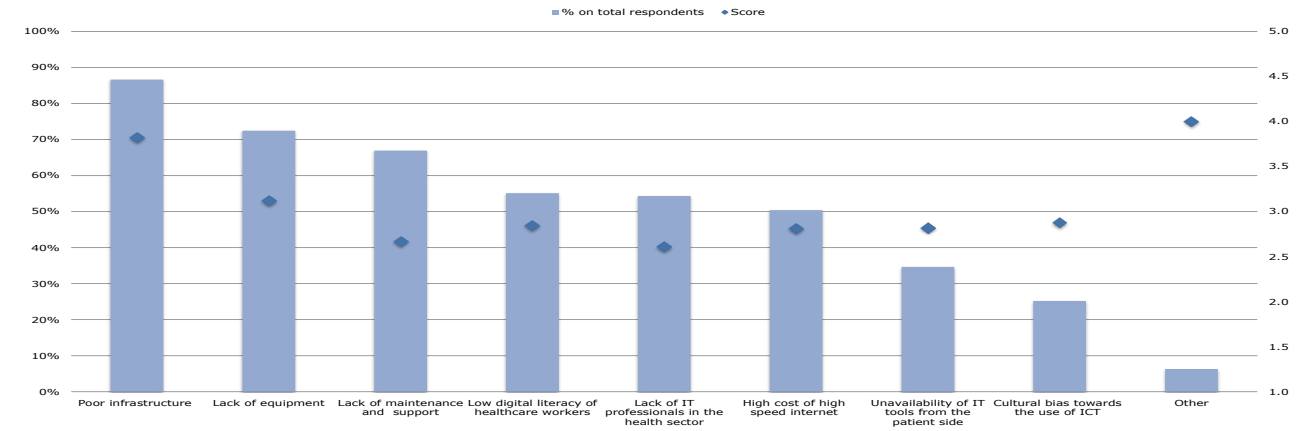


For both C3 and C4 questions the percentage of experts selecting 'no opinion' is higher than for other questions, accounting respectively for 11% and 17%. Across different affiliations the percentage of experts that chose not to answer to these questions is quite similar, ranging from 8% for for-profit organisations to 13% for non-profit organisations for question C3, and from 15% for non-profit organization to 20% for public authorities for question C4.

5.5.4 Factors hampering the use e-Health in LMICs

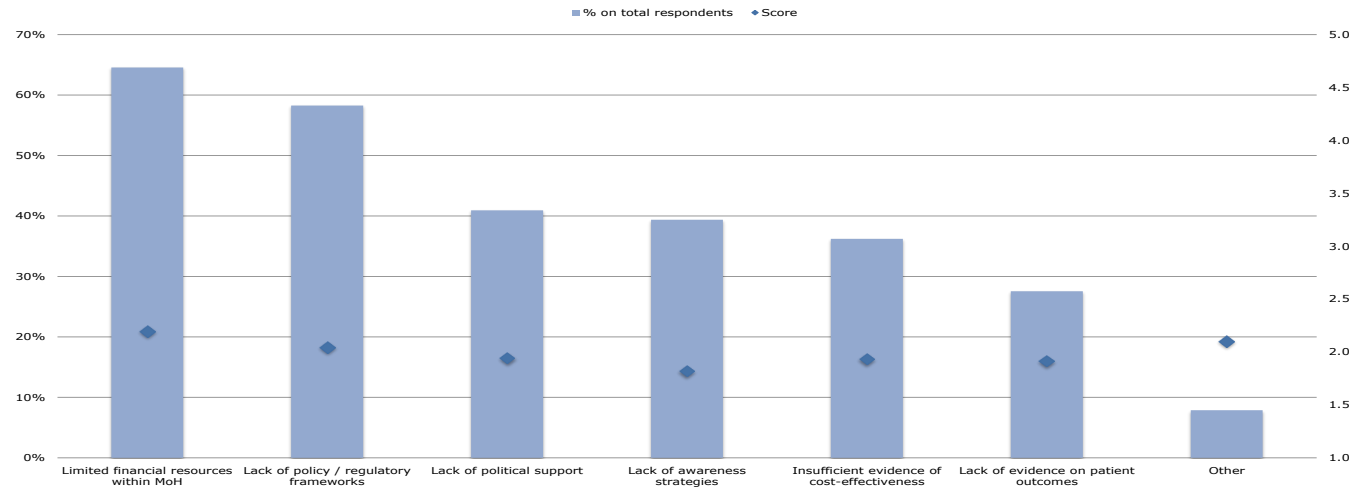
The main obstacles hampering the use of e-Health in LMICs echo those limiting ICTs diffusion *tout court* in these countries, seen in the previous section of this analysis (role of ICTs in the economic development of LMICs). Again a poor infrastructure endowment is the most acute problem, which can simply impede the development of some e-health applications (e.g. telemedicine programs cannot be implemented without internet connectivity). Lack of equipment (due to poor affordability) follows, whereas obstacles in the sphere of human capital rank third. In addition a hypothetical 'cultural bias' towards the usage of ICTs is indicated again as a minor problem with respect to others (Fig. 34). Finally, 4% of respondents did not express any opinion on this issue.

Figure 34. Question C5. Please rank the 5 main obstacles that mostly hamper the use of e-health in LMICs (% of respondents and score) [127 respondents]



When asked to indicate the obstacles which mostly prevent scaling up of e-Health projects, respondents signalled that the lack of policy and regulatory frameworks is the major problem, after the limited financial resources within Ministries of Health. Interoperability and standardization are examples of necessary requirements for the scalability of e-health projects that can be pursued effectively only by central governments. The lack of political support has been selected almost as frequently as the lack of awareness strategies and the insufficient evidence of cost-effectiveness (Fig. 35). 6% of experts selected "no opinion".

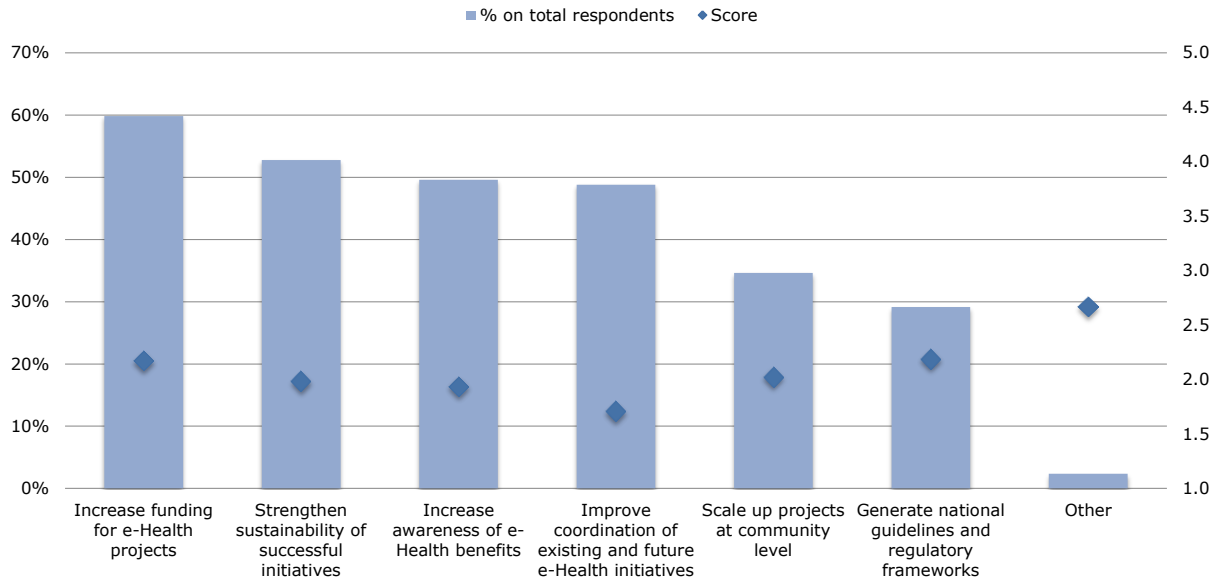
Figure 35. Question C6. Please rank the 3 obstacles which mostly prevent scaling up of e-Health projects in LMICs (% of respondents and score) [127 respondents]



5.5.5 Policies which can foster the use of e-Health in LMICs

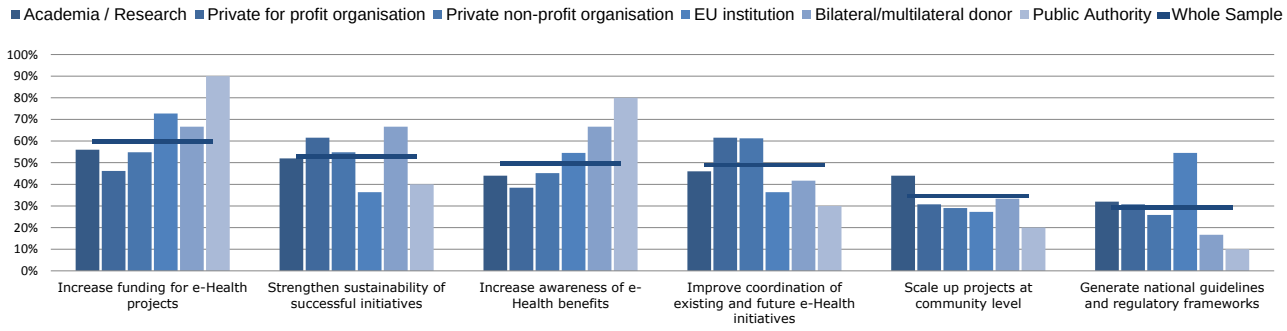
Focusing on policies that can contribute to foster e-health usage, after the need for more funding, sustainability is indicated as a major issue, along with e-health benefits awareness increase and e-health initiatives coordination (Fig. 36).

Figure 36. Question C7. Please rank the 3 most relevant policy which can contribute to foster the use of e-Health in LMICs (% of respondents and score) [127 respondents]



The importance of sustainability is underlined in particular by bilateral/multilateral donors and by experts working in the private sector (both for-profit and no-profit), who are also the ones that stress more often the need for a greater coordination in e-health initiatives (Fig. 37). E-health benefits awareness is instead particularly relevant for respondents working for public authorities, 80% of whom selected this answer (against an average of 50%). 3% of experts did not answer to this question.

Figure 37. Question C7. Percentage of respondents by type of affiliation [127 respondents]



Some further (and heterogeneous) insights on the main barriers, problems and advisable policies for the development of e-Health in LMICs were collected in the open question at the end of this section.

5.5.6 General comments to section C (Question C8) [19 respondents]

Nineteen experts provided written comments expanding on the issues discussed in Section C of the questionnaire. Some of them were related to barriers, problems and advisable policies of e-Health in LMICs. They are reported here below divided by type of affiliation.

Private for-profit organizations

1. A combination of different approaches would be the most effective way to support e-health in LMICs: ensuring that projects are conducted with good monitoring and evaluation protocols and that the results are recognized by the government, supporting the sharing of knowledge at national level, making sure that sustainability is embedded in the project design, building local capacity and if possible also helping to build a facilitating environment.

2. ICTs are mainly limited to urban areas and towns. Remote areas face complex issues such as lack of power and of technical or professional staff, which hamper the potential of e-Health policies.

Academia/ think tank

3. Seeking local communities' awareness and involvement in planning e-health initiatives is crucial for their effectiveness and sustainability.

4. I don't think there is any scope as of now for e-health or m-health for LMICs, other than creating pretty demos.

European Union Institution

5. Establishing a sound and coherent policy framework for ICTs in health is fundamental to scaling up initiatives successfully.

Private for-profit organisation

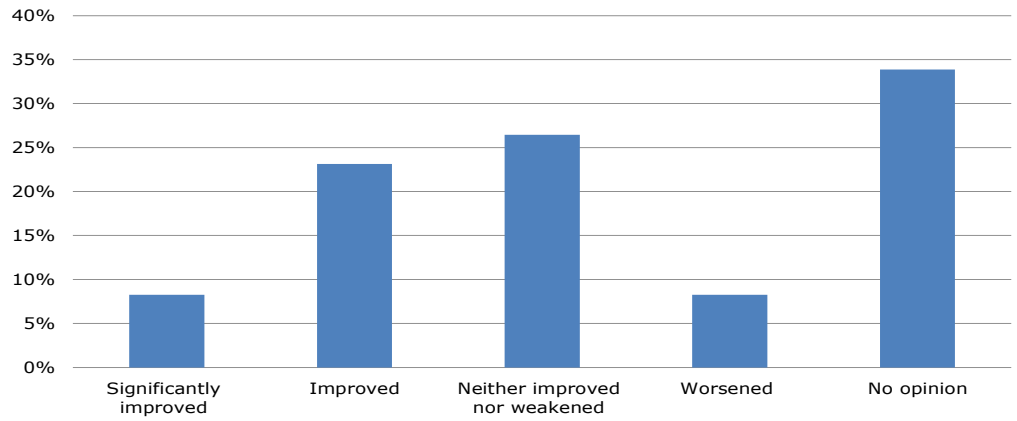
6. The discussion about the scale should take into account business models. The main issue is not which specific approach to e-health to adopt, but rather to understand whether the business model "attached" to it is right or not. This is a very important point, especially for social entrepreneurs.

5.6 EU institutions' policies in ICTs for development (Section D)

5.6.1 Evaluation of the EU institutions on ICT4D in the last 10 years

The first questions of this section were focused on the past and current ICT4D policies carried out by European institutions, asking an assessment of policies improvement over the last years and of the EU cooperation with other international actors in this field. The survey suggests that the EU institutions' support to ICT4D is not likely to have considerably improved over the last ten years. The proportion of those indicating that it remained stable is almost equal to those that reported an improvement, and those that observed a significant improvement are perfectly balanced by "pessimists" with an opposite evaluation (Fig. 38).

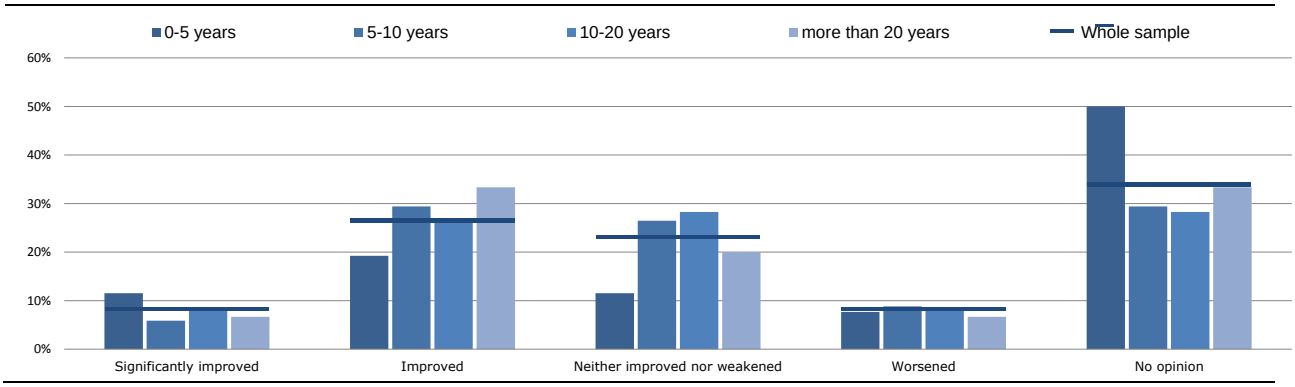
Figure 38. Question D1. According to your experience, in the last 10 years, to what extent have the EU institutions improved their support to ICT4D as compared to the past? (% of respondents). [121 respondents]



It is worth noticing that 41 respondents (34%) do not have an opinion on this issue. For sake of robustness all the results presented in this section have been checked also only for the sub-sample of individuals who expressed an opinion (thus excluding those with no opinion). This subsample is made of 80 experts (66% of respondents to this section of the survey). Focusing on this group no different outcomes have been observed. In particular, for all questions the order of answers by frequency of selection does not change, i.e. answers that have been considered more relevant by those that expressed an opinion about EU policies improvement are the same ones that have been chosen more frequently by the whole sample (including those with no opinion). The only partial exception is constituted by the last question of this section ("in order to remove the obstacles hampering the dissemination of ICTs in LMICs, which action should EU take?"), in which the first two most selected answers are the same for the two groups, but the third one changes. In particular, for the whole sample including those with no opinion the third most selected answer turns to be "Rise LMICs policy markers' awareness of ICTs benefits", whereas considering exclusively those with an opinion, the third answer is "Build ICTs capacity at international level, enhancing co-ordination among actors".

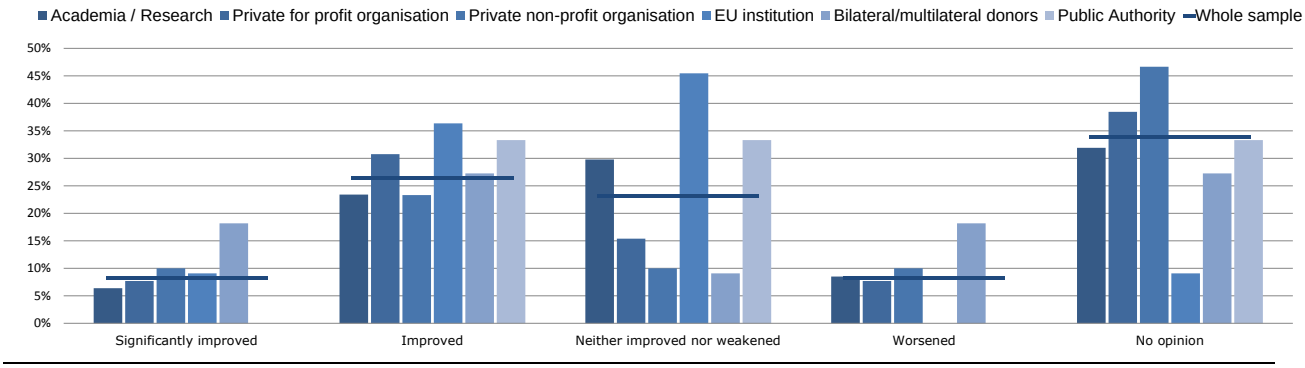
A breakdown by years of experience shows that the evaluation about EU institutions ICT4D policies improvement does not significantly change for those that operate in the development/health/ICTs sector since more time (that are supposed to be able to have seen more clearly possible changes in the EU institutions' ICT4D policies). A slightly better assessment is given only by those with more than 20 years of experience, but not by those between 5 and 20 years. Even though experts with the highest level of experience may perceive an improvement over decades which is less easily observable by others, this can hardly constitute the whole explanation for this outcome (Fig. 39).

Figure 39. Question D1. Percentage of respondents by years of experience in the development/health/ICTs sector [121 respondents]



Breaking down answers by experts' type of affiliation, it emerges that according to 45% of those working for European institutions, which on average are supposed to be more informed than others on this topic, think that EU Institutions neither improved nor weakened their efforts (Fig. 40).

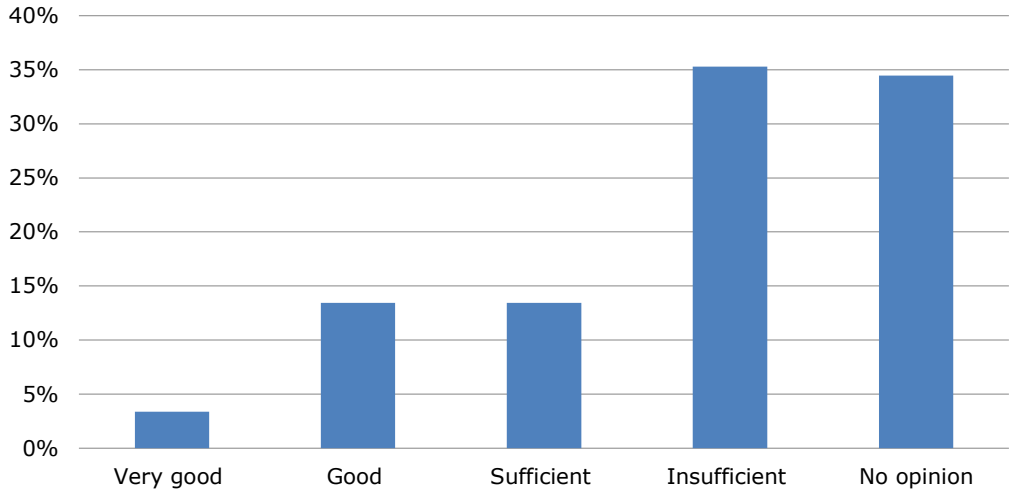
Figure 40. Question D1. Percentage of respondents by type of affiliation [121 respondents]



5.6.2 Evaluation of the EU cooperation with international organisations on ICT4D

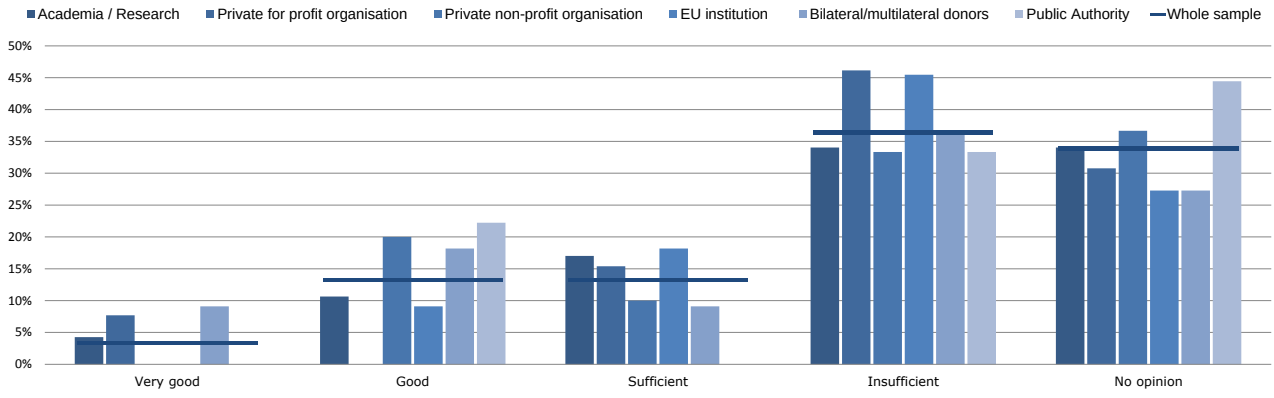
The evaluation of EU cooperation with international organizations emerged from the survey is more severe, as it is considered insufficient by 44 participants to the survey (35% of respondents) (Fig. 41).

Figure 41. Question D2. According to your experience, how do you judge the EU cooperation with international organizations in the field of ICTs diffusion in LMICs? (% of respondents) [121 respondents]



Again experts working for EU Institutions turn out to be among the most critic ones, together with those affiliated to private for-profit organisations: for both categories about 45% of experts judge the EU Institutions cooperation as insufficient (Fig. 42). Of all, 41 (34%) of experts chose not to express any opinion on this topic.

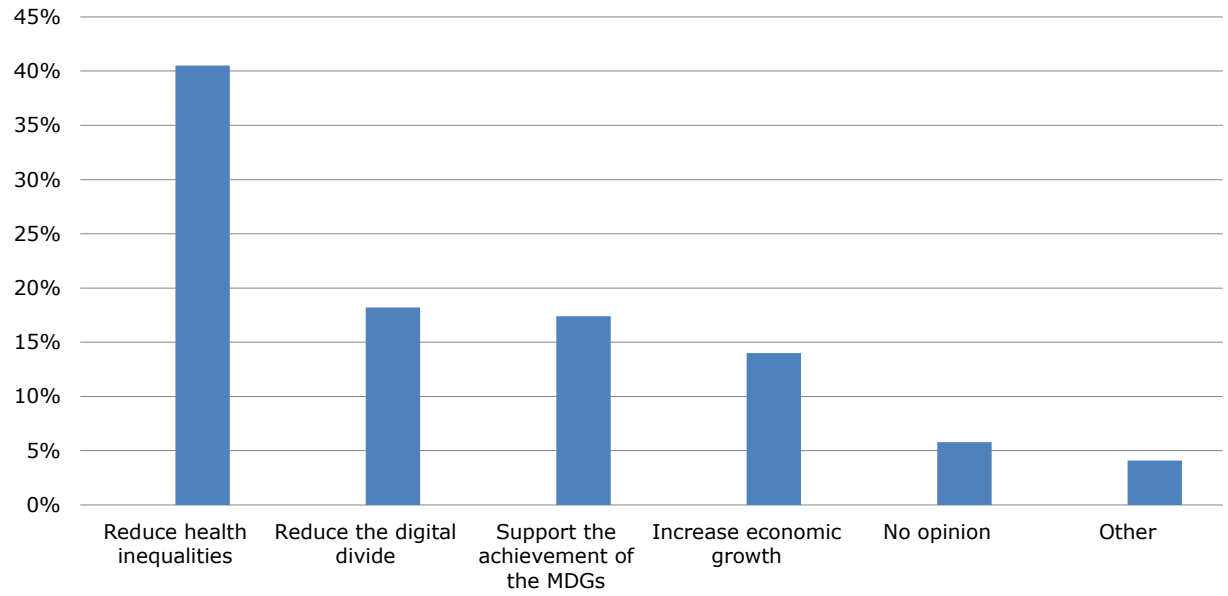
Figure 42. Question D2. Percentage of respondents by type of affiliation [121 respondents]



5.6.3 Objectives to be pursued by the EU policies in ICT4D

According to respondents EU policies in the ICT4D area should address primarily the reduction of health inequalities, followed by the MDGs achievement and the digital divide reduction (Fig. 43).

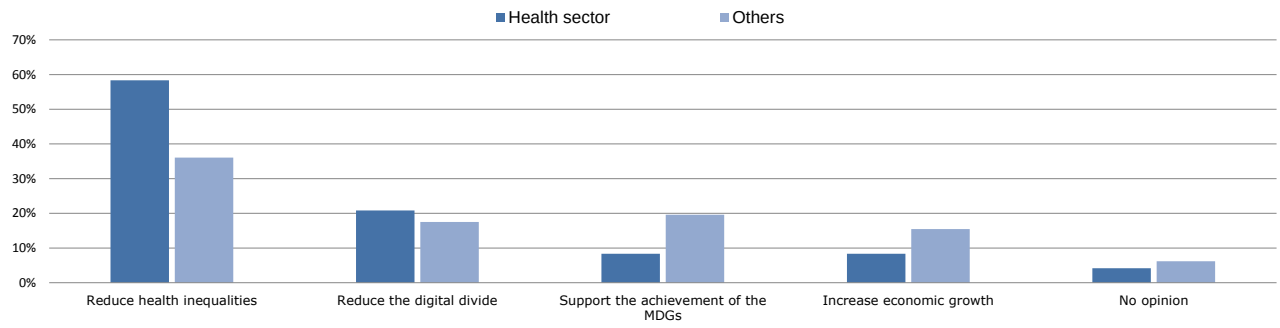
Figure 43. Question D3. Please select the objective that in your opinion should be the key priority of the EU policies in ICT4D (% of respondents) [121 respondents]



Experts that are affiliated to organizations clearly focused on health issues chose much more frequently this option than others. However, this choice was the one taken more often also by other experts (Fig. 44).

The relevance of ICT4D for the health sector in LMICs emerges throughout the whole survey, highlighting experts' belief in the potential benefits of ICTs in this sector in the context of LMICs. Despite the lack of conclusive evidence of a clear relation between ICTs diffusion and poverty reduction discussed in the literature review, it has to be noted that more than 50% of respondents indicated priority issues (Health, MDGs achievement) that concern more poverty and deprivation alleviation than economic development.

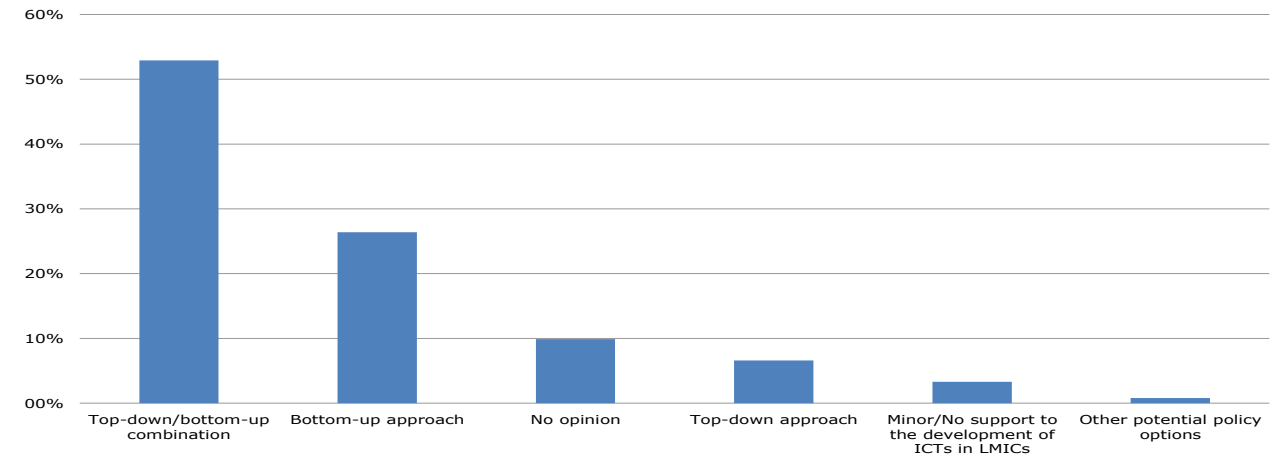
Figure 44. Question D3. Percentage of respondents with affiliation in the health sector [121 respondents]



5.6.4 Approach to be followed

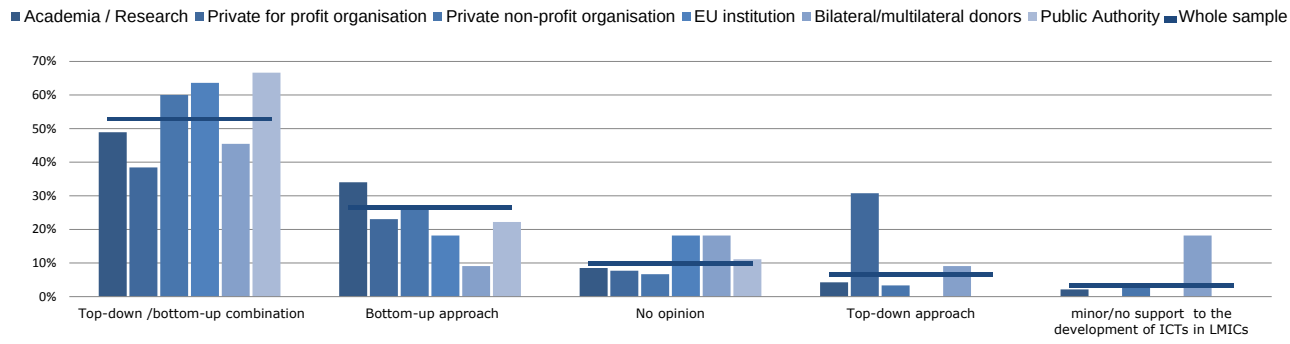
For what concerns the general policies and approaches that should be followed by European Institutions, the prevalent opinion of surveyed experts is that EU should carry out a mix of "top-down" and "bottom-up" policies (Fig. 45).

Figure 45. Question D4. EU has adopted mixed strategies, co-operating with the large international organisations and the regional associations of the LMICs (top-down approach), but also launching programmes to finance projects in the field (bottom-up approach). In your opinion, which policy should be followed by the EU for the development of ICTs diffusion in LMICs? (% of respondents) [121 respondents]



However some differences can be observed among different categories of experts. For example among the academia and no-profit organizations there are more experts convinced of the importance of a bottom-up approach, whereas for-profit organizations (and to a minor extent public authorities) support the top-down one more than the average (Fig. 46).

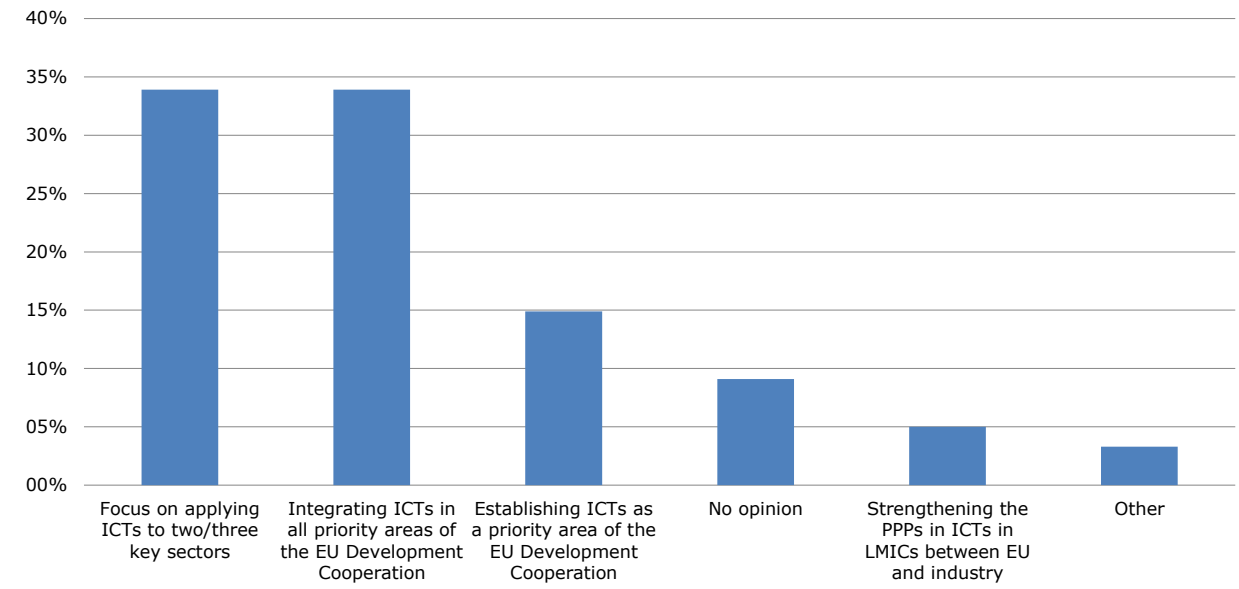
Figure 46. Question D4. Percentage % of respondents by type of affiliation [121 respondents]



5.6.5 ICT4D integration in EU Development strategy

In the literature review it has been noticed that there is consensus about the fact that ICTs diffusion is not beneficial *per se* but rather it can be instrumental to improve other areas of development (a view explicitly stated by some respondents that left written comments in some sections of the survey). The survey confirms this point of view: only few of the survey's participants think that ICT4D should be a priority area of EU development cooperation, whereas almost 70% believe it should be integrated in few or all other areas (Fig. 47).

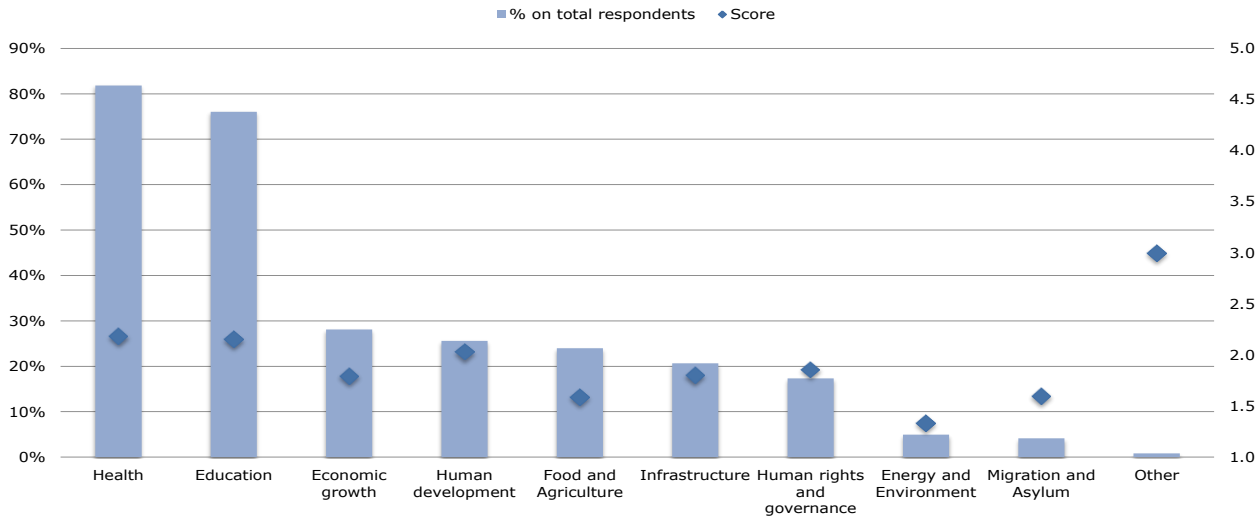
Figure 47. Question D5. Please select the policy approach that, in your opinion, should be followed by the EU institutions in ICT4D (% of respondents). [121 respondents]



5.6.6 Areas of intervention

In light of the findings emerged in section B of the survey, health and education are surely among areas of intervention in which ICTs should be incorporated. These areas have been also indicated as those in which EU Institutions should increase the use ICTs (Fig. 48).

Figure 48. Question D6. In which priority sector should the EU increase the use of ICTs in LMICs? Please rank the most important 3 (% of respondents and score) [121 respondents]

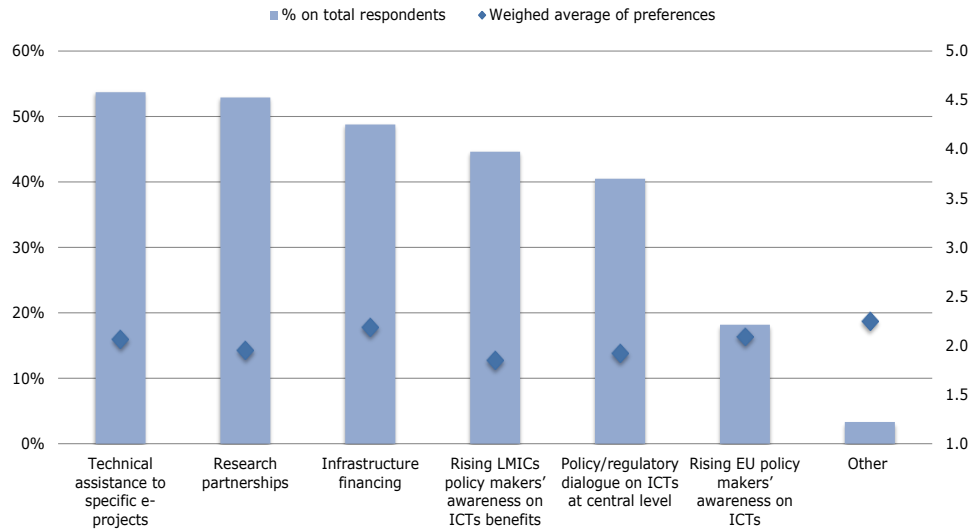


5.6.7 Most effective actions

As seen in the literature review, EU interventions in support of ICTs for development can be grouped in four main areas: ICTs infrastructure development, establishing of national research and education networks of EU and LMICs, development of ICTs capacity building initiatives and ICTs relevant policy and regulatory framework harmonization.

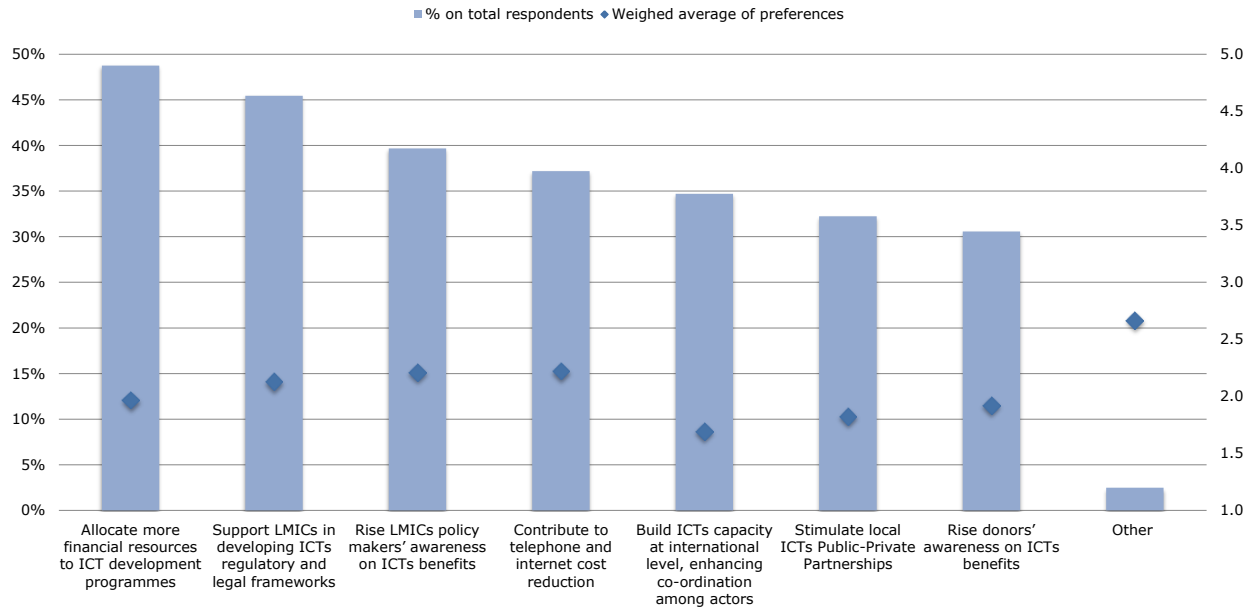
According to the survey respondents the first three instruments are those in which EU Institutions policy instruments have been more effective. More in details, "Technical assistance to specific e-projects", a definition which embraces capacity building initiatives, and "Research Partnerships" were the answer selected more often, followed closely by "Infrastructure Financing" (which however shows the highest score). "Policy dialogue on ICTs policy and regulatory issues at central level" on average was considered an area where the EU Institution intervention is relatively less effective (Fig. 49). Nine percent of respondents expressed no opinion.

Figure 49. Question D7. According to your experience, which instruments are more effective in promoting ICTs within the EU Development Cooperation? Please rank the most important 3 (% of respondents and score) [121 respondents]



Interestingly supporting LMICs in developing their regulatory and policy ICTs framework is also the action that for the majority of respondents EU Institutions should take to remove the obstacles hampering the dissemination of ICTs in LMICs (after "allocating more resources to ICTs development programmes"). This may seem at odds with the fact that this area was not among the ones chosen more often in the previous question. A possible explanation can be that even if EU Institutions efforts in this ambit are relatively less effective than in other ones, there is much scope for EU to operate more successfully in this area (Fig. 50).

Figure 50. Question D8. In order to remove the obstacles hampering the dissemination of ICTs in LMICs, which action should EU take? Please rank the most important 3 (% of respondents and score) [121 respondents]



The third action most frequently indicated as the one that EU should take to remove obstacles to ICTs dissemination in LMICs is to "Rise LMICs policy makers' awareness on ICTs benefits".

It is worth reporting that, if one excludes here the sub-sample of individuals that in the first question of this section did not express any opinion on the EU Institutions' ICT4D policies over the last 10 years (34% of the sample of respondents to this section), focusing instead on those that showed an opinion, the third most selected answer turns to be "Build ICTs capacity at international level, enhancing co-ordination among actors". If one assumes that the group of respondents that expressed an opinion concerning the first question represents a cluster of experts that are relatively more aware of EU Institutions' ICT4D and its specific potential, the importance of building ICTs capacity at international level is thus greater than what the Figure 36 suggests. As already mentioned, no other noteworthy differences have been found between answers provided by the sub-sample of experts that provided a reply to the first question of this section, and the overall sample of respondents of this section.

5.6.8 General comments to section D (Question D9) [12 respondents]

Additional suggestions about initiatives EU Institutions should undertake in the area of ICT4D, and observations about its past and current policies were left by experts responding to the open question of this section. They are reported here below distinguishing by type of affiliation.

Private non-profit organizations

1. EU has tried to improve regulatory frameworks in some LMICs, but with limited success. Development co-operation funding should be tied more closely to regulatory improvements, in particular in order to achieve a greater competition for network infrastructure, including international connectivity.

2. The training of local communities is a vital issue.

3. EU should help creating local policies, and reinforcing evidence on the impact of local ICT4D initiatives.

Private for-profit organizations

4. Promoting ICTs should not be considered as a goal in itself, but as a means for more efficient development policies and programs wherever it is indeed cost efficient. Promoting ICTs at all costs makes no sense. In addition, often ICT4D approaches are outdated and inappropriate for recent ICT4D developments. The EU could play a key role in removing these barriers by listening to local actors and conveying their issues at the national level, where the EU can be effective in influencing policy makers. These are low hanging fruits for EU intervention.

5. EU should integrate ICT4D as a cross cutting and focused development agenda.

Academia / Think tank / Research centre

6. Often in African initiatives too much of projects are led by professional for-profit-consultants with little or no substance knowledge of ICT4D. An improved approach to mobilize academia and private sector professionals is needed, and much less room should be given to professional "coordinators and event managers" with little knowledge of ICT4D substance and implementation.

5.7 Conclusions

Though the wide versatility of ICTs can make it hard to come up with generalisations about their usage in the field of development, some key aspects have distinctly emerged from the survey. One of them is that health and education are the two policy areas in which ICTs can mostly contribute to the economic development of LMICs. This opinion is shared by roughly 90% of surveyed experts, regardless of their job and affiliation.

Most of participants also agree that the main barrier hampering the usage of ICTs in LMICs is constituted by their scarce infrastructure endowment, including both ICTs-specific infrastructures and more basic ones, whose poor performance can affect the latter (e.g. lack of a stable electricity supply). Other major barriers concern affordability ("High cost of ICTs products", "Lack of access to modern ICTs") political support, and human capital ("Low digital literacy of end-users", "Lack of IT professionals").

Donors' efforts to overcome these limits and promote ICTs are frequently vanished by their scarce sustainability, as stressed in particular by experts working for NGOs. The absence of adequate maintenance provisions, an excessive focus on technologies with a 'solution-looking-for-a-problem' approach, an insufficient capacity building lead to this result. Open comments suggest that the strategy of many projects in the area of ICT4D is often too narrow, failing to take into account key context variables, which affects the durability of initiatives. In line with that, lack of coherence and little attention in supporting ICT applications relevant to LMICs are identified as other main deficiencies of donors' initiatives.

Focusing on the area of health, the main potential benefits of ICT tools lie on their ability to facilitate access to health information, health services, and training materials for local professionals. Limits preventing e-Health to fully deploy its advantages in LMICs echo the ones of ICTs diffusion as a whole, i.e. poor infrastructures, lack of equipment, and deficiencies in human capital, both in terms of healthcare workers and IT professionals in the health sector.

Strengthening sustainability is a key step to be made also in this ambit. Among factors impeding the scaling-up of projects, the lack of policy and regulatory frameworks is a major issue.

The survey suggests that the EU institutions' support to ICT4D has probably not improved to a significant extent over the last ten years. Experts indicating that it remained stable are almost equal to those that reported an improvement, and those that reported a significant improvement are perfectly balanced by those with an opposite evaluation.

There is scope for EU Institutions to do more to grasp the potential advantages that can be achieved collaborating with international organizations and leveraging different comparative advantages. The relative majority (35%) of respondents maintain that the EU cooperation with international organizations in the field of ICTs diffusion is insufficient.

From a strategic point of view, there is consensus on the fact that ICTs should not be seen as a goal in itself but as instrumental to other areas of development and, as such, be integrated in few or all other areas rather than a self-standing priority. Health and education are indicated as key sectors. According to the majority of surveyed experts the primary aim of EU ICT4D policies should be the reduction of health inequalities, followed by the MDGs achievement and the digital divide reduction.

As for the EU policy approach, surveyed experts believes that the EU should try to balance the top-down approach that has traditionally characterised its initiatives in the ICT4D with bottom-up interventions. At the same time, important actions in order to remove the obstacles hampering the dissemination of ICTs in LMICs remain top-down initiatives supporting the development of regulatory and legal frameworks where the EU has a shall maintain its recognised role.

6. Interviews with ten experts

6.1 Introduction

The aim of the structured interviews was to expand and elaborate on stakeholders views about the ICT4D, for the purpose of developing Policy Options. Interviewees have been selected in coordination with STOA among experts and policy makers that participated in the survey and that expressed their willingness to be interviewed in an ad hoc section of the survey (Question D.10). Interviewees were selected in such a way as to guarantee a balanced representation of different types of affiliations, areas of expertise and geographical coverage. The full list of interviewees is included in Annex IV.

Most of questions were based on the results of the online survey, and to a minor extent to the literature reviews.

Interviews followed a structured form, with a predefined list of questions, available in Annex III. For some questions interviewers were asked to focus on some specific aspects which could vary from one interviewee to another, depending on his/her specific expertise. The interviews were carried out by phone and lasted between 45 and 60 minutes.

To prepare for the interview, interviewees received the list of questions in advance.

This chapter provides a summary of the ideas emerged from the interviews.

6.2 Summary of findings

The interviews investigated on some aspects of the three topics that formed the structure of the online survey. Comments contributing to enrich the picture provided by the survey are summarized here. Key issues emerged during the interviews have been included in the discussion about EU policy options in ICT4D, following this chapter.

6.2.1 ICTs for Development

Most of interviewees maintain that ICTs can be beneficial to foster LMICs economic development, but shall not be kept as a goal *per se*. In particular some of them contest that their diffusion can help reducing poverty, highlighting that they can rather widen inequalities (income inequalities, health inequalities, gender inequalities, rural-urban gaps, discrepancies between developed and developing countries).

In this context many interviewees agree that a key action that donors should do is to focus on most marginalised groups in order to ease their access to ICTs and engaging in multi-stakeholder partnerships. Helping these groups in achieving access to free/cheap internet would significantly contribute to development goals, keeping into account that access itself is becoming a dimension of deprivation. Also digital literacy is an important aspect to be considered.

The problem of poor infrastructures and affordability is largely recognised. Many LMICs lack connectivity and Internet access, and mobile telephony are more costly than in richer countries, for reasons that often refer to regulatory environments and the desire of the private sector to gain profits over short periods of time. Donors' support to infrastructural projects should include the effort to guarantee conditions of non-discriminatory and transparent prices.

Interviewees cite several areas in which they are convinced that initiatives based on the usage of ICTs can facilitate poverty eradication. Health and education are often mentioned. Apart from the obvious benefits of health improvement, some experts highlight the economic consequences of bettering health conditions in marginalised communities. People who hold informal jobs or consume mainly what they produce see the economic conditions of their family jeopardized in case of illness.

In the area of education, the diffusion of educational digital content has been indicated as the "the lowest-hanging fruit" ICTs can provide to tackle poverty. ICTs can for example help to increase access to the education, improve teacher training, manage student information. Though of course none of these aspects can authomatically improve students' performance, in the medium term they can make a major difference in improving the access to and the quality of education services.

Other mentioned field of application is agriculture. ICTs can play a beneficial role also in the field of agriculture. Farmers can access to information about market prices and potential customers, or access to online markets avoiding to travel miles to sell their products. ICT-supported trainings/mLearning and ICTs use in banking and microfinance is also quoted as a significant opportunity for farmers.

Some experts underline also the benefits of e-governance and e-government. For instance one of the interviewees suggests that the efficiency of population registries can have a non-negligible economic impact to citizens. In addition, using ICTs to improve transparency in public administration systems, improving accountability, would "help people make their voices heard" and facilitate them in advocating for their rights.

6.2.2 ICTs for health in LMICs

Though not all interviewees had a direct experience in e-Health, many examples of different projects were provided in several areas, as Clinical Decision Support, Supply Management Systems, telemedicine. Interviews overall do not allow to think that some e-Health practices are particularly effective or should be recommended more than others.

In general interviewees express a positive opinion of the potential usage of ICTs in LMICs. However, one of them particularly familiar with the subject stresses that it should always be carefully considered the extent to which ICTs actually fit into existing healthcare systems. The importance of a holistic and flexible approach in choosing whether development initiatives in LMICs should adopt ICT tools is highlighted also in this context. Donor-imposed priorities can constitute a serious barrier. According to one interviewee for example donors sometimes put a lot of emphasis on ICT for collecting healthcare data even when the local context requires primarily other types of interventions. Solutions emerged in response to actual needs are more promising.

When asked which factors hamper the sustainability e-Health initiatives, several interviewees tend to widen the scope of their answer, so to comment of the sustainability of ICT4D initiatives in general.

One of the interviewees highlights that the problem of sustainability reflects a poor project preparation activity: often donor-supported projects overlook sustainability issues since the beginning. They are usually designed as small, pilot projects, with the expectation that they will expand and become sustainable.

The fragmentation of donor interventions is another barrier. Collaboration between different actors, and in particular the local governments, should be carried out, in order to avoid duplicating and overlapping. Instead some donors build up "parallel systems" competing with public systems and draining human resources from the public sector.

Indeed the integration of programs with public programs, aligning with the governmental priorities, increases substantially the probability that project will be scaled-up.

Finally, the insufficient consideration of existing field practices and an excessive focus on innovation can affect considerably projects' sustainability. Some donors focus more on innovative ICT projects rather than on technologies that have been already validated. A careful consideration of past experiences on the field can allow to save time and resources.

6.2.3 EU policies for ICTs diffusion in LMICs

When asked to comment on the fact that EU development cooperation is not guided by a general policy document concerning ICT4D interventions, interviewees give mixed answers. Only one of them strongly supports that ICT4D should constitute a distinct strategic area, on the ground of the increasing importance of these tools. Several interviewees point out instead that this would favor the adoption of a narrow, "technology-driven" view. In this perspective, a lack of strategic focus can be seen as an advantage. On the other hand, a poor strategic definition of ICT4D within DEVCO is expected by some experts to affect coherence, hamper data collection, impede other actors (as donors and potential beneficiary countries) to understand which are EU funding opportunities in this area. Some suggest that embedding ICT issues in existing strategic areas seem a better and more flexible solution.

Interviews with experts leave the general impression that the visibility of EU initiatives in LMICs – at least in the ICT4D field – is quite low. Which is in line with the high percentage of survey respondents (34%) that did not have an opinion about the EU ICT4D policies over the last 10 years. Some comments on initiatives carried out by the EU so far concern the fact that EU should seek a greater coordination with other donors (which seems a widespread problem in the field of ICT4D), at least improving its federating role among EU Member States active in the field of ICT4D.

Some experts point that one key advantage of the EU in supporting e-projects in LMICs has been its ability to attract high level technicians.

For what concerns the type of approach that the EU should follow, interviewees agree that a mixed approach (bottom-up and top-down) is ideally the best one, in that it would allow addressing different problems in the most convenient way. The suitability of different approaches depends on country-specific issue, as the level of development, the strength of the government, the strength of NGOs. For example, in countries in which the governments is relatively less active in supporting poorer groups a bottom-up approach is advisable.

However, some interviewees seem to maintain that concretely the EU Institutions current comparative advantages concern top-down initiatives, and they may not have sufficient capacity to engage with small organizations operating on the ground.

In general terms, some of the advantages of top-down initiatives emerged during interviews are that they are not affected by the endemic poor durability that undermines many local based projects, and they do not require a complex routine project management. On the other hand, they tend to exclude local communities from decisional processes.

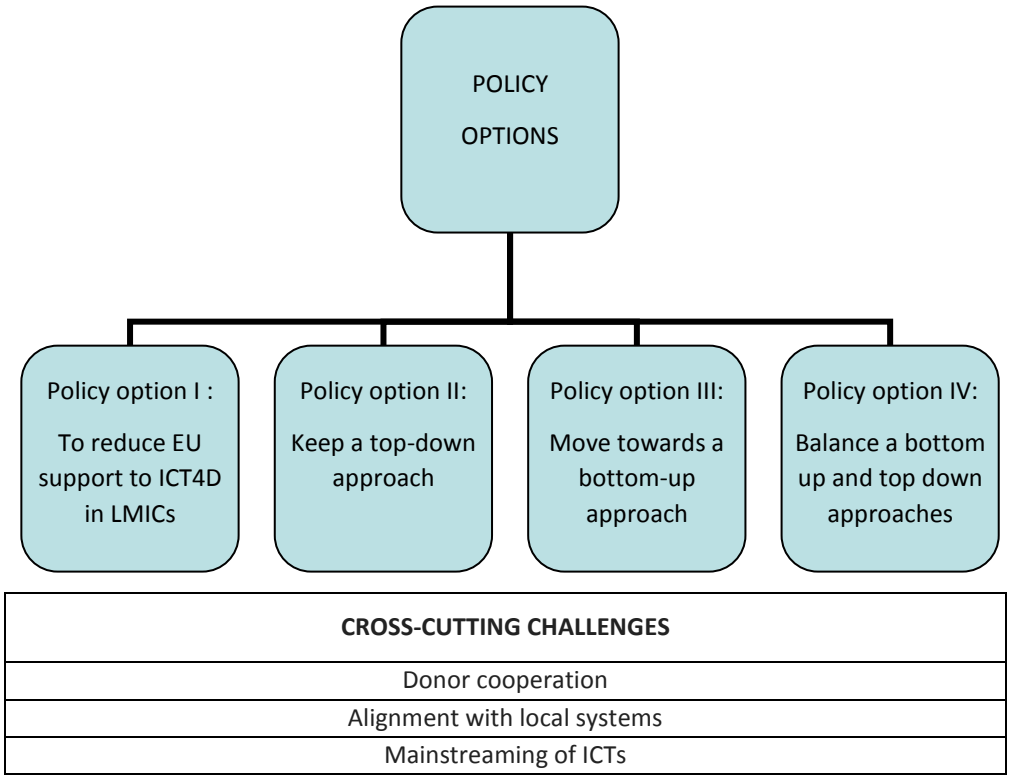
Another advantage is that EU countries' regulations are taken as benchmarks by many LMICs. In the field of telecommunications, African countries often look at the example of OFCOM and BEREC, and also at PTS and other European communication authorities. This makes EU Institutions particularly suitable to use its expertise in the regulatory field to support LMICs.

7. Policy options

7.1 Introduction

This chapter assesses the different policy options, discussed in light of the literature reviews, the online survey and a round of structured interviews with selected experts on the role that the EU could pursue to promote ICTs in LMICs (Figure 51). Each option has its own advantages and disadvantages depending on the existing internal capacity within EU institutions and overall approach to development cooperation. Clearly, any approach for ICT4D should first be compatible with the overall goals of the EU development cooperation, as well as with its delivery channels and instruments. In particular, as pointed by the literature review, in the EU policy framework ICT4D is not an end in itself, but ICT is a crosscutting issue and considered an enabler of economic development. A major consequence of this strategic approach is that ICT is not considered a priority, but its use is rather encouraged across other priority sectors. Within this strategic framework four policy options emerge. They are presented and discussed in the following sections.

Figure 51. The 4 policy options and the cross-cutting challenges discussed in this chapter.



7.2 Policy option I: reduce EU support to ICT4D in LMICs

Whereas there is wide recognition that ICT can be an enabler of economic growth, its impact on reducing poverty is more contested. ICT in LMICs can also be an instrument for widening the existing inequalities, especially because access to ICT is not universal. Some interviewees argued that, due to various issues, such as the cost and expertise involved, donor driven ICT solutions rarely prove to be the most effective and cost-effective solution to most of the problems faced by LMICs in relation to poverty. Along this line, there could be rooms for maintaining the idea that ICT should be adopted as a solution to poverty only when there is enough supporting evidence about its effectiveness. According to this view, mainstreaming ICT systematically within donor programs or targeting it as a priority sector is seen

as an inappropriate way to tackle poverty issues. The possible economic growth driven by ICTs development would not necessarily lead to a poverty decrease, which can be better addressed by specific interventions in the area of health, education, agriculture, microfinance. In addition, interests of telecommunication industries to push for a faster uptake of ICT in LMICs should also be better resisted if there is no validated evidence of development results and improved cost-effectiveness.

However, given the rapid diffusion of mobile phone technologies and the increased availability of locally developed ICT in LMICs, there is a feeling of missed opportunity in reducing the support to ICT4D in LMICs. In fact, it is a shared opinion that it would not be advisable to the EU to reduce its support to ICT: only 3% of the respondents to the survey think that the EU should not intervene in this sector. On the contrary, it is perceived that the EU can greatly contribute with its expertise and help increase awareness among recipient countries about the potential of ICT for reducing poverty.

7.3 Policy option II: keep a top-down approach

In the ICT sector, this results in interventions that address the policy and regulatory frameworks (e.g lack of competition) or that support building backbone infrastructures. By reducing systemic constraints these interventions aim at improving accessibility to ICT by reducing prices. These are types of interventions that the EU has been supporting (especially in ACP countries). Technical assistance to governmental institutions is a well consolidated practice within the EU development cooperation. Being based on regional programmes, it allows a concentration of funding that reduces administrative and project management burdens for both the EU delegations and the recipient countries. It is also recognised that an advantage of the top-down approach is that it is not affected by the endemic poor durability that undermines many local based projects in the area of ICT4D.

However, providing accessibility to ICT is not enough to achieve development outcomes. The reviews highlighted that the full potential of ICT can only be exploited when people and institutions have the capacity to understand them. There are user barriers (e.g. illiteracy or IT illiteracy) that also need to be tackled. The review of EU policy contributions to ICTs programmes in LMICs points that, so far, the EU approach has focused on systemic issues that are relevant to increase accessibility, but has done little to support ICT use by the poorest. One of the core advantages of the EU is its capacity to pursue regional approaches in promoting ICT, that is key for creating markets with a sufficient critical mass and reducing barriers due to different regulations.

While top-down approach is therefore an effective way to tackle important barriers to the adoption of ICT in LMICs, concentrating on a purely top-down approach can be a limit. Only 7% of the surveyed people think that EU Institutions should pursue an exclusive top-down approach. A possible improvement is seen on building on the existing top-down initiatives to expand and strengthen their reach and development impact. For example, infrastructures projects, should include conditions for an open access regime with prices that are non-discriminatory and transparent. Another promising avenue is that the EU could better build on the fact that most African countries have already taken EU countries' ICT regulatory frameworks as benchmark. Again, as one of the major donors, the EU should better leverage its policy dialogue with recipient countries to increase awareness about the potential use of ICT for economic growth and poverty reduction. Finally, other areas where the EU has been less active, but it is deemed to have the potential to play a more relevant role, are e-government and e-governance.

7.4 Policy option III: move towards a bottom-up approach

A bottom up approach entails that local actors are involved in decision making process. It is less dependent on technology transfer and it is geared towards identifying local change agents. The advantage of these initiatives is that they are more likely to target the poorest and to be tailored to their needs. They rarely require high level political support, that is often difficult to ensure for programmes

that address policy and regulatory changes, but their geographical scope tend to be limited unless governments are involved to scale up the supported initiatives and integrate them into country systems. Bottom-up approaches are considered to be more effective for tackling the limited IT skills that hold back the poverty reduction potential of ICTs. These often consist in training and educational initiatives targeting both the public and private sectors.

However, there are concerns related to the effectiveness of bottom up ICT4D projects. To be successful these initiatives have to be built on sound understanding of local markets and contexts and seek government approval. Alignment with national strategies increases probability of scalability and sustainability. Because of their high innovative contents, bottom up ICT4D projects tend to propose experimental solutions that provide theoretical benefits. This often creates unrealistic expectations and increases the perception that ICT projects have a high probability of failure. Learning from past experiences and selecting already tested and validated solutions would be more appropriate.

Nearly 26% of surveyed experts think that EU should privilege a bottom-up approach. However, this approach is also less prevalent in current EU development cooperation policies, therefore less experience is already in place to build upon. There are several reasons behind this, including the need to concentrate funding to achieve more tangible impacts and the difficulties of civil society organizations to follow EU grant procedures. Because of its limited field presence, the EU would have to channel its aids through many small organizations, which is not a core advantage of the EU development cooperation.

7.5 Policy option IV: balance a bottom up and top down approaches

In principle, a two-fold approach that tackles both ICT accessibility and capacity constraints is deemed to be the most effective for achieving economic growth and poverty reduction in ICT4D initiatives. The specific balance between the two approaches is country-specific, and depends on several factors, including the level of development, the strength of the government, of the civil society and the private sector. A mixed approach allows overcoming the limitations of both top down and bottoming up approaches and increases ICT4D programmes' sustainability and inclusiveness. However, a mixed approach is more difficult to implement as it based on a larger variety of options that need to be combined to achieve synergies. It also requires that recipient countries have a vision or strategy for the digital development of their economies and societies.

The majority of surveyed experts (52%) believe that a mixed approach would be the more appropriate for the EU. In particular, interviewees think that the EU should reinforce its bottom-up initiatives to achieve a better balance between the two approaches. This is however in contrast with the strategic choice of concentrating funding and making a larger use of budget support.

7.6 Cross-cutting challenges

Important issues that limit the effectiveness of donor approaches for ICT4D have emerged during the present study. Regardless of the policy options selected, these are relevant to help better design EU interventions for promoting ICT.

7.6.1 Donor cooperation

Lack of donor coordination hampers scalability and interoperability of ICT4D projects, creates unrealistic expectations as systems that works at the local level cannot be implemented on a larger scale. In this respect, it was reported that the EU could improve its federating role among EU Member States that have been active in promoting ICT in LMICs.

7.6.2 Alignment with local systems

In supporting ICT in LMICs donors sometimes develop "parallel systems" that compete or are not compatible with the existing local ones. Scarce IT skilled human resources are drained from public systems into donor projects. This is particularly evident in the health sector that strongly depends upon donor support. In principle, donor should refrain from pursuing technology-driven approaches that are poorly aligned with LMIC contexts and promote the use (and dependency from) of ICT that are developed by industrialized countries. There is a sharp contrast between locally developed applications for mobile phones that rapidly reach the national or transnational scale and the myriad of pilot of e-health projects that never survived the pilot phase because of lack of sustainability without donor support.

In this respect, the lack of an ICT4D strategy is an advantage for the EU that has more flexibility in meeting the needs of LMICs with respect to introducing ICT. Without a clear indication of the priority sectors in which most support to ICT should be directed, this can be determined on a case by case basis.

7.6.3 Mainstreaming of ICTs

Integrating ICT within other priority sectors allows to fully seizing the development potential of ICT in different sectors of LMIC economy and society, but has several challenges for donors. First, it requires that sector staff is familiar with the possibility to use ICT effectively within their sector of expertise. Secondly, mainstreaming increases the risk of dispersing and fragmenting ICT4D knowledge across donor organizations, unless information on ICT4D is systematically collected and disseminated. To address these issues some donors (e.g. the WB, Sida), established ICT support units.

DEVCO does not have such a unit in place, but it sometimes relies on DG Connect expertise for ICT programme design and implementation (e.g. e-infrastructure projects). However, mainstreaming has not been systematic so far and little progress has been achieved. An alternative approach to a full mainstreaming of ICT that emerges from the survey findings and the experience of France, consists of increasing the use of ICT in a limited number of sectors. In this case, education and health are considered to be the sectors with the highest potential for reducing poverty.

8. Conclusions

While the diffusion of ICTs is acknowledged as a driver of growth, its effects on poverty are more controversial. Uneven access to ICTs in LMICs can lead to a widening of existing inequalities among territories and social groups. Benefits of ICTs diffusion in LMICs are widely reported in the literature and cut across different sectors, including agriculture, health, education, governance and microfinance. Most successful ICT initiatives, including in the health sector, are based on the mobile phone technology that has the advantage of having lower access costs, thanks to increasing network coverage, user-friendliness and decreasing costs of calls and SMS. Differently, the full potential of internet and of broadband connection has not materialized yet in most LMICs due to a number of constraints that limit access, especially for the poor and in rural areas.

Donors support to ICT has changed across the years. It was strong and geared toward setting up telecommunication infrastructure at the beginning of 2000's and decreased when there was not enough evidence about the contribution of ICT towards tackling poverty and achieving the MDGs. In recent years, thanks to the diffusion of mobile phone across all sectors of population in LMICs and to the emergence of locally-developed ICT-based applications donors have renewed their attention towards ICT. Although approaches in ICT4D vary greatly depending on internal strategic priorities and capacities, donors are gradually embracing the principle of ICT as an enabler of development and mainstreaming ICT across their priory sectors. Health and education were reported to be the two most relevant sectors for using ICT in reducing poverty.

Poor durability of ICT projects, especially when these are designed with a bottom-up approach, is generally reported as a major weakness. The risk of a poor durability is frequently rooted into the first stage of projects, when their design does not include a thorough consideration of the conditions at which they can endure after the pilot phase, including adequate provisions for project maintenance or for capacity building. Assessment of local capacity is not adequately integrated in the project design to reflect the level local IT competences, social and cultural norms.

The healthcare sector of LMICs has also gradually seen a larger use of ICTs for a variety of purposes, including increasing outreach of healthcare services, improved medical knowledge of local health staff, support to patient management or improve disease surveillance. However, most e-health projects in LMICs are still in their pilot phase and have a local scale. Scalability at the regional and national level remains often unexplored, whereas cost-effectiveness of e-health interventions is rarely integrated in evaluation or impact studies. Dependency from donor funding is also high and project sustainability, both in terms of financial and human capacity, is rarely investigated. Some donors focus more on innovative ICT projects rather than on technologies and programs that have been already validated, and this can undermine the effectiveness of interventions. Insufficient collaboration and alignment with local government planning too often results in the creation of "parallel systems" in the health sector that compete with public systems and drain human resources from them. Parallel systems also concern the use of different standards and protocols and to the lack of interoperability among the many different systems that are being developing at local level.

There are a number of barrier that still hold back ICT diffusion in LMICs. These refer *in primis* to a poor infrastructure endowment, including electricity supply, that makes connection difficult and unreliable. Scarce affordability, especially of the internet and of wired broadband connection, severely limits the possibilities of using ICTs in the life of the poor. Weak local political support does not help to raise adequate financing for necessary local infrastructure, whereas flawed policy and regulatory frameworks establish a barrier to competition that in turn hampers prices from falling down. Literacy and digital literacy also remain low amongst the poor, that are so limited to use the simplest features of ICT. Lack of donor coordination, combined with lack of local leadership, leads to a proliferation of unsustainable

business models with a short-lived impact. With the exception of middle income countries, local capacities to benefit from ICT diffusion and to use it as a tool to exit poverty are still weak.

Although not a leading donor in this specific sector, the EU has actively promoted ICT in LMICs with four type of interventions: i) harmonisation of ICT policies and regulatory frameworks; ii) ICT infrastructure development; iii) ICT capacity building, and iv) collaboration in ICT research and innovation. As for other sectors of the EU development cooperation, the geographical focus, has been on ACP countries. Interviews with experts, as well as the desk research, leave the impression that the visibility of EU ICT4D initiatives is low.

The EU approach in ICT4D is not guided by a strategic framework that identifies priority areas for action. So far, the approach followed was to integrating ICT in regional strategies and mainstreaming across focal sectors. However, whereas the latter has been implemented, integration of ICT in other sectors as an instrument to improve development outcomes, programme effectiveness and efficiency, is progressing slowly. The use of ICT in the health sector is still at its early stage of development in the EU development cooperation and mostly focused on supporting the use of telemedicine and the establishment of medical research networks.

Still driven by a technology-centred and top-down approach, the EU cooperation in this sector is not perceived to having being improved significantly over the last ten years. Bottom- up initiatives, that more directly address the poor, are scarcer and the EU is not perceived to have enough experience, or the appropriate instruments, to deliver these types of interventions. Traditionally the core of EU interventions in based upon a policy dialogue with recipient country governments to modify regulatory conditions and establish a more enabling business environment. This is an area where the EU is perceived to be effective. Funds concentration, through an increased use of budget support and infrastructure investment facilities, suggests that the EU is not moving towards a bottom-up approach.

As more evidence on the positive impact of ICT on the life of the poor emerges, the large majority of experts interviewed for this study supported an increase in the commitment of EU development cooperation in the ICT sector. Evidence of the study suggests that there are rooms for EU Institutions to enhance the effectiveness of their ICT4D interventions by having a more balanced approach combining bottom up and top down interventions in function of different context variables, such as recipient countries' level of development, the strength of the government, civil society and the private sector. Many EU member states are also actively supporting ICT with their national cooperation systems. However, it appears to be little coordination of approaches and interventions that could be achieved with the federating capacity of the EU.

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10. Annexes

10.1 EU ODA by sector

Description of ODA by sector (million euro)		2007			2008			2009			2010			2011			2012			2013		
Macro -sector	Sector of Destination	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs
Social infrastructure and services	Education, level unspecified	116.1	95.7	20.4	101.5	97.9	3.7	265.0	260.8	4.2	306.0	271.4	34.6	236.7	221.5	15.3	212.4	196.8	15.6	207.5	198.7	8.9
	Basic education	157.2	112.2	45.0	193.4	186.9	6.5	104.3	102.3	2.0	182.8	182.0	0.7	108.7	105.5	3.2	110.4	106.3	4.1	124.1	122.6	1.5
	Secondary education	100.6	77.9	22.7	79.6	57.7	21.8	90.4	67.4	23.0	57.8	52.1	5.8	77.3	54.4	23.0	81.1	58.8	22.3	67.1	64.8	2.3
	Post-secondary education	172.4	154.7	17.8	143.0	130.1	13.0	175.6	149.9	25.6	191.3	151.9	39.4	203.0	40.0	163.0	275.1	189.0	86.1	243.3	193.5	49.8
	Health, general	49.9	48.4	1.5	125.7	123.6	2.1	111.5	98.3	13.2	122.3	117.8	4.5	98.9	86.5	12.4	91.7	85.9	5.7	84.9	79.3	5.6
	Basic health	396.9	328.8	68.1	367.2	315.6	51.5	433.4	432.3	1.1	213.4	210.7	2.7	392.1	389.0	3.1	336.6	334.3	2.3	368.4	366.8	1.6
	Population polices/programs and reproductive health	101.6	87.4	14.2	107.7	106.0	1.7	50.4	49.9	0.5	89.6	72.5	17.1	97.7	86.0	11.7	94.1	81.9	12.2	72.6	72.6	0.0
	Water supply and sanitation	266.6	256.8	9.9	332.3	322.8	9.5	380.4	360.8	19.6	382.1	349.0	33.0	328.8	297.1	31.7	401.0	348.0	53.0	329.2	292.5	36.8
	Government and civil society	1321.6	831.4	490.2	1430	868.6	561.3	674.4	962.3	712.1	1499	1003.6	495.4	1483.9	891.5	592.4	1477.8	860.9	616.9	1548.3	870.7	677.6
	Other social infrastructure and services	756.9	719.5	37.4	658.3	647.5	10.8	560.5	482.7	77.8	434.0	407.4	26.6	516.0	471.2	44.8	453.5	373.9	79.6	475.7	394.4	81.3
Economic infrastructure and services	Transport and storage	805.7	788.9	16.8	899.6	869.2	30.4	672.2	590.7	81.4	753.9	668.3	85.6	689.4	644.3	45.1	781.4	648.9	132.5	599.6	500.9	98.7
	Communications	32.8	28.2	4.6	29.5	21.1	8.4	43.7	33.6	10.1	28.5	24.4	4.0	37.5	23.8	13.8	31.4	26.3	5.1	30.3	24.8	5.5
	Energy	203.0	142.8	60.2	259.5	195.4	64.0	242.8	197.2	45.6	279.1	231.9	47.2	349.0	318.5	30.4	419.5	383.8	35.8	317.8	300.0	17.8
	Banking and financial services	54.5	54.0	0.5	55.3	26.2	29.0	27.2	16.4	10.8	33.2	25.6	7.6	39.5	36.3	3.2	25.5	21.9	3.6	12.8	9.7	3.1
	Business and other services	113.6	79.1	34.5	111.3	90.4	20.9	109.9	56.7	53.3	85.2	69.5	15.7	88.0	60.9	27.1	62.6	44.8	17.9	49.5	45.1	4.4
Production sectors	Agriculture	230.5	219.7	10.8	257.8	248.3	9.5	513.6	496.4	17.2	384.3	356.2	28.1	406.6	294.2	112.5	306.7	275.4	31.3	460.1	405.9	54.2
	Forestry	40.2	40.2	/	43.7	43.4	0.3	39.2	39.0	0.2	35.6	34.5	1.1	41.9	40.6	1.4	57.3	57.3	/	44.9	44.6	0.2
	Fishing	18.4	13.1	5.2	16.9	15.9	1.0	13.3	10.5	2.9	26.7	26.3	0.4	30.2	28.6	1.6	17.9	17.5	0.4	24.3	24.2	0.1
	Industry	134.8	129.4	5.4	147.7	131.0	16.7	187.6	173.9	13.6	231.7	216.2	15.5	/	/	/	149.5	140.6	9.0	127.6	118.2	9.4
	Mineral resources	42.2	42.2	/	51.9	44.7	7.2	38.5	33.9	4.5	29.6	28.4	1.3	16.3	15.9	0.4	10.5	10.3	0.2	11.0	10.8	0.2
	Construction	0.1	0.0	0.1	0.1	/	0.1	4.2	3.8	0.5	3.0	3.0	0.0	1.3	1.3	/	3.0	2.3	0.7	1.5	1.3	0.2
	Trade policy	158.4	143.3	15.1	135.8	121.3	14.5	166.4	153.1	13.4	217.7	201.1	16.6	162.5	149.4	13.1	136.6	124.8	11.8	177.5	164.1	13.4
	Tourism	10.8	10.0	0.8	11.1	10.3	0.8	9.9	9.2	0.8	15.6	15.0	0.6	11.6	9.8	1.8	11.2	9.2	2.0	8.8	6.9	1.9

Description of ODA by sector (million euro)		2007			2008			2009			2010			2011			2012			2013		
Macro -sector	Sector of Destination	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs	Total	Europe Aid	Other DGs
Multisector / crosscutting	General environmental protection	165.57	142.57	23.00	148.34	122.61	25.73	191.94	114.96	76.98	179.86	141.28	38.58	185.11	163.32	21.79	314.71	218.55	96.16	273.62	213.15	60.46
	Other multisector	454.85	314.97	139.89	556.87	325.73	231.14	571.17	294.02	277.15	614.16	397.96	216.20	517.04	283.43	233.61	588.90	378.38	210.52	591.79	386.77	205.03
Commodity aid and general programme assistance	General budget support	689.66	669.53	20.13	553.51	513.37	40.14	865.66	800.35	65.32	1102	951.30	150.70	741.78	686.78	55	808.25	778.25	30.00	701.49	688.26	13.23
	Development food aid/ food security assistance	272.73	259.71	13.02	263.68	260.3	3.39	373.28	373.27	0.01	342.57	342.10	0.47	206.61	206.08	0.53	228.57	223.30	5.27	169.41	165.87	3.54
Action relating to debt	Action relating to debt	/	/	/	85	85	/	115.49	110.49	5	119.22	114.22	5.00	13.09	13.09	/	14.73	14.73	/	1.75	1.75	/
Humanitarian aid	Emergency Response	848.25	166.23	682.02	946.69	109.38	837.31	921.3	163.66	757.64	1094.85	168.58	926.27	1037.84	56.72	981.13	1,189.14	143.05	1,046.09	1,208.77	44.13	1,164.64
	Reconstruction relief and rehabilitation	214.79	213.34	1.46	416.42	409.56	6.86	163.49	127.07	36.42	102.34	78.60	23.74	131.12	99.64	31.48	88.83	58.74	30.10	105.91	40.45	65.45
	Disaster prevention and preparedness	17.44	0.13	17.30	49.63	23.52	26.11	55.61	28.56	27.05	50.64	12.95	37.68	75.73	43.06	32.67	78.34	39.59	38.75	79.33	38.27	41.06
Other/unallocated/ unspecified	Administrative costs of donors	481.56	359.96	121.60	549.36	366.54	182.82	524.48	341.34	183.14	535.93	353.58	182.36	555.82	425.46	130.36	572.59	445.51	127.08	567.58	439.4	128.17
	Support to NGOs	0.37	0.33	0.04	3.06	3	0.06	12.24	11.97	0.27	/	/	/	/	/	/	/	/	/	/	/	/
	Refugees in donor countries	/	/	/	1.08	1.08	/	/	/	/	5.77	/	5.77	/	/	/	/	/	/	13.77	0	13.77
	Unallocated/unspecified	62.84	41.24	21.60	62.01	35.4	26.6	90.61	55.27	35.34	91.21	74.87	16.35	109.27	87.84	21.44	103.84	95.35	8.50	162.4	88.26	74.13
GRAND TOTAL		**8,492.7**	**6,571.6**	**1921**	**9,1943**	**6,929.5**	**2,264.8**	**9,799.7**	**7,202.1**	**2,597.6**	**9,840.8**	**7,354.2**	**2,486.5**	**9,213**	**6,536.3**	**2,676.7**	**9,534.7**	**6,794.3**	**2,740.4**	**9,262.6**	**6,418.6**	**2,843.9**

Source: own elaboration on Annual Report on the European Union's Development and external assistance policies and their implementation in 2008-2014.

10.2 Survey's questionnaire

Section A – General information

A.1 Name

A.2 Age

A.3 Gender

A.4 Affiliation

A.5 Typology of affiliation

- ☐ Public organisations (e.g. WHO, UN, Sida, etc.)
- ☐ Public Authority (e.g. national governmental agency, MoH, etc.)
- ☐ Academia
- ☐ Think tank/Research centre
- ☐ European Union institution (e.g. European Parliament, European Commission, EU delegations, etc.)
- ☐ Private for profit organisation (e.g. ICT providers, telecom operators)
- ☐ Private non-profit organisation (e.g. NGOs)
- ☐ Other (please specify)

A.6 What is your job description?

- ☐ Civil servant / Administrator
- ☐ ICT specialist, advisor or consultant
- ☐ Policy adviser
- ☐ Project Manager
- ☐ Researcher
- ☐ Teacher / Professor / Lecturer
- ☐ Health worker
- ☐ Other (please specify)

A.7 How many years of experience do you have in ICT4D, development cooperation or Health in LMICs ?

- ☐ 0-5 years
- ☐ 5-10 years
- ☐ 10-20 years
- ☐ More than 20 years

A.8 Which country / ies do you work in?

(List of countries)

Section B – Role of ICT in LMICs

B.1 Please rank the 5 policy areas where, in your opinion, ICTs are more relevant for economic development in LMIC.

- ☐ Health
- ☐ Education
- ☐ Food and Agriculture
- ☐ Energy and Environment
- ☐ Research
- ☐ Finance and banking
- ☐ Employment
- ☐ Business development
- ☐ Humanitarian aid and disaster management
- ☐ Other (please specify)

B.2 According to your experience, which ICTs mostly impact economic development?

- ☐ Traditional ICTs (e.g. radio & television)
- ☐ Basic mobile phone
- ☐ Internet connectivity
- ☐ Smartphone/tablet/PC
- ☐ Other (please specify)

B.3 Please rank the 5 main obstacles that in your opinion mostly hamper the use of ICTs for economic development in LMICs.

- ☐ Poor infrastructure
- ☐ Lack of IT professionals
- ☐ Low digital literacy of end-users
- ☐ Low literacy rate of end-users
- ☐ High cost of ICTs products
- ☐ Insufficient political support (e.g. lack of ICTs national strategies)
- ☐ Lack of access to modern ICTs, especially the Internet
- ☐ Lack of content in local language
- ☐ Limited women access to ICTs
- ☐ Lack of applications tailored to micro-entrepreneurs
- ☐ Cultural bias towards ICTs, resistance to change
- ☐ Other (please specify)

B.4 Please indicate up to 3 of the main shortcomings in donors' approaches in promoting ICT4D.

- ☐ Lack of a coherent approach (e.g. tied aid)
- ☐ Lack of alignment with countries' strategies
- ☐ Poor sustainability of the interventions realized

- ☐ Little attention in supporting ICT applications relevant to LMICs
- ☐ Too much attention on showcase projects
- ☐ Other (please specify)

B.5 Please provide any general comment to this section.

Section C – ICT and health

C.1 Please indicate which level of priority ICTs should have within healthcare planning as compared to other health priorities in LMICs.

- ☐ Very high
- ☐ High
- ☐ Average
- ☐ Low
- ☐ No opinion

C.2 Please rank the 5 main benefits of e-Health in a LMICs context.

- ☐ Facilitate access to health services
- ☐ Facilitate access to health information
- ☐ Facilitate training for health workers
- ☐ Reduce healthcare expenditure
- ☐ Improve quality of healthcare services
- ☐ Improve health promotion and disease prevention
- ☐ Improve management of emergency crisis
- ☐ Speed-up health care services
- ☐ No opinion
- ☐ Other (please specify)

C.3 According to your experience, which e-Health technology is mostly used in LMICs? Please rank the most important 5.

- ☐ Telemedicine
- ☐ Health information systems
- ☐ Electronic health records
- ☐ M-Health
- ☐ Computerized physician order entry/e-prescription
- ☐ Clinical decision support/diagnosis
- ☐ E-Learning for healthcare workers
- ☐ Surveillance system for healthcare
- ☐ Population health registries
- ☐ No opinion
- ☐ Other (please specify)

C.4 According to your experience, please rank the 5 m-Health applications that proved to be more successfully used in LMICs.

- ☐ Remote monitoring (e.g. adherence)
- ☐ Patient tracking
- ☐ Supply chain management
- ☐ Health financing
- ☐ Emergency services
- ☐ Support for clinical decision making
- ☐ Diagnostics support
- ☐ Better recordkeeping
- ☐ Communication and training for healthcare workers
- ☐ Surveillance
- ☐ Disaster management
- ☐ Remote data collection
- ☐ Disease prevention
- ☐ Education and awareness
- ☐ No opinion
- ☐ Other (please specify)

C.5. Please rank the 5 main obstacles that mostly hamper the use of e-Health in LMICs.

- ☐ Poor infrastructure (e.g. unreliable internet service)
- ☐ Equipment (e.g. lack of computers, mobile devices, etc.)
- ☐ Cultural bias towards the use of ICT in healthcare
- ☐ Lack of IT professionals in the health sector
- ☐ Lack of maintenance and technical support
- ☐ Low digital literacy of healthcare workers
- ☐ High cost of high speed internet services
- ☐ Unavailability of IT tools from the patient side
- ☐ No opinion
- ☐ Other (please specify)

C.6. Please rank the 3 obstacles which mostly prevent scaling up of e-Health projects in LMICs.

- ☐ Limited financial resources within Ministries of Health
- ☐ Lack of policy and regulatory frameworks
- ☐ Insufficient evidence of cost-effectives
- ☐ Lack of evidence on patient outcomes
- ☐ Lack of awareness and dissemination strategies
- ☐ Lack of political support
- ☐ No opinion
- ☐ Other (please specify)

C.7 Please rank the 3 most relevant policy which can contribute to foster the use of e-Health in LMICs.

- ☐ Increase funding for e-Health projects
- ☐ Increase awareness of e-Health benefits (i.e. for LMICs policy makers)
- ☐ Improve coordination of existing and future e-Health initiatives
- ☐ Generate national guidelines and regulatory frameworks
- ☐ Strengthen sustainability of successful initiatives
- ☐ Scale up projects at community level
- ☐ No opinion
- ☐ Other (please specify)

C.8 Please provide any general comment to this section.

Section D – EU policies in ICT4D

D.1 According to your experience, in the last 10 years, to what extent have the EU institutions improved their support to ICT4D as compared to the past?

- ☐ Significantly Improved
- ☐ Improved
- ☐ Neither improved nor weakened
- ☐ Worsened
- ☐ No opinion

D.2 According to your experience, how do you judge the EU cooperation with international organizations in the field of ICTs diffusion in LMICs?

- ☐ Very good
- ☐ Good
- ☐ Sufficient
- ☐ Insufficient
- ☐ No opinion

D.3 Please select the objective that in your opinion should be the key priority of the EU policies in ICT4D.

- ☐ Increase economic growth
- ☐ Reduce health inequalities
- ☐ Support the achievement of the MDGs
- ☐ Reduce the digital divide
- ☐ No opinion
- ☐ Other (please specify)

D.4 The EU has adopted mixed strategies, co-operating with the large international organisations and the regional associations of the LMICs (top-down approach), but also launching

programmes to finance projects in the field (bottom-up approach). In your opinion, which policy should be followed by the EU for the development of ICTs diffusion in LMICs?

- ☐ Policy option 1: minor/no support of EU institutions to the development and dissemination of ICTs in LMICs
- ☐ Policy option 2: strong support of EU institutions with a top-down approach (aimed at LMIC governments and international organisations), influencing political choices of national governments, and integrating ICTs into development and implementation planning
- ☐ Policy option 3: strong support of EU institutions with a bottom-up approach (by close co-operation with local, often non-governmental entities, with the aim of carrying out projects in the field to directly impact local stakeholders)
- ☐ Policy option 4: a combination of top-down and bottom-up approaches
- ☐ No opinion
- ☐ Other potential policy options (please specify)

D.5 Please select the policy approach that, in your opinion, should be followed by the EU institutions in ICT4D.

- ☐ Focus on applying ICTs to two/three key sectors (e.g. education, health, governance)
- ☐ Establishing ICTs as a priority area of the EU Development Cooperation
- ☐ Integrating ICTs in all priority areas of the EU Development Cooperation
- ☐ Strengthening the PPPs in ICTs in LMICs between EU and industry
- ☐ No opinion
- ☐ Other (please specify)

D.6 In which priority sector should the EU increase the use of ICTs in LMICs? Please rank the most important 3.

- ☐ Health
- ☐ Education
- ☐ Human rights and governance
- ☐ Food and Agriculture
- ☐ Human development (e.g. employment, social protection)
- ☐ Economic growth (e.g. private sector development, trade, regional integration)
- ☐ Infrastructure
- ☐ Energy and Environment
- ☐ Migration and Asylum
- ☐ No opinion
- ☐ Other (please specify)

D.7 According to your experience, which instruments are more effective in promoting ICTs within the EU Development Cooperation? Please rank the most important 3.

- ☐ Research partnerships
- ☐ Infrastructure financing
- ☐ Policy dialogue on ICTs policy and regulatory issues at central level

- ☐ Technical assistance to specific e-projects
- ☐ Rising LMICs policy makers' awareness on ICTs benefits
- ☐ Rising EU policy makers' awareness on ICTs benefits
- ☐ No opinion
- ☐ Other (please specify)

D.8 In order to remove the obstacles hampering the dissemination of ICTs in LMICs, which action should EU take? Please rank the most important 3.

- ☐ Rise donors' awareness on ICTs benefits
- ☐ Rise LMICs policy makers' awareness on ICTs benefits
- ☐ Support LMICs in developing ICTs regulatory and legal frameworks
- ☐ Contribute to telephone and internet cost reduction
- ☐ Stimulate local ICTs Public-Private Partnerships
- ☐ Allocate more financial resources to ICT development programmes
- ☐ Build ICTs capacity at international level, enhancing co-ordination among actors
- ☐ No opinion
- ☐ Other (please specify)

D.9 Please provide any general comment to this section.

10.3 List of questions for the structured interviews

Topic I. ICTs for development

Q1. When asked which should be the key priorities of EU Institutions' ICT4D policies, about 40% of the survey's participants selected "Reduce health inequalities", followed by "Support the achievements of the Millennium Development Goals" (17%). "Increase economic-growth" was selected by only 14% of interviewees. In general, ITCs role in development can be seen both as a driver to economic development and as a tool to tackle deprivation and poverty. The result of the survey stresses the importance of the latter dimension, even though the scientific literature provides poor systematic evidence of a clear relation between ICTs diffusion and poverty reduction.
In light of your experience to which extent ICTs can help tackling poverty reduction? Can you provide concrete examples?

Q2. According to the survey the main obstacle that hampers the use of ICTs for economic development in low and middle income countries (LMICs) is their poor infrastructure endowment. Another major issue is the "Lack of access to modern ICTs, especially the internet" and their high costs.
a) Do you agree with this picture?
b) In your opinion how can international donors support LMICs in overcoming their poor ICTs infrastructure endowment? Can you provide examples of failures and successes in this field?
c) And how should donors contribute to tackle the scarce affordability of ICTs in low and middle income countries? Do you have relevant examples?

Q3. Do you have any further comment on this topic?

Topic II. ICTs for health (e-health) in LMICs

Q4. The majority of professionals participating in the survey indicated that ICTs should have a high or very high level of priority in healthcare development in LMICs countries.
In case you agree, why do you think e-health should be considered so important in the context of countries in which sometimes basic health structures and services have not been fully developed? Could you provide relevant examples based on your experience?

Q5. According to the survey the most used e-health technologyin LMICs are Health Information Systems and Telemedicine. Other major e-health technologies are E-learning, and mobile-supported health practices.
Do you have any direct experience of initiatives based on any of these technologies? If yes, could you indicate the main problems and benefits, and provide an overall judgement on these initiatives?

Q6. According to the survey strengthening the sustainability of successful initiatives would be a key step in order to foster e-Health usage in LMICs.
a) Which factors hamper the sustainability e-Health initiatives?
b) Which strategies should donors adopt to improve this aspect?

Q7. Do you have any further comment on this topic?

Topic III. EU policies for ICTs diffusion in LMICs

A) EU Strategy and coherence

Q8. Whereas other donors, such as the World Bank or the African Development Bank have a clearly focused ICT4D strategy, the EU development cooperation in this sector is not guided by a general policy document.
a) In your opinion which can be the disadvantages of this lack of strategic focus?
b) Should the EU better integrate ICT into its development programs?
c) Should there be sectors in which ICT should have a higher prominence in the EU development cooperation strategy?

B) General evaluation of EU/other donors ITC4D policies

Q9. EU interventions in support of ICT for development can be grouped in four main areas: ICT infrastructure development, relevant policy and regulatory frameworks harmonization, establishing of national research and education networks of EU and low and middle income countries, and the development of ICT capacity building initiatives. According to the survey the first three most effective instruments adopted by the EU have been the technical assistance to e-projects, followed by research partnerships, and infrastructure financing.
Do you agree with this picture? Why do you think the EU has been particularly successful in the e-projects technical assistance as compared to other areas? In which area do you think the EU is weaker, and why?

Q10. To what extent is the EU development cooperation using ICT into its health development programs? Which are its target sectors andthe instruments used? Is there an area were the EU proved to be particularly successful? Is there an area were the EU has not gained experience yet?

C) Approach to be followed

Q11. So far, the EU has mostly being following a "top-down" approach in ICT4D, co-operating with large international organisations and regional associations of the LMICs, with limited experience in "bottom-up" approaches, partnering with local entities (often non-governmental) in projects targeting directely the end users.
The majority of the survey respondents indicated that the best approach would be a mix of the two.
a) Do you agree with the respondents? Do you think the EU is in a position to implement a truly balanced mixed approach? What would be needed?
b) Do you think that the current top-down approach of European Institution may actually result from a specific comparative advantage of European institutions?

D) Areas of intervention

Q12. When asked which actions EU should take to remove the obstacles hampering the dissemination of ICTs in low and middle income countries, the majority of respondents underline the importance to support them in defining ICTs regulatory and legal frameworks.
a) How do you think the EU should achieve this goal? Are there already successful programs that could be replicated? What is the specific comparative advantage of the EU in this area of intervention as compared to other donors?
b) Do you have any idea in order to improve EU actions to overcome obstacles to ICTs dissemination?

Q13. Most participants think that Health and Education are the priority sectors in which the EU should support the diffusion of ICTs in low and middle income countries. These are also considered areas in which ICTs are more relevant for economic development.
In your opinion, have the European institutions got any comparative advantage in supporting the diffusion of ICTs in either Health and/or Education areas in developing counties? Which kind of policies they should implement to do so? Is a more bottom-up approach advisable in those areas? Should EU be more present in the field and having more connection with field staff?

E) Partnerships and cooperation – both within EU Institutions and with other donors

Q14. According to the survey result, the EU cooperation with other international organizations in the field of ICTs diffusion is insufficient.
Do you agree with this perception? In which areas/which kind of projects European institutions may be more effective if collaborating with other international organizations? Do you have experience of positive or negative cooperation initiatives of the EU with other donors?

F) EU Governance - only for interviewees working for European Institutions

Q15. Within the European Commission support to ICTs in development cooperation is mainly delivered through the Directorate-General for International Cooperation and Development (DG DEVCO), that also establishes the general and ICT-specific direction of the EU development cooperation. Other relevant European Commission Directorates are the DG RESEARCH, which funds ICT research and innovation initiatives in LMICs, and the DG CONNECT, which provides advisory services to DG DEVCO on ICT issues
Do you think the European Institutions faces a problem of governance complexity in the field of ICT4D? Could you provide any concrete example from your experience concerning this topic? Which are the limits of this approach and how could it be improved?

Q16. Do you have any further comment on this topic?

Free general comment

Q17. Any other point you would like to add? Any other topic not well covered by our study?

Building on three literature reviews, the study first describes the conditions hampering or facilitating the support of ICT to poverty reduction in LMICs, then focuses on the specific opportunities and obstacles in the use of ICTs in the healthcare sector and, finally, it illustrates the EU policy approach for promoting ICTs in LMICs.

Evidence from desk analysis is complemented by the opinions of 145 surveyed experts, ten of which were also interviewed. Experts' opinions confirm the evidence of desk analysis pointing to health and education as the main areas in which ICTs can play a significant role in LMICs development.

On the basis of the evidence collected, the study discusses the options that EU policies can follow in this field, in particular by illustrating advantages and drawback of top-down and bottom up approaches.

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