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1 PROJECT ABSTRACT

The EuroAfrica-ICT.org project is defined in full continuity with and builds upon the substantial results obtained and the significant momentum created by two previous European projects: the FP6/IST START and the FP7/ICT EuroAfriCa-ICT FP7 projects.

“The EuroAfrica-ICT initiative”, which has been developing since 2006 through these two projects and which is supported by a high number of key stakeholders in Europe and in Africa, has established close synergies with most national and international programmes and initiatives; has already started to identify research priorities to support the development of policy dialogues; and has provided the European and African research communities with continuous and reliable support and guidance.

The EuroAfrica-ICT.org partnership built this new support action by capitalising on its past experience, its significant network of contacts, its past achievements, and the conclusions of the 1st and the 2nd “Euro-Africa Cooperation Forums on ICT Research” which has been successfully and respectively organised in March 2009 in Belgium and in February 2010 in Ethiopia by the FP7/ICT EuroAfriCa-ICT project.

Project activities (all specifically targeting Europe and sub-Saharan Africa) will be implemented over a 24-month period:

- Research priorities in the ICT field will be explored through an approach involving the highest number of stakeholders from the two continents and recommendations for future cooperation opportunities will be derived from them,
- Cooperation events will be organised both in Europe and Africa, synchronised whenever and wherever possible with policy dialogue meetings in order to facilitate the development of synergies with other programmes and initiatives (including the CAAST-Net INCO project), involve key stakeholders in the field (such as the ETPs and JTIs in the ICT area), fine tune priorities, etc. To be noted: two key cooperation events organised by the project will be the 2010 and 2011 editions of the “Euro-Africa Cooperation Forum on ICT Research”, which provide key stakeholders in the field with a key opportunity to celebrate and further strengthen the development of cooperation on ICT research between Europe and Africa,
- Support and guidance will be provided to European and African organisations in their efforts to connect and develop joint research projects in the ICT field (through an active online community of researchers from both regions, a database of African excellence research centres, proactive helpdesk services, etc.),
- Dissemination activities will support all other project activities and maximise the overall project impact.

The EuroAfrica-ICT.org project is therefore:

- A focused, result-oriented and ambitious project,
- Presented by a limited yet well-established partnership, offering all necessary skills to efficiently implement planned activities from the very beginning of the project.

2 INTRODUCTION

The present document is a deliverable of the EuroAfrica-ICT.org project, funded by the European Commission's Directorate-General Information Society and Media (DG INFSO), under its 7th EU Framework Programme for Research and Technological Development (FP7).

The EuroAfrica-ICT.org project is divided into Work Packages (WP), each of them being subdivided into Tasks (T). One of the project Work packages (WP1: Research priorities) consists in increasing the project impact through two main activities: Identification and analysis (Task 1.1) and Recommendations (Task 1.2).

Within this Work Package, a two-phase study was conducted into researchable priorities in ICT between Europe and Africa.

Phase 1 was completed in 2010 through desk studies, an e-Consultation, online surveys and one-to-one interviews. During phase one (see deliverable report D1.1) it emerged that the broad categories identified as priorities in the FP7 theme on ICT continue to be important areas for mapping out future research priorities. It also emerged, however, that in order to define potential researchable topics around major challenges of common interest and mutual benefit to Europe and Africa it would be necessary to drill down further into specific domains.

This report relates the outcomes of phase 2 of the study, the purpose of which was to drill down into three specific domains identified in phase 1 as having high priority for future bi-regional collaborative research ventures. The agreed domains were:

- e-Learning (ICT for education),
- e-Health (advanced technologies to improve health),
- m-Applications (mobile applications).

The objectives of phase two were, within the listed domains, to:

- Identify, through expert consultation and literature review, key challenges in the domains which may be hindering greater their contribution to socio-economic development, and associated researchable topics of common interest or mutual benefit to both Africa and Europe to address the challenges, and
- Formulate outline proposals around the researchable topics for consideration by the EC for possible future framework programme support.

The present deliverable (D1.2 – Research priorities: final report), prepared by Meraka/CSIR, ACU and AUF, is the 2nd and final report related to this activity.

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4 EXECUTIVE SUMMARY

The EuroAfrica-ICT initiative conducted a two-phase study into researchable priorities in ICT between Europe and Africa. The study used online questionnaires, interviews and desk studies to gather opinion from a diversity of stakeholders to identify and elaborate priorities. Phase 1 of the study confirmed that the broad categories identified as priorities in the FP7 theme on ICT continue to be important areas for mapping out future bi-regional collaborative research priorities.

Phase 2 of the study looked in more detail at three specific domains: e-Health, e-Learning and m-Applications. Through a targeted online questionnaire, discussion forum and desktop study the second phase gathered opinion on key challenges in each of the three domains that may be limiting the potential of the domains to contribute to social and economic development in Africa. Participants were invited to suggest researchable topics, technologies and their applications which could address the challenges, and to explain the impact such research would generate.

Questionnaire response rate was lower than expected, with just 18 of 128 invited participants responding fully to the survey (although 50 participants started the questionnaire, only 18 responses sets were complete). While a low response rate potentially undermines the representative nature of the data, it does not invalidate the few responses supplied, but in fact synergy between those responses received and the literature gives confidence that even this small sample set is reasonably representative of wider opinion.

Challenges listed by respondents in each of the domains, were diverse and rather generic in nature yet could be codified into groups. Perhaps not unexpectedly, challenges could be divided at the broadest level into issues of a technological and infrastructural nature on the one hand, and on the other hand were policy, institutional, social, and system issues. For each domain, there were several common generic technological and infrastructural challenges such as poor connectivity and restricted access to broadband and 3G/GSM networks, especially in remote regions, limiting the potential of e-Health, e-Learning and mobile technologies.

Respondents provided similarly diverse suggestions for researchable topics, key technologies and their applications to address challenges although more detail would have been valuable in all cases, and in many cases researchable topics were indistinct from challenges. Delivery systems, national policy, standardization and interoperability, low-cost hand-held mobile devices, cloud computing, local mobile networks, and WiMax all featured among the responses.

From the desktop study, two themes emerge: firstly that there is a degree of synergy between the challenges raised by respondents to the questionnaire and the challenges listed in the literature, and secondly that there is an evident abundance of innovative initiatives on the continent of Africa yet which, judging from the questionnaire responses, are not widely known. To some extent this situation may be a reflection of domains currently, in relative terms at least, being still in their infancy.

For the e-Health, e-Learning and m-Applications domains two outline proposal topics have been drawn from the questionnaire responses (inevitably, these outline topics will need further elaboration):

e-Health:

- 1) Study providing up-to-date picture of the state of play of e-Health regarding, for instance, acceptability of e-Health technology, rural and local sustainability of e-Health.
- 2) Research on e-Health system components for remote and rural communities in Africa.

e-Learning:

- 1) Research on e-Learning for primary, secondary and higher & continued education via mobile devices powered by renewable energy sources.
- 2) Study providing an up-to-date picture of the state of play of e-learning regarding, for instance, best practices at primary education level

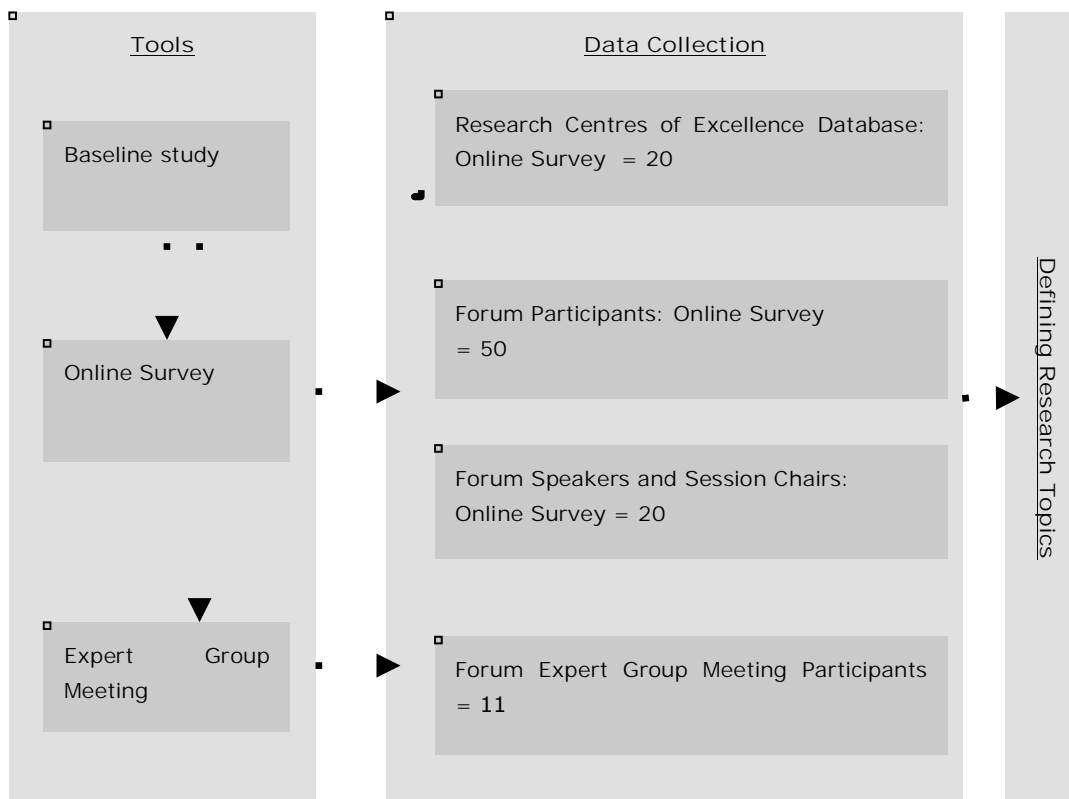
m-Applications:

- 1) Study providing an up-to-date picture of the state of play of m-Applications (phones, multimedia tablet) related to e-Health and e-Learning at various levels across Europe and Africa
- 2) Interdisciplinary research on computational linguistics to support multi-lingual access to mobile applications and content.

5 Methodology

To address its objectives, phase 2 relied principally on an experts’ consultation exercise conducted via an online questionnaire. An informal discussion session at the November 2011 Cape Town ICT forum, and a literature review complemented the online questionnaire. The approach taken in phase two is described schematically in figure 1 below.

Figure 1: Phase 2 methodology



5.1 Online questionnaire and assessment

The EuroAfrica-ICT study into researchable priorities in ICT between Europe and Africa relies substantially on electronic consultation of stakeholders and experts via online surveys to gather opinions. In response to the challenges encountered during phase one of the study of a low online questionnaire response rate and of rather broad and non-specific answers, for the second phase of the study the EuroAfrica-ICT consortium endorsed a second questionnaire being specifically targeted at a restricted range of selected experts, with stated experience in one or more of these domains, in the anticipation of a higher response rate and more specific feedback. The selection of experts was based on the criteria explained in section 5.3.

The simple online questionnaire¹ consisted of twelve open-ended questions (following four introductory questions, and with two follow-up questions at the end) arranged in a logical sequence, designed to investigate participants' opinions on challenges in their domains, and on approaches to addressing the challenges (annex section 9.1). The questions embraced the following issues;

- Challenges, and researchable topics to address challenges,
- Technologies and their applications to address challenges,
- Constraints in the technology innovation system,
- Impact of addressing the challenges.

The first question asks respondents to suggest a list of challenges in their respective domains i.e. e-Health, e-Learning and m-Applications. These could be issues which, in their own views and opinions, hinder or restrict greater contribution of the domain to social and/or economic development. Subsequent questions ask respondents to suggest how such challenges might be addressed, perhaps through addressing a specific researchable topic, perhaps through the development of a new technology or adaptation of an existing technology, or through the lifting of a constraint in the innovation system.

In the final questions about impact, respondents were asked to indicate which populations would benefit from the research or technologies they are proposing, and why, and to give a quantitative indication of the scale of the impact, perhaps geographically, or by social group, or in direct numbers, and to suggest qualitative impact if feasible to do so.

The questionnaire set out to gather opinion, not to test a hypothesis or to assess variables, with the intention of using collated opinion to formulate researchable topics having the potential to impact on the contribution of the domains to social and economic development. No hypothesis or variables have been tested or evaluated. A non-statistical, descriptive summary of responses to the questions in section 6.1 of this report relies on the aggregation of responses determined by the authors. Researchable topics have been formulated and are presented in section 7. The full set of responses to all 12 questions is found in annex section 9.2. Summaries, researchable topics and response data are all presented without reference to individual respondents.

The report is made available through the EuroAfrica-ICT project website and at future EuroAfrica-ICT events. In response to participants' request, the report will be made directly available to all respondents.

5.2 ICT Forum expert group meeting

On the second day of the 4th EuroAfrica Cooperation Forum (Cape Town, 15 November 2011) an expert group meeting was conducted as part of data collection for the study. The purpose of the meeting was to consult a targeted group of experts in the fields of e-Learning, e-Health and m-Application to provide complementary inputs on the identification of research priorities in the three domains. The meeting was attended by 11 researchers selected according to the criteria outlined in section 5.3 of this report. This meeting started with an introduction to the research priorities study reported in D1.1 in phase one of the study.

The meeting was conducted as an open but focused discussion intended to identify areas of mutual interest and key research priorities that should be the centre of focus in the EuroAfrica-ICT cooperation programmes in the three domains, technology needs not yet fulfilled in these domains, technology innovation opportunities in the domains, and the niche areas for innovation relevant to Africa and Europe were discussed. A summary of the output of this meeting is presented in section 6.3.

¹ Created using SurveyMonkey software

5.3 Selection of questionnaire and discussion meeting participants

Both the phase two questionnaire and the discussion meeting at the Cape Town ICT Forum sought to gather opinion from a limited number but broad range of experts including for example academics, researchers, policy makers and representatives of civil society organisations such as NGOs implementing ICT research, development and innovation projects and programmes in Europe and in Africa. Participants were selected from two principal sources:

- 1) The EuroAfrica-ICT database of ICT research institutes in Africa; and
- 2) The registered delegates at the 4th EuroAfrica Cooperation Forum on ICT Research, which took place on November 14-15, 2011 in Cape Town, South Africa.

The database of African research institutes includes fields on principal institutional expertise. For delegates at the ICT forum, information on their areas of expertise was given in their registration documents.

For both sources, entries (research institutes in the case of the database, or individuals in the case of forum delegates) were scanned and filtered for expertise on any one or more of the three domains.

That filtering resulted in 64 experts from the database, and 41 from the list of forum delegates. An additional 18 delegates were selected from among session speakers whose names were not included on the basis of their registration data.

Six specifically francophone participants were identified by the Agence Universitaire de la Francophonie using the same selection criteria of expertise in one or more of the selected domains, giving a final total of 128 identified participants. All identified participants were invited to participate by email.

For the ICT Forum group discussion meeting, invitations were extended to a small group of registered participants at the Cape Town ICT Forum who had already received the phase two questionnaire.

5.4 Baseline study

A baseline study of Internet-available literature was conducted to identify relevant topics and understand current and future trends for ICT RDI in the three focus domains, and also to document possible research topics and innovation interventions.

The documents consulted are listed in annex section 9.4. These include academic scientific articles, business reports, ICT research and technology magazines, EU and AUC reports and related documents. This base-line survey was conducted with the following objectives:

- To identify key world-wide trends that can feed into strategic research priorities in the focus areas.
- To identify future direction and opportunities for ICT research in these domains from a literature point of view.

6 Outcomes of the phase 2 of the study

6.1 Questionnaire

Of the 128 individuals invited to respond to the phase two questionnaire, 50 started and 18 fully completed the questionnaire. This assessment is based on the responses from just 20 individuals which include two unsolicited sets of responses.

6.1.1 Summary of responses on e-Health

Four individuals, from Uganda, Nigeria, France and Switzerland responded to the questionnaire from the perspective of e-Health. Two were from universities, one from the UN system and one from an industry-funded research institute. Unedited responses are listed in the annex, section 9.2.1 (typographic errors have been corrected by the authors of this report).

Challenges in the e-Health domain listed by respondents could be resolved broadly into two sets of issues which act to constrain the e-Health system: 1) shortcomings in systems, policies and infrastructures, and 2) lack of capacity in human and physical resources.

Researchable topics, key technologies and their adaptations proposed to address the challenges referred on the one hand to general improvement to mobile and broadband coverage and their technologies, and to their inter-connectivity, as well as to exploiting and enhancing certain specific technologies and applications (such as cloud computing, local language translation, HD video conferencing, electronic patient records) for supporting the delivery of services such as remote diagnostics, and on the other hand to establishing the evidence base (for policy makers, health care professionals and end users) for the implementation of e-health systems. In the opinion of the respondents, such topics are of interest and benefit to both Europeans and Africans.

Constraints to technologies and their applications mentioned by respondents referred to familiar themes such as weak infrastructure, human capacity and training needs, high costs of devices, as well as to the need for greater investment in local technologies and local research.

In terms of impact arising from addressing the challenges through the researchable topics suggested, through the application or modification of technologies or the lifting of constraints, responses referred to or implied greater access to health services by remote and/or marginalised populations (through language for example), to greater equity in health care delivery, and to reduced costs of health care delivery.

Respondents mentioned few measurable indicators of impact, but cited specific examples such as reduced maternal mortality, and longer life expectancy.

Based on responses received, two outline project proposals are presented in section 7.1 addressing the two challenge areas:

- 1) Generating the evidence base for e-Health systems in Africa,
- 2) Research on e-Health system components for remote and rural communities in Africa.

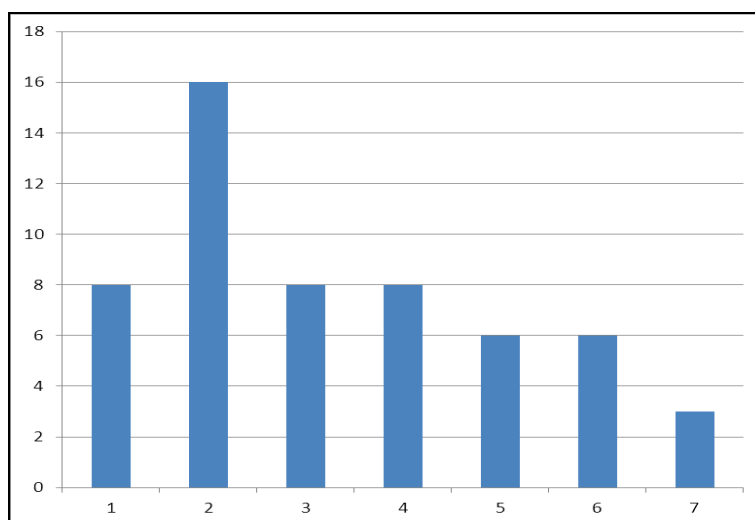
6.1.2 Summary of responses on e-Learning

Twelve individuals from Cameroon, Ethiopia, Italy, Kenya, Namibia, Nigeria, South Africa, Sudan, Uganda, and Zimbabwe responded to the questionnaire from the perspective of e-Learning. Of the 12 respondents, eight were from universities, two from government funded research institutes, and two from NGOs. For the complete set of unedited e-learning responses please refer to annex section 9.2.2.

The 55 challenges in e-Learning listed by respondents from the e-learning domain were clustered into seven *ad hoc* categories:

- 1) National level e-Learning policy, governance, strategy, planning, coordination & donor issues;
- 2) Human resources / skills, training & capacity issues, networking;
- 3) Technical resources, technical support;
- 4) Infrastructural & access issues (broadband, GSM networks etc.);
- 5) e-learning systems and & standards optimisation / choice, incl. data and evidence for such;
- 6) Institutional issues (capacities, governance, management, curricula);
- 7) Societal issues (e.g. gender).

Figure 2. Frequency of challenge categories among e-learning responses.



(see above for the key to horizontal axis category definitions)

The graph in Figure 2 shows that among the challenges, those related to human resources / skills, training and human capacity were the most frequent. Although frequencies are an artefact of the clustering, the process demonstrates that, as with e-health, human resources and capacity issues are perceived as a major constraint to progress.

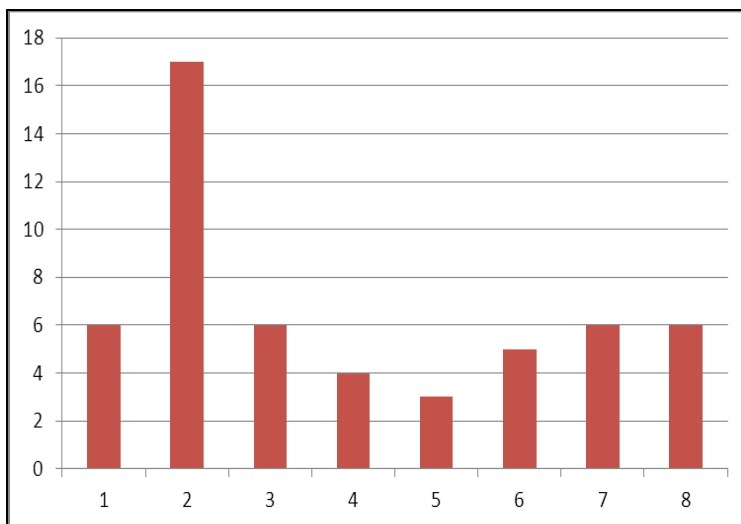
The 53 topics provided by respondents in response to the challenges were aggregated into eight broad categories:

- 1) National / regional policy, frameworks, strategies;
- 2) e-Learning systems, platforms, and standards, their evaluation and establishment;
- 3) e-Learning HR, training for teachers;
- 4) Infrastructure issues, connectivity etc.;
- 5) Technologies, software, applications, evaluation, and technical support;
- 6) Social studies (attitudes, acceptance etc.);
- 7) Institutional issues (course delivery, courses, curricula etc., sustainability, resource sharing between institutes);

8) Technical applications for e-Learning.

While the frequency of each category is again a function of the arbitrary definition of the category, Figure 3 serves to demonstrate the much higher frequency of topics related to the evaluation and establishment of e-Learning systems, platforms and standards, reflecting what may be a dearth of basic data in this broad area. All other researchable topic categories have more-or-less similar frequencies.

Figure 3. Frequency of researchable topics to address challenges.



(see above for the key to horizontal axis category definitions)

Listed benefits of proposed topics were diverse, but with few exceptions, such as the development of ICT curricula for developing economies for example, in the opinion of respondents most proposed topics were considered to have benefit for Africa-Europe collaboration, with examples of both generic and specific benefits being offered. Many of the generic benefits listed allude to e-learning acting as a mechanism to raising capacity, or to addressing development goals and poverty, and through these means to narrowing bi-regional divides. Other respondents emphasised the mutual benefit of sharing best practices, transfer of information, of new contexts for testing systems and generation of knowledge, and the applicability of new knowledge, systems and technologies to both regions. An example of the specific benefits listed is the reduction of e-fraud.

In considering technologies and their applications which could advance the domain respondents tended to avoid specific technologies, restricting responses to broad suggestions such learning systems, Web 2 tools, NRENs, mobile technologies, and cloud computing. Some specific responses took a tangential approach, and thus for example the suggestion of the use of renewable (wind and solar) energy to power e-learning technologies appeared as a response to several questions and from more than one respondent.

Addressing the question of the development and/or adaptation of these technologies, respondents continued to place emphasis on broad issues such as systems and platform development, their adaptation to local contexts (to local languages for example), generic research, pilot scale testing and toolkit development, and addressing the PC-mobile phone linkage (i.e. transferability of content). Training continued to be emphasised in response to many questions.

While the question on constraints to technologies sought responses about innovation system, responses in fact considered constraints more broadly, citing for example resource limitations in terms of low incomes, high technology and support costs, poor grant availability, limited collaboration opportunities, and weak institutional capacity / structures. Connectivity and access issues are again cited. Specific points were made about the disconnect between development to e-learning programmes and access by and suitability for their end users, and about the fact that many

mobile devices in use in Africa are made for the EU/US market, rather than for the African market. Lastly, regulatory issues, network operator practices, and technological bottlenecks each received mention, but without elaboration.

Suggestions for overcoming constraints are, in several cases, simply the corollaries of the constraints themselves, thus the making available of grants or the increasing of connectivity are suggested to overcome the respective constraints. Several suggestions point not to researchable issues of bi-regional interest but to matters best resolved at national / regional level, such as policy overhaul or regulatory reform, and socially aware suggestions such as provision of support to marginalised groups. More tangible suggestions include research directed at developing devices specific for the e-learning market to overcome the adaptation issues of mobile phones designed primarily for leisure.

In terms of potential impact, diverse responses range from the broad and generic to the specific, and from societal impact to impact on e-learning systems themselves. Among the tangible responses, the more optimistic allude to wide impact across multiple social communities of increased knowledge availability, for informed decision making for example, arising from implementation of e-Learning systems, supported by cheap mobile devices using cloud technologies, by the networking of schools, by wide provision of training, and with systems supported by renewable energy sources such as solar and wind. A more specific response illustrates the impact of e-learning by reference to potential gains in specific sectors such as environmental management. One respondent encourages alignment with an existing curriculum framework for teachers from UNESCO. Another alludes to the positive impact of e-Learning system testing for enhanced efficacy.

With regard to indicators of impact, contrary to the responses for the e-health domain, responses in the e-learning domain provide several potential indicators of impact including increased incomes, reduced illiteracy, reduced project abandonment, improved educational outcomes, an increase in the extent of networked institutions (schools, universities, etc.), as well as quantitative indicators related to internet use such as the number of blog, websites, online workshops, etc.

In considering the responses received, two outline project proposals are presented in section 7.2:

- 1) e-Learning for primary, secondary and higher & continued education via mobile devices (m-Learning) powered by renewable energy.
- 2) Generating the evidence base through research for informed decision making for wider adoption of e-Learning in developing countries

6.1.3 Summary of responses on m-Applications

In the first phase of this study we reported that mobile technologies provide a significant opportunity for ICT in Africa, and particularly in the domain of ICT for development, but that the potential is largely untapped due to lack of capacities, and no investment in relevant technologies such as voice-based services. Much of the feedback from phase one pointed to the need to strengthen the enabling environment in Africa, and that future collaboration would be largely dependent on the progress made in improving research capacity, policy and telecoms regulatory environments, and in the cost and availability of high-speed bandwidth. However, future research activity should take account of the revolution which has taken place on the African continent in terms of the penetration and uptake of mobile technologies:

- Mobile phones represent more than 90% of all telephone lines in Africa (2010), with the most advanced markets e.g. South Africa, having passed the 100% market penetration mark;

- Growth is anticipated at an average of 20% per year, although growth may be as much as 100% per year in countries with single-digit penetration²;
- According to the ITU's 2010 figures, Africa shows only 1% of the population has access to fixed broadband and minimal mobile broadband usage³;
- ITU's 2010 figures indicate that mobile penetration rates reached an estimated 41% at the end of 2010 (compared to 76% globally) leaving "a significant potential for growth".⁴ In contrast, only 9.6% of the African population has access to the internet, as compared to 65% in Europe. Africa therefore falls far behind the world average of 30% and the developing country average of 21%. The increased availability of 3G through mobile networks, and the high levels of mobile penetration point to increased opportunities in research to support mobile applications and technologies;
- Significant research is being carried out on mobile technologies and applications in Africa. Below are a few selected examples:
 - Microsoft has been supporting research in mobile-based healthcare to cover a range of applications:
 - Egypt – patient monitoring and advice system using mobiles
 - Uganda - mobile microscopy for malaria diagnosis; SMS services for TB treatment
 - Sierra Leone – distributing educational materials via mobiles to reduce infant mortality rates
 - The Meraka Institute (South Africa) has been involved in extensive research on the application of wireless mesh networks in rural communities
 - Mobile applications for e-learning:
 - Launching of mobile books projects for teenagers to promote affordable reading
 - Mobile banking applications
 - Several countries have launched m-banking (e.g. M-PESA in Kenya, South Africa)
 - Mobile agricultural applications
 - Niger's grain markets⁵

Four individuals, from South Africa, Burundi, Kenya and Senegal, of which three were from universities and one from a commercial enterprise, responded to the questionnaire from the perspective of m-Applications. For the complete set of unedited responses on m-Applications to the questionnaire in the second phase of the study please refer to annex section 9.2.3. Of the 21 challenges offered by these respondents, more than half can be aggregated into three broad sets of issues:

- 1) Access to GSM/3G networks and broadband (especially rural access);
- 2) Resources and capacity: partnerships, training, infrastructure, & costs;
- 3) Content including applications for specific needs (governance, for example), and content authenticity.

Because of the limited number of respondents, other challenges not falling into the above groups were represented by single responses only and are not shown in the above list (refer to the full set of responses in annex 9.2.3). As a horizontal domain, the challenges raised operate in cross-cutting fashion with application for example to both the e-health and to e-learning domains also discussed in this report. Thus issues of rural access to mobile networks and to broadband appear in responses on m-applications as well as in responses on e-health and e-learning, and likewise for the issue of multi-lingual content.

² <http://www.developingtelecoms.com/research-and-markets-50-mobile-penetration-in-africa-this-year.html>

³ The World in 2009: ICT facts and figures. http://www.itu.int/ITU-D/ict/material/Telecom09_flyer.pdf. It should be kept in mind that ITU figures are usually 1-2 years behind current estimates

⁴ The World in 2010: ICT facts and figures. <http://www.itu.int/ITU-D/ict/material/FactsFigures2010.pdf>

⁵ <http://www.mobileactive.org/research/can-you-hear-me-now-how-cell-phones-are-transforming-markets-sub-saharan-africa>

As with responses in the e-Health and e-Learning domains, the researchable topics suggested by respondents were often presented as corollaries to the challenges and with too little detail on which to develop meaningful project outlines. Thus, as responses to the aggregated challenges around access, respondents referred to the adoption of localised mobile webs for small towns, the use of fibre optic cable (to extend broadband access/connectivity), to government policy support for broadband in rural communities and to removal of taxes on mobile devices. In terms of access to content, aside from developing sector specific applications, responses include for example sharing content systems across rural boundaries, developing local knowledge systems, and use of cloud computing on mobile devices. With respect to the aggregated challenges around resources, respondents refer to creating partnerships, and the provision of training around m-Application development. A common aspect of many responses is the emphasis placed on social and cultural values, and by implication the role that m-Applications can play in their preservation through, for example, the use of adapted, local and multi-lingual content.

As many of the challenges listed are seen not as unique to Africa, respondents list several topics of mutual interest including multilingual and local content, specific sector applications, measurement of content authenticity, as well as ubiquitous topics of bandwidth and infrastructures.

With regard to key technologies or their adaptations which could address the challenges, respondents provided a concise list of points which essentially aggregate into adapted / lower costs devices / input systems (e.g. tablets), local networks and cloud computing, sector specific apps (such as e-Learning, e-Health, e-Governance) and multilingual content, and free basic information.

Key constraints include slow and inconsistent policy environment, limited funding and slow funding cycles (vs. high costs), inadequate local and applied research and m- Application capacity / expertise, and weaknesses in mobile systems (such as out-dated mobile browsers). For overcoming these constraints, respondents refer to better coordination of funding opportunities, coordination of regional and national policies and across / between sectors, to support for mobile application developers, and specifically to support for computational linguistics.

The potential impact of addressing m-Application challenges unsurprisingly have synergy with those for e-Health and e-Learning. Thus respondents refer to wealth generation in small communities, improved / facilitated access to relevant / adapted knowledge and to information sharing (for example between governments and citizens), and to gains in key specific sectors such as governance, education, and health.

In consideration of the responses received, two outline project proposals are presented in section 7.3:

- 1) Evidence based research on M-applications,
- 2) Research on computational linguistics.

6.1.4 Questionnaire conclusion

Questionnaires are useful tools for gathering attitudes and opinions but do suffer from a number of disadvantages.

It is unfortunate that despite the careful selection and targeting of participants, the number which responded in full was much lower than either anticipated or desired. Furthermore, despite presenting relatively detailed questions and providing opportunity for multiple concise responses, there may have been misinterpretation of the questions by a few respondents and a general tendency towards fewer and rather shorter responses than ideal.

While a questionnaire based on open-ended questions allows respondents the freedom to express opinion, and was indeed what we sought, among the disadvantages of a questionnaire based on open-ended questions is the difficulty of interpreting and then coding diverse responses to draw out commonalities.

6.2 Baseline study outcome

Based on a review of the literature listed in annex 9.4, the following sections provide brief summaries of trends influencing ICT innovation, firstly on a global level, and then in each of the three domains pertinent to this study. In each case, we present just a list of key trends. At the end of the section we present a simple correlation matrix between trends emerging from the literature and the topics defined by the questionnaire responses.

Technology trends were defined for the purpose of this study as the general direction of increase in specific types of technology research and innovation activities, which are widely common, popular and seem to attract interest of researchers working in these domains.

Global Trends Influencing ICT Innovation:

At a high level, a number of global trends were identified from literature which currently influences technology research and innovation in the three domains, and these include among other things:

- Increased access to internet by individuals and countries;
- Access to broadband connectivity;
- Availability of cloud computing;
- Environmental sustainability;
- Increasing availability of mobile smart phones and personal devices;
- The increasing capacity / desire for user driven applications' development;
- Health management solutions via mobile and online services;
- Making B2B, B2G⁶ services accessible via mobile platforms;
- Secured mobile payment solutions in developing countries;
- ICT for improving learning outcomes, experience and content delivery;
- Social media, networking platforms, mobile interaction and communication on the move; and
- Increased demands for individualised, personalised services and content.

6.2.1 Focus area one: e-Health trends

The technology trends reported below are some of the emerging innovations changing the health care system in many industrialized and developing countries. The list provides an overview of some of the trends in this domain documented from the base line study:

- Clinical information systems
 - Radiology Information Systems,
 - Nursing Information Systems,
 - medical Imaging,
 - Computer Assisted Diagnosis,
 - Surgery Training and Planning Systems.
- Telemedicine and homecare
 - personalised health systems and services,
 - disease management services,
 - remote patient monitoring (e.g. at home),
 - tele-consultation,

⁶ Business to business, Business-to-government.

- tele-care,
 - tele-medicine,
 - e-prescriptions
 - e-referrals.
- Secondary usage non-clinical systems
 - health portals or online health information services
 - bio statistical programs for infectious diseases
 - health supply chain management,
 - scheduling systems,
 - health billing systems administrative and management systems.

Trends in e-Health can be said to cover applications and innovations for interaction between patients and health-service providers, transmission of data, or peer-to-peer communication between patients and/or health professionals; it also includes health information networks, electronic health records, telemedicine services, and personal wearable and portable communicable systems for monitoring and supporting patients.

6.2.2 Focus area two: e-Learning trends

The technology trends reported below are some of the emerging innovations shaping and changing learning experience and the education system and have the potential to influence the direction of technology innovation in this domain in the future. The list provides an overview of some of the trends in this domain documented from the base line study.

- Open educational resources and practices
 - e-Libraries and shared library resources
 - Collaborative resource sharing
 - Open source systems for authoring technology enhanced learning indigenous and informal learning
- Personal learning environments
 - Self-learning through technology enhanced learning, web learning, offline learning environments
- Blended learning environments
 - Adaptive systems combining including web 2.0 new technologies combining learning management and adaptive systems
 - Use of VOIP
 - Educational games
 - e-Reading devices
 - instructional design
- Technology platforms
 - Using new ways to identify ways to adapt, e.g. adapting to user experiences rather than new technologies
 - Campus networks
 - Platform for handicapped learning
 - Mobile and low bandwidth access platform

The trends reported above provide evidence of the growing demand for online self-learning environment as opposed to instructor led face-to-face teaching. This inevitably will lead to redesigning the teaching and learning system and possibly to the re-skilling of teachers.

This wave of new learning technologies will increase active learning, and provides ways to collect, organize and assess student and certainly improve performance of the education system in many ways.

6.2.3 Focus area three: mobile application trends

There is an increasing consumer demand, not least in Africa, for services on the basis of “anything”, “anywhere” and “anytime”, delivered via mobile devices and tailored to different languages options. This consumer attitude is driving new trends and provides growing opportunities for research and innovation particularly in the following areas:

- Mobile money transfer
 - Sending money between persons, institutions
 - Lower costs, faster speed transactions
 - Mobiles as e-wallet

- Mobile payments
 - Mobile payments when few alternatives are available
 - Extension of online payments for easy access and convenience
 - Authentication for enhanced security.

- Mobile advertising
 - Smartphones as PC's
 - Monetize content on mobile internet
 - Larger advertising campaigns
 - Corporate business-to-consumer (B2C) apps.

The increase in global smartphone penetration seems to be a strong trend that continues to increase the demand for mobile applications in billing, transactions, gaming and entertainment. The availability of smartphones and similar hand held mobile devices presents enormous opportunities for dedicated applications in field geared towards social and economic development.

6.2.4 Trends and priorities emerging from the Baseline Study

This section provides a simple matrix showing the correlation between trends and priorities emerging from the baseline study and the topics defined from the questionnaire. These are areas where there is an increasing interest and the scope for bi-regional collaboration on innovative technologies.

	Trends and priorities emerging from baseline study	Proposed topics emerging from from questionnaire					
		e-health		e-learning		M-applications	
		Generating the evidence base for e-health systems in Africa.	Research on e-health system components for remote and rural communities in Africa	E-learning for primary, secondary and higher & continued education via mobile devices (m-learning) powered by renewable energy	Evidence based research on e-learning	Evidence based research on M-applications	Research on computational linguistics
1.	To improve learning experience and improve learning outcomes through efficient delivery of content to students. Management of education delivery.			✓	✓		

2.	ICT for human health, safety, asset location, disaster response, modelling and simulation and management of diseases using mobile based applications.	✓	✓			✓	✓
3.	ICT to support enhanced agricultural production, principally for the purpose of increasing food security, export and mitigating environmental impact using mobile based applications.						
4.	Management and tracking of physical assets e.g for optimal utilisation and disposition.						
5.	All means using ICT to create a greener environment (e.g. reducing energy usage, improving waste management, reducing CO2 footprint, planning of scarce resources, green transport, green towns, towns, resource conservation & management, energy storage mechanisms).	✓	✓	✓	✓	✓	✓
6.	Leveraging procurement power of Governments and industry supply chains to stimulate the development of local content, services and skills development.					✓	✓
7.	Fibre connectivity as access point for government, e-services and e-commerce.					✓	✓
8.	Human language and disability platforms for resource scarce environments and for education requirements including self-learning, exam preparation.			✓	✓		
9.	Health management offerings and business models delivered via mobile and online services, including ability to cater for implications of common diseases in Africa.	✓	✓				
10.	Software platforms for management of services industries, involves back-office integration, management information systems, business intelligence and localisation.			✓	✓	✓	✓
11.	Secure payment solutions for developing economies, including peer to peer, addressing cash-less, unbanked needs, and addressing security and regulatory considerations.					✓	✓
12.	Making services accessible via mobile platforms.					✓	✓
13.	Utilising future Internet and pervasive ICT as platform/environment for the development of new applications.					✓	✓
14.	Supply chain optimisation and logistics management (interesting aspects could include traceability of assets, food, cold chain management, etc).					✓	✓
15.	Electronic delivery of government services including applications in Smart Cities.					✓	✓
16.	Development of business models and scalability cases for ICT (especially mobile) products and services to the developing world market.					✓	✓
17.	Development of content and services for the local African contexts taking into account local language, data and needs. Creating local landing platforms for multinationals wanting access to developing world market.	✓	✓			✓	✓

The intersection between the trends and priorities emerging from the baseline study and the topics defined from the questionnaire indicates that most of the priorities reported on the online survey are already at the centre of ICT research work in literature.

6.2.5 Conclusion

The baseline study provides an annotated overview of trends which appear to be driving technological / ICT innovation in the three domains of interest to this study. The trends are indicators of potential opportunities for bi-regional research and innovation in the three domains.

The baseline study indicates a correlation between the key technologies in the focus domains with the technology challenges that were reported during the online survey. In many instances the challenges reported by the online survey respondents were similar to innovation and application developments reported in the documents. Among the challenges raised by questionnaire respondents, in e-Learning for example, is the requirement for applications suited to local languages and content. The research trend is already appearing in many documents consulted and reviewed.

6.3 Cape Town ICT Forum expert group meeting

The following section presents an annotated summary of the views and opinions of the participants in the forum experts' group meeting.

6.3.1 Enabling Environment

New innovation models are needed to bridge technology gaps, to meet societal needs and reduce the digital divide. New cooperation models and mechanisms, for example, cooperation with industry regarding mobile applications in the education sector are important.

European industries could benefit from outsourcing to Africa and establishing subsidiary research companies in Africa and this will strengthen ICT R&D capability in Africa and help to maximise benefits of the already existing cooperation programmes between the two regions.

Understanding who the users are, what their needs are, and what socio economic problem they confront with, is necessary in order to enhance project technology innovation needed in the future. User needs' market analysis has to be undertaken in order to decide what should be considered as ICT research priorities.

Geography and specific context in each African country influence innovation in each region. Innovation is inherent to geographic areas, thus nomadic people in Nigeria would not face similar social challenges to populations in urban centres. Therefore, various urban and rural communities in Africa provide a fertile ground for new technology solutions and products to be developed, but these must be context specific solutions.

Research priorities should be about innovations for competitive advantage in different sectors of the economy and society, not one-size-fits-all approach, as this will not work. Regional technology roadmaps should be established to building capacity in modelling future technologies.

Europe and Africa should operate to find devices that are of mutual interest to both regions in specific sectors. Sustainable energy and renewable energy sources should be amongst the priorities for cooperation. Low energy consuming technologies should not be ignored. It is important to find an equilibrium between African and European interests.

6.3.2 *Innovation opportunities*

Below is an overview of areas identified for innovation through ICT and where there is a need to develop technology applications. Any future research activity has to take the following areas into consideration:

- Consumer supply chain;
- Exportable solutions;
- Better, cheaper, faster technologies;
- Technology localisation;
- Micro payments;
- Mobile language translation services;
- e-Learning – students and teachers;
- Resources – open access technologies;
- Applications to change the entire education system;
- e-Learning: teachers, students, administrators;
- Mobile technology – infrastructure –distance learning; and
- Entrepreneurial content.

6.4 Summary of phase two outputs

The baseline study, the questionnaire, and the ICT forum experts' meeting provided complementary contributions to our understanding of trends and challenges in the e-Learning, e-Health and m-Applications domains. Although detail emerging from stakeholders and experts was scant, phase two outputs do point to a number of areas where scope exists for bi-regional research (not necessarily technological in nature) to advance the capacity of each domain to contribute to social and economic development.

7 Proposed research topics

7.1 e-Health

7.1.1 *Generating the evidence base for e-health systems in Africa*

Description of the context

Improved access to broadband Internet, to GSM networks, to mobile devices with dedicated applications such as electronic patient record systems, and mobile diagnostics, each supported by e-Learning, and with local language adaptations, all have the potential to enhance the contribution of e-Health systems in Africa to personal and public health and thereby to social and economic development. A number of factors make it important to examine e-Health in the Euro-African context at this particular time. To begin with, the absence of legal and legislative frameworks in many [African] countries may be limiting their capacity to introduce nationwide e-health projects. Similarly, the absence of national / regional plans and roadmaps in many countries may result in numerous pilot projects and the duplication of efforts. In addition, a lack of interoperability and standardization between systems make projects unsustainable because data cannot be exchanged, much training is needed with the consequent need for repeated investment with each new project. Last but not least, these issues are compounded by inadequate human and institutional capacity and financial resources.

The study should provide an up-to-date picture of the state of play of e-Health at various levels across Europe and Africa including, to begin with, through bi-regional collaborative ventures, to provide the evidence base for conducive national / regional e-health policies and strategies. Moreover, it is important to demonstrate under which conditions, on the one hand, investment in rural ICT will have returns and, on the other hand, parallel investment in local research capacity, in locally adapted solutions and local innovation systems will bring long-term local sustainability. Similarly, efforts are needed to evaluate e-health systems, and evidence is needed to support efforts to create national / regional standards and norms which assure the interoperability of initiatives. Successful deployment of solutions will require acceptance by health care professionals and by end-users: collaboration with these groups is seen as vital. Social studies into perceptions of health care professional and end users of e-health systems (on issues such as patient confidentiality for example) will be an important aspect of the study.

Expected impacts

- Personal and public health gains, particularly in communities marginalised through distance from health centres, or by language.
- Enhanced evidence base for decision making in e-Health.

7.1.2 *Research on e-Health system components for remote and rural communities in Africa*

Description of the context

Low doctor-patient ratios in many regions of Africa, isolated communities, and large geographic distances between health centres are conditions which could favour the adoption of e-Health care systems with the potential for radically altering health care provision in rural and remote communities.

The application of e-Health systems in Africa, however, remains scanty (see for example Drury 2005⁷, Ouma, and Herselman 2008⁸). Although widely adopted in wealthy countries, e-health systems reliant on extensive infrastructure and services are not applicable in regions of low infrastructure and high poverty. Militating against e-health systems in Africa are factors such as sub-optimal use of ICTs, low internet penetration and PC availability especially in rural areas, limited electrification, diverse language use, untested / un-adapted e-Health systems and low levels of knowledge among health care professionals of such systems, and inadequate policy environments.

Multidisciplinary, bi-regional collaborative efforts are needed to evaluate and adapt a diversity of emerging technologies and systems for e-health care pilot schemes around localised content to serve the specific needs of rural and remote communities in Africa to improve health outcomes. Such efforts should comprise investigation of e-health system components such as remote diagnostics and telemedicine, electronic patient health records and secure user identification, knowledge management and consumer health informatics (e.g. for disease information), and optimised systems for routing and supply of medicines. Such components should examine scope for cloud computing and the use of mobile, handheld devices such as PDAs, smart phones, and tablets to deliver applications via the internet. Efforts should focus also on adapted communication media and data devices, for example through the widespread adaptation of ubiquitous mobile devices (e.g. smart phones with dedicated healthcare applications) as patient input and monitoring tools, and HD video conferencing for patient-doctor interface.

With the many languages and dialects in Africa, research into the use of Speech-To-Text and Text-To-Speech translation may provide an additional dimension to e-health care pilot schemes allowing communities isolated by language or literacy levels to benefit from mainstream health care services.

Expected impacts

- e-Health systems allow doctors to be located in centres of expertise while serving remote populations;
- Improved personal and public health outcomes in remote and/or rural communities (longevity, maternal / neonatal survival);
- Reduced health care delivery costs;
- Equality in access to qualitative health care;
- Enhanced evidence base of decision making in e-health.

7.2 e-Learning

7.2.1 *e-Learning for primary, secondary and higher & continued education via mobile devices (m-Learning) powered by renewable energy sources*

Description of the context

Technological needs should be appraised in relation to the educational and social needs context, finding a balance between educational, technological, social and market-related parameters.

Low levels of rural electrification and restricted access to internet connected PCs are among many factors which may favour the deployment of m-Learning in remote and rural communities.

Bi-regional effort is needed to establish and test pilot schemes based on use of mobile devices (such as smart phones, personal digital assistants, tablet computers) powered by renewable energy sources for m-learning in rural and / or remote regions.

⁷ Available from <http://www.ehealthinternational.net/>

⁸ Available from <http://www.waset.org/journals/ijbls/v4/v4-4-36.pdf>

Pilot schemes in rural locations could provide test-beds for bi-research into a diversity of perceived constraints to e-learning systems in developing countries. Researchable topics could for example cover the development / adaptation of low-cost m-learning devices and their renewable power sources, the relative advantages of m-learning delivery over GSM networks and/or via WiFi / WiMax connectivity, content generation and sharing via the cloud, and the interconnectivity of educational establishments via NREN-like networks. In addition to a primary focus on research into technical and infrastructural issues, pilot schemes should be used to investigate national / regional standards and norms for e-learning systems, the translation of e-learning delivery platforms into m-applications, the scope for integration of m-learning with primary, secondary, higher, technical and vocational adult and continued education curricula. Research could additionally take account of social issues such as breaking gender barriers, and promoting inclusive societies through ICT.

Cooperation between national and regional centres of excellence in ICT, institutions specialised in education and e-learning delivery, private firms / industry and government departments is encouraged.

Expected impacts

- Technological innovation driven by educational needs;
- Extension of mainstream education into remote and rural regions;
- Equitable access to education;
- Knowledge-based decision making;
- Enhanced literacy, adult education, and vocational training.

7.2.2 Generating the evidence base through research for informed decision making for wider adoption of e-Learning in developing countries

Description of the context

A number of factors make it important to examine e-Learning in the Euro-African context at this particular time. To begin with, e-Learning is a relatively young domain in Africa but one with the potential to radically transform and enhance education provision. Yet the issues being raised and the questions asked through stakeholder / expert surveys point to a diversity of challenges as well as to some fundamental issues around the understanding of e-Learning concepts among experts and stakeholders. Aside from the infrastructural and technical / technological barriers around e-learning, stakeholders point to additional factors related to systems and management, to policies, standards and practices which appear to be equally important barriers to wider mainstream adoption of e-learning in Africa, and these therefore underline the importance of research not only into the “hard” science issues, but also into these “softer” (Unwin 2008⁹) issues.

The study should provide an up-to-date picture of the state of play of e-Learning at the various levels across Europe and Africa illustrated by the following aggregated questions and issues to be addressed:

- What are good practices in e-Learning?
- What reasons lead to success and failure in e-Learning initiatives?
- Employability and jobs: how to assure the relevance / quality of content for professionally oriented (technical and vocational) curricula?
- How to access to e-Learning? How to use and teach with new e-learning technology?
- How to combine e-Learning and m-applications in teaching?
- How to improve e-Learning at the primary school and secondary school levels?

⁹ Unwin, T. (2008). Survey of e-learning in Africa. Available from <http://www.gg.rhul.ac.uk/ict4d/elareport.pdf> . Consulted on 11/01/2012.

- How to improve e-Learning to have a positive impact on literacy?
- What does comparison of e-Learning management systems tell us about the most effective methods for resource constrained situations?
- What national e-Learning policies exist and what are the experiences?
- Scenarios and technology for the future of e-Learning: education is likely to radically transform over the next 10 to 20 years. We need a better understanding of how it will change and where these changes need to be speed up
- What are the factors that would promote connectivity in peri-urban and rural areas?
- What regional know-how and expertise exists and to what extent do we observe adaptation and customization of free and open source learning management systems?

Research-based evidence for informed decision-making to achieve optimal efficiencies and reduced resource wastages, through duplication of efforts for example, and to assure compatibility and interoperability of new and existing initiatives is necessary. In addition, it is particularly important to find a balance between prioritising challenges and flexibility, to conduct research and review experiences and to assure wide dissemination of research results and experiences in order that e-learning systems can be optimised for African contexts.

Expected impacts:

- Such study will provide an important reference contribution for the establishment of appropriate and contextualised local/ national / regional policies, frameworks and strategies, of e-learning system standards and norms and delivery platforms, as well as the development of supporting infrastructures and adapted technologies.

7.3 m-Applications

7.3.1 *Research-based evidence on m-Applications:*

Description of the context

A number of factors make it important to examine m-Applications in the Euro-African context at this particular time. Baseline studies indicate a growing worldwide trend towards the use of mobile applications for delivery of services in a diversity of spheres, and that this presents opportunities, not least in Africa (where for example fixed phone lines are few but conversely where there is a dramatic increase in mobile phone usage, and where rural electrification and internet penetration remains low) for partnerships for applied strategic research and innovation on the extended use of m-applications for key services, for example in health, education and trade.

Notwithstanding the existence of pockets of excellent research and innovation (and examples of Africa's clear lead in some areas such as mobile banking), real challenges and constraints do persist, particularly in rural and / or remote communities, hindering the wider adoption of m-applications for social and economic development.

Stakeholders point to diverse challenges, both around infrastructural and technological hardware and networking issues such as spots of restricted 3G access over GSM networks in rural communities, need for improved broadband access, and extending local WiFi / WiMax networks, availability of low-cost hand-held devices, as well as around "softer" issues such as building RDI partnerships, building capacity of HE institutions to support m-Application development (e.g. via m-labs), creating dedicated applications & trusted content development in specific domains and/or for specific populations, and the testing and choice of service delivery models/platforms.

Noting the potential of m-Applications, prioritising these challenges is essential to the allocation of resources in order to maximise the impact on lifting barriers and facilitating the contribution of m-Applications to social and economic development in rural and remote populations as well as urban areas.

Various technologies are in use and being developed, such as mobile web, sms, voice in local language, WiMax or similar for all rural communities, pen-based tablets and improved input systems for mobile devices, free access and content of some technologies, localised peer-to-peer networks for access and sharing information, wireless technologies for mobile, and mobile cloud computing. Each has potential to address domain challenges but there is considerable fragmentation and scope for increased efficiencies across the domain for a study that would provide an up-to-date picture of the state of play of m-Applications (for mobile phones, PDAs, mobile tablets in relation to e-Health and e-Learning) across Europe and Africa.

The survey suggests the need to generate research-based evidence that provides the state of the art on all concepts, real experiences and best practices as well as future perspectives on m-applications technologies. Some recommendations for future researchable topics based on analysed evidence should be presented by the consortium which could bring together research centres and universities, private enterprises, mobile developers, and target groups in order to address the main m-Applications research challenges. Research should build on existing European, African and national studies, research and documentation; updated by existing information and data; drawn on information gathered from a broad range of governmental and non-governmental stakeholders.

Expected impacts

- Improved local economic development in rural areas;
- Improved governance;
- Low-cost, accessible services for rural populations.

7.3.2 Application of computational linguistics to support multi-lingual access to mobile applications and content.

Description of the context

The massive increase in use of mobile, hand-held devices and the potential of these devices to deliver key services to diverse communities in Africa, especially in rural and remote locations, call for investment in research into some of the key challenges facing their wider use, and especially of m-applications for social and economic development.

Recognising the rich diversity of languages and dialects across Africa, one issue frequently raised by stakeholders / end users is the importance of assuring delivery of services via mobile devices with multi-lingual content and access. The field of computational linguistics (both theoretical and applied components) with an interdisciplinary approach, the automated translation of languages, speech recognition and synthesis, and its application to mobile services provide the potential of extending the impact of m-applications for social and economic development far beyond the reach of major languages allowing future dialogue and exchanges, for instance, between major languages and minority languages. In addition, development of services such as speech-to-text and text-to-speech provides access for low literacy communities to the benefits of digital content via m-applications.

Expected impacts

- Development of new hardware and software responding to the inter-linguistic dialogue between majority and minority languages;
- Improved personal, private and public exchanges.

8 Conclusions

Through this study, the EuroAfrica-ICT.org initiative has gathered inputs from a wide range of African and European stakeholders whose contributions have assisted in understanding priority issues in ICT for Africa which could be addressed through future collaborative research activities between Europe and Africa for mutual benefit.

In the first phase of this study it emerged that stakeholders' opinion on research priorities is broadly aligned with the priorities in the ICT thematic programme of the EU's FP7. Stakeholders' opinion pointed to the domains of e-Learning and e-Health as among the most important for receiving the attention of future collaborative research. The field of m-Applications emerged from wider investigation in phase one to be also an area of high potential for collaboration.

The second phase of the study took a more in-depth look into these three domains with the aim of investigating trends and identifying topics for possible future collaborative research. The second phase drew on three sources for its data: an online questionnaire (e-Consultation), an expert group meeting, and Internet-based literature. Other tools, such as one-to-one interviews used in phase one, were not employed in the second phase.

The principal tool, the questionnaire, is valuable for gathering opinion but has disadvantages, some of which became evident in the present study. As a result the study experienced a number of limitations. For example, it is possible that the relatively complex concepts investigated by the study may not have been conveyed optimally through the medium of an online questionnaire. The number of respondents completing the questionnaire relative to the number starting it, an evident degree of misinterpretation of the questions, and the scant detail in the responses are all possible effects of presenting complex concepts via this medium. The nature of the study probably merited a more expansive tool and it seems likely that the questionnaire did not fully capture the detail of stakeholder insights and that some respondents were put off by the questionnaire format.

Despite identifying specific individuals as recipients of the questionnaire, responses rates remained quite low and so the numbers of stakeholders contributing to this study was less than we had anticipated or would have wanted. To be representative, a questionnaire should draw on a population sample of adequate size to assure responses are representative of the actual population of stakeholders. The effect of a low response rate was to reduce the effective sample size far below the optimal size, with the risk that responses would be unrepresentative population. Judging however from the literature reviewed, the responses received do seem to be closely aligned with wider opinion suggesting that the views of respondents were in fact representative.

An open-ended questionnaire has the advantage of allowing respondents to express diverse opinion. The corollary is that the diversity of opinion received presented a challenge to interpretation, and then to codifying and aggregating responses in order to elucidate trends and common views.

The focus of study was Africa's ICT challenges in e-Health, e-Learning and m-Applications and the scope presented by those challenges for bi-regional collaboration. Given the scale of the continent and number of countries the study made no attempt to capture country-specific issues, taking instead a continent-wide approach.

Notwithstanding the limitations, much useful information emerged from phase two of the study: the domains of e-Learning, e-Health and m-Applications are each at early stages of maturity and all the more so in Africa, where policies, regulatory environments, systems and platforms, standards, infrastructure and technologies are all evolving, although not necessarily in parallel, nor in coordinated fashion.

In a globalised world however, trends emerging in one region become drivers of technology in other regions. Developing regions in particular, where older systems, standards and technologies may not yet be fully embedded, have significant opportunities to leapfrog intermediate technologies and become leaders.

Organisations and individuals are thus grappling with a rapidly changing and fragmented landscape in which knowledge transfer is far from optimised. Yet, faced with an ever deeper penetration of ICT awareness and a cascade of new technological possibilities consumer attitudes and expectations about the role of ICT in society are also changing rapidly. The delivery of services via the Internet and mobile devices is a pertinent example.

In this context, it is not in the least surprising that there should be the perception among the stakeholders and experts consulted in the study of such a diversity of challenges to the domains in question. It is evident however that many challenges perceived by experts are generic in nature, applicable across multiple domains. Thus for example tangible issues of infrastructure weaknesses, technological hardware and devices, network and broadband access came up repeatedly in discussion, in the literature and in online questionnaires in both study phases. Similarly, “softer” issues related to institutional matters, content, systems, standards, policies, regulatory environments and social attitudes also appeared routinely. At the same time, notwithstanding the many generic issues, each domain has its own priorities, and these may present opportunities for collaborative research.

A striking conclusion arising from the study is that, across the continent of Africa, there is abundant evidence for a multiplicity of innovative applications of ICT and particularly of the migration of services from PCs to mobile devices across many domains including health and education, each having the potential to radically overhaul the way in which services and knowledge are delivered and flow. The demand for mobile applications and solutions is rising and represents a huge opportunity to drive innovation in any ICT-supported domain. Developers are increasingly becoming aware of this and mobile-based applications will continue to be an important element of the innovation ecosystem in the short and medium term.

The perception among stakeholders of such a diversity of challenges may sit at odds with the diversity of initiatives which would seem, with just a cursory investigation, to be addressing many of the challenges raised. This apparent contradiction may simply be a feature of relatively early phase of the domains of e-Health and e-Learning in Africa in which technologies and systems are being tested and from which in due course “winners” will emerge and spread more widely. Stakeholders refer to incompatibilities between initiatives and systems causing inefficiencies, and it seems to be the case broadly speaking that few successful initiatives have yet been scaled up to a continental level.

Faced with diversity it is a challenge in itself to identify tangible researchable topics which could be addressed through bi-regional collaboration. In our recommendations we have sought nevertheless to fairly represent the views of the stakeholders. The supposition that these domains are at early stages may point the way to recommendations for collaborative action whose focus is on generating research based evidence for informed decision making, on expanding successful initiatives, and on support for key enabling IC technologies which have applicability across multiple domains.

9 Appendices

9.1 Questionnaire structure

No.	Question
Preliminary questions	
1	Contact details
2	Type of organisation
3	Country: Professional location
4	The domain to which responses refer.
Main questions	
5	What, if any, in your opinion, are the key challenges in your domain which hinder or constrain its contribution to social and economic development. Briefly describe up to five key challenges:
6	Among these challenges, can you identify specific researchable topics which would contribute to resolving the challenge?
7	Among the topics listed [above], are there any which, in your opinion have both African and European interest and which could therefore benefit from being addressed as joint research topics?
8	Could you explain concisely what would be the particular African and/or European interests and benefits deriving from the researchable topics identified in question 6 above?
9	Are there, in your opinion, any key technologies or their applications which, if adopted, adapted, developed or brought to market, would significantly contribute to addressing one or more of the challenges you have previously identified?
10	Can you explain how, in your opinion, the technologies or their applications you have mentioned above could be adopted or developed? Please try to provide a concise explanation for any of the technologies you have listed.
11	In your opinion, are there any constraints in the innovation system which are currently hindering or constraining any of the key technologies you have listed? Please briefly and concisely describe any constraints, indicate how they operate, indicate the technologies to which they apply (up to 5 separate suggestions):
12	What would be required for these constraints in the innovation system to be overcome? The answer might refer to research, or to policy, to incentive schemes, to credit availability, etc. Please try provide a concise explanation. Use a different box for each different suggestions you may have. Indicate the constraint to which they refer.
13	Are there opportunities for Africa-Europe cooperation to address these constraints? Please explain any the opportunities as you perceive them.
14	Considering the challenges you have suggested, what would be the impact if the researchable topics, the technologies or the constraints you have identified could be implemented or addressed? Think especially about the population(s) or the system(s) which would benefit and the scale of the impact. What would be required to extend the geographic or social scale of impact?
15	Can you identify any measurable indicators of impacts?
16	Are there any specific networks or organisations which, to your knowledge, have the capacity to address the challenges, technological issues or innovation system constraints?
17	Do you wish to receive notification of the completed assessment of this questionnaire, by email from the EuroAfrica-ICT partners?
18	Do you have any comments or suggestions about any aspect of this questionnaire which you would like to convey to the EuroAfrica-ICT partners?

9.2 Questionnaire responses

9.2.1 e-Health responses (Q5-16)

Q5: What, if any, in your opinion, are the key challenges in your domain which hinder or constrain its contribution to social and economic development. Briefly describe up to five key challenges:

Respondent ID.	Challenge No.	Description of challenge
A	1	Remote diagnostic
A	2	Nurse / Doctor tour optimisation
A	3	Online explanation to look after a disease
A	4	Optimisation of the routing of medicines
B	1	Lack of knowledge of funding opportunities
B	2	Sub optimal usage of ICTs
C	1	Infrastructure for implementation of e-health in virtually non-existent
C	2	Lack of sincerity/political will of policy makers to implement this far-reaching innovation in health delivery
C	3	Poor enlightenment; Very few people including those in the medical profession know little or nothing about e health
C	4	Poverty; people are more concerned with etching a living than thinking of high-falluting ideas
D	1	Legal and legislative frameworks don't exist in many countries which limits their capacity to introduce nation-wide E-health projects
D	2	Information and communication technology is lacking in most developing countries, such as broadband, GSM in rural areas, etc.
D	3	National plans and roadmaps do not exist in many countries which results in many pilots and duplication of efforts.
D	4	Lack of interoperability and standardization make implementation of projects impossible as they don't connect together and data cannot be exchanged and a lot of training is needed. investment has to be repeated every time a new project is initiated.
D	5	Lack of resources: human, finance mainly.

Q6: Among these challenges, can you identify specific researchable topics which would contribute to resolving the challenge?

Respondent ID.	Challenge No.	Description of challenge
A	1	HD video conferencing
A	2	Cloud computing
A	3	Online HD video on demand
A	4	Cloud computing

B	1	Funding matching
B	2	Optimal usage of ICTs for health
C	1	Challenge 1: Comparing costs of implementing e-health in a particular community with the costs of delivering health care in the same community using the face-to face method.
C	2	Challenge 3; A qualitative assessment of the role of mass media in changing the perception of the populace within a specified time frame
D	1	Research to establish evidence that absence of legal framework hinders advancement of e-health.
D	2	Research to create evidence that investment in ICT in rural areas will have return on investment.
D	3	Comparative studies to evaluate systems that follow standard against those that are proprietary.
D	4	Research the perception of healthcare professionals and users of privacy, confidentiality and use of ICT for health.
D	5	Research on what ICT solutions can work better under which conditions (mobile, internet, etc.)

Q7: Among the topics listed [above], are there any which, in your opinion have both African and European interest and which could therefore benefit from being addressed as joint research topics?

Respondent ID.	Topic No.	Topics with African and European interest:
A	1	HD video conferencing
A	2	Cloud computing
A	3	Online HD video on demand
B	1	Reducing maternal mortality in developing countries
B	2	Increasing female fertility in developed countries
C	1	Challenge 1 can be addressed jointly. The European counterparts with better grasp of the concept can serve as resource personnel for the implementation of the pilot schemes
C	2	Design of collaborative research can be daunting, synergy across frontiers can surmount some of these challenges
D	1	Topic 1 is applicable to all countries
D	2	Topic 3 is applicable to all countries
D	3	Topic 4 is applicable to all countries

Q8: Could you explain concisely what would be the particular African and/or European interests and benefits deriving from the researchable topics identified in question 6 above?

Respondent ID.	Response No.	Response:
A	1	In Europe expert Doctor also sometime far from the patient

A	2	It is an economical need to optimise distribution tour of any product
A	3	Already exist in Europe, a need to build content in the right languages
B	1	Optimising female fertility
C	1	Possibility of reducing costs of primary health delivery
C	2	The possibility of managing chronic diseases and thereby conserving scarce resources and also extending longevity in vulnerable groups
D	1	Policy makers and law makers need evidence to convince them to move to make legislations and to create policies.
D	2	Evidence to support efforts to create and apply standards and norms rather than follow the private sector push to sell products.
D	3	Acceptance by professionals and end users is the single most important factor to a successful deployment of solutions.

Q9: Are there, in your opinion, any key technologies or their applications which, if adopted, adapted, developed or brought to market, would significantly contribute to addressing one or more of the challenges you have previously identified?

Respondent ID.	Response No.	Technology:
A	1	High quality videoconferencing
A	2	Language translation
A	3	Cloud storage
A	4	User Identification
B	1	Mobile technologies
C	1	Broad band technology
C	2	Mobile/cellular technology
D	1	Broadband
D	2	GSM networks and mobile technology
D	3	Electronic health records at the community level
D	4	Internet with local language support
D	5	e-Learning for all

Q10: Can you explain how, in your opinion, the technologies or their applications you have mentioned above could be adopted or developed? Please try to provide a concise explanation for any of the technologies you have listed.

Respondent ID.	Response No.	Response:
A	1	A need to check connectivity capacity
A	2	A need to get sufficient language corpus in order to cover most of the population (dialects)
A	3	A need to check connectivity capacity
A	4	A need to offer an easy way to identify securely users

B	1	By using them to reach to the developing countries, since mobile telephone coverage is very high there
C	1	Cheaper access to internet with web cam and other 3G facilities can facilitate telemedical applications
C	2	Mobile telephony due to its ubiquity, if enabled with the necessary features' interphase can play a positive role
D	1	Bring internet, GSM and connectivity to every single home, hospital, school, library.
D	2	Personal health and public health can benefit from good electronic health record system.
D	3	Web content in local language can change the life of people. Information and education are the only weapon to fight diseases, ignorance, poverty.

Q11. In your opinion, are there any constraints in the innovation system which are currently hindering or constraining any of the key technologies you have listed? Please briefly and concisely describe any constraints, indicate how they operate, indicate the technologies to which they apply:

Respondent ID.	Response No.	Constraints:
A	1	Connectivity
A	2	Language corpus
A	3	Identity
B	1	Nothing
C	1	The infrastructure problem---lack of electricity, slow connectivity---1
C	2	Non -affordability of these high tech telephones
D	1	Sponsor local and joint research in African countries.
D	2	Stop importing solutions from Europe/USA to Africa. Stop one size fits all and support local development.
D	3	Invest in training of local researchers, respect their effort, publish their work, translate their research into policies and actions.

Q12: What would be required for these constraints in the innovation system to be overcome? The answer might refer to research, or to policy, to incentive schemes, to credit availability, etc. Please try provide a concise explanation. Use a different box for each different suggestions you may have. Indicate the constraint to which they refer.

Respondent ID.	Response No.	Overcoming constraints:
A	1	Money to help operators to deploy connectivity every where
A	2	People which are able to translate manually a large corpus of different languages
A	3	Secure identification of people -> regulation
B	1	Incentive schemes
C	1	Targeted research to improve applicability of mobile phones
C	2	Focused policy on infrastructural development

C	3	Alleviation of poverty schemes----The poor in the society are more vulnerable
D	1	Institutional capacity building, development of centres of excellence
D	2	Assess needs in countries and develop solutions accordingly.
D	3	Leave economic gains aside for some time until a culture of research, development, innovation is created. In the long term this will bring value.

Q13: Are there opportunities for Africa-Europe cooperation to address these constraints? Please explain any the opportunities as you perceive them.

Respondent ID.	Response No.	Responses:
A	1	There are already initiatives in this field but it takes time
B	1	Yes, funding opportunities as well as match making because some southern universities have the ideas and the capacity but don't know whom to match with from the north
C	1	Exchange visits---understanding the challenges on one hand and understudying to be able to tackle the challenges
D	1	Europe should invest in institutional capacity building and not in supporting individuals.
D	2	Separate politics from development and support the countries based on their needs and not based on political agenda.
D	3	Support South-South collaboration and exchange of knowledge and experience between countries.

Q14: Considering the challenges you have suggested, what would be the impact if the researchable topics, the technologies or the constraints you have identified could be implemented or addressed? Think especially about the population(s) or the system(s) which would benefit and the scale of the impact. What would be required to extend the geographic or social scale of impact?

Respondent ID.	Response No.	Impact of your suggestions:
A	1	Doctors could be located in high expertise degree hospitals and people could benefit from their specific expertise in one domain without having to move
A	2	Many dialects exist in Africa with people who are not able to read or to write, SpeechToText, translation and Text TO speech could help these people to explain their diseases
B	1	Depends on the scope
C	1	Reduced cost in health care delivery
C	2	Longer life expectancy
C	3	Equity in access to qualitative health care
D	-	-

Q15: Can you identify any measurable indicators of impacts?

Respondent ID.	Response No.	Measurable indicators of impact:
A	1	No
B	1	Number of reductions in maternal mortality
B	2	Number of reductions in fertility related problems reported
C	1	Longer life expectancy
C	2	Improvement in infrastructure will impact positively on the generality of the populace
D	-	-

Q16: Are there any specific networks or organisations which, to your knowledge, have the capacity to address the challenges, technological issues or innovation system constraints?

Respondent ID.	Response No.	Networks or organisations:
A	1	NEM ETP is able to help in Video Conferencing, Language translation and online education
B	1	Makerere university
B	2	
C	1	Mobile Telecommunications outfits, the academia
C	2	African Union
D	-	-

9.2.2 e-Learning responses (Q5-16)

Q5: What, if any, in your opinion, are the key challenges in your domain which hinder or constrain its contribution to social and economic development. Briefly describe up to five key challenges:

Respondent ID.	Challenge No.	Description of challenge
E	1	No clear policy for implementation of eLearning
E	2	Absence of standards for the implementation of eLearning in higher education
E	3	Lack of in-service training
E	4	Lack of technical support
E	5	Low proficiency in English Language
F	1	Lack of commitment and institutional setup at the beneficiary institution level
F	2	Lack of proper ICT governance, policy and roadmap for the implementation and usage of ICT
F	3	Priority given to building the institutions themselves rather than the technology - which I feel is right
F	4	Lack of experts in the area
F	5	Unable to involve key stakeholders like the teachers, and unable to motivate them
G	1	Inadequate instructors: many of the instructors do not have what they are expected to give as many just struggle on
G	2	Inadequate power supply
G	3	Many have next to no idea about e learning as many from the rural areas from where many of the students emerged are coming across even the computer for the first time through their coming to the higher institution
G	4	Inadequate access to internet
G	5	Lack of access to adequate soft and hardware as many cannot afford these
H	1	Evidence of which modalities of eLearning are most effective
H	2	Availability of targeted courses
H	3	Access by students/trainees to specific courses, re: bandwidth etc
I	1	Management - lack of strategic commitment towards technology and their enabling role
I	2	Infrastructure - reliable power supply, poorly designed and implementation of technologies
I	3	Human - lack of motivation, skill gap, awareness and appreciation problem
I	4	Standardization - platform and content/document standards
I	5	Technology and e-resource management
J	1	Access or lack of ICT connectivity in rural and peri-urban areas
J	2	Lack of ICT skills among stakeholders
J	3	Lack of sustainable organizational frameworks
J	4	Poor coordination of developmental efforts among actors e.g. government, donor organizations, and practitioners
J	5	Lack of a curriculum that appeals to as many eLearning stakeholders

K	1	Access
K	2	Facilities
K	3	Infrastructure
K	4	Platform
K	5	Management
L	1	Adaptation of programs to local problems
L	2	Adaptation of programs or solution to the end-users
L	3	Identification of the end-users for different problems and their implication in search of solution at different levels, mainly in Africa
L	4	Development of individual capacities to local populations for building solution for local problem
M	1	Connectivity density
M	2	Resource sharing using ICTs.
M	3	Broadening access to ICT to rural folks
M	4	Promoting an e-inclusive society
M	5	Breaking gender barriers through ICTs
N	1	Educational ICT project implementers' preoccupation with technology instead of pedagogy
N	2	Lack of competence within government in the area of educational ICT
N	3	e-learning policies exist and are good but they are largely symbolic and not implemented
N	4	Insufficient or substandard professional development of teachers in ICT integration leads to lack of implementation in the classroom
N	5	Growing disconnect between what teachers are doing in the classroom and what is relevant and valuable to the real lives of learners
O	1	Schools networking
O	2	Access to computers or computing devices
O	3	Educational content and services
P	1	Lack of data on the successes of e-learning at university level - impact studies
P	2	Limited collaborative research opportunities in this area
P	3	Lack of collaborative teaching and learning with the use of ICT
P	4	Limited capacity to implement e-learning for open and distance learning
P	5	The use of e-learning and m-application in teaching at university level (OERs and mobile learning)

Q6: Among these challenges, can you identify specific researchable topics which would contribute to resolving the challenge?

Respondent ID.	Topic No.	Description of researchable topic
E	1	Policy Making at institutional level / Lack of clear policy
E	2	Building Quality Standards/ Absence of standards
E	3	Teacher needs / designing training according to the needs of teachers
E	4	Quality of technical support /Matching technical support to the needs of eLearning/
E	5	Support to eLearning/ the growth of English language as a global language reflected badly

		on Sudan with the implementation of wide policy of Arabization
F	1	Identifying appropriate frameworks for the implementation of e-learning systems in the country
F	2	Assessments on the key challenges of involving key stakeholders and project management
F	3	Sustainability framework for e-learning in developing countries
F	4	IT Service Management for the e-learning in developing countries
F	5	Running and managing e-learning systems in resource constrained situations
G	1	Survey of capability of instructors with a view to train the trainers as a result of finding (especially outside the main cities)
G	2	Assessment of the access and use of e - learning tools/ facilities
G	3	Literacy in e - learning among students
G	4	Problem of electricity in Africa: research into alternate sources of energy generation
H	1	Analysis of eLearning modalities to determine most effective methods
H	2	Comparison of eLearning modalities in parallel to determine most effective methods
I	1	Strategies for sustainable integration of e-learning and m-application: institutional, national as well as comparative studies
I	2	Technological assessment in respect to languages, culture, fitness-to-purpose, selection criteria, etc.
I	3	Regional know-how and expertise interchange and integration: region-specific studies and analysing the role in adaptation and customization of free and open source tools
I	4	Social science related studies on motivation to bring attitudinal changes and identification of motivational factors
I	5	How to measure success factors in e-learning integration and adaptation
J	1	Challenge 1: Factors that would promote connectivity in peri-urban and rural areas
J	2	Challenge 2: ICT human resource gaps study in productive sector organizations
J	3	Challenge 3: Organizational sustainability challenges in implementing ICTs
J	4	Challenge 4: Factors affecting the coordination of ICT implementation among government, donors and practitioners in developing economies
J	5	Challenge 5: Factors to consider when creating a universal ICT curriculum in developing economies
K	1	E-learning Accessibility and Digital Libraries
K	2	Networking and Information Sharing
K	3	Course Sharing and Reuse
K	4	Mentorship through E-Learning
K	5	Research and Supervision through E-Platforms
L	1	Climate change and water resources management: Integration of local populations and mainly, women
L	2	Identification of the parameters or indicators that could contribute to characterise, to evaluate and to follow the evolution of water resources, in view of modelling water resources evolution in the context of climatic change
L	3	Determination of climatic zones and study of their evolution, and modelling their surface in view of the adaptation and anticipation of local agricultural politics related to the management resources in cultivable soil

L	4	Determination of trends on precipitations and temperature in different climatic zones, and modelling their evolution in 21 first century in view of adaptation of type of agricultural culture
L	5	Determination of extreme events related to the indicators of water resources, precipitation and temperature, and level and return time, in view to prevent for negation impacts on populations
M	1	Utilising ICT's to promote resource sharing among Higher and Tertiary institutions.(Challenge 2)
M	2	Using science and technology to promote an e-inclusive society (Challenge 4)
M	3	New Alternatives: Investigating the use of solar energy in the use of ICT's (challenge I)
M	4	Utilising ICT'S to promote gender equality and equity (Challenge 5)
N	1	Challenge 1: interview policy implementers and international funders on their beliefs about what constitutes best practice in the classroom
N	2	Challenge 2 and 3: Survey of country policies and evidence of implementation
N	3	Challenge 4: The nature of teacher beliefs surrounding the value of ICT In their teaching and the value of ICT professional development that they have received.
N	4	Challenge 5: interview and survey learners on how they would design their own school learning to best prepare them for the future
O	1	Models for 100% schools broadband connectivity
O	2	Low cost devices, leveraging power of mobile
O	3	Platforms for collaborative content generation
O	4	Scenario's and technology for the future of learning
P	1	Research on combining e-learning and m-application in teaching at university level (OERs and mobile learning)
P	2	Research on Approaches to enhance e-learning for improving outcomes of the education system in Africa
P	3	Initiate and implement collaborative research, teaching and learning projects on ICT and m-learning/applications
P	4	Compilation of e-learning approaches that worked and that can be replicated in similar cases
P	5	Evidence where ICTs in education have improved the quality of learning outcomes

Q7: Among the topics listed [above], are there any which, in your opinion have both African and European interest and which could therefore benefit from being addressed as joint research topics?

Respondent ID.	Topic No.	Topics with African and European interest:
E	1	Policy Making
E	2	Building Quality Standards
E	3	Training
F	1	Running and managing e-learning systems in resource constrained situations
F	2	Sustainability framework for e-learning in developing countries
F	3	Assessments on the key challenges of involving key stakeholders and project management

G	1	Alternate energy sources
G	2	Determination and improvement of quality of instructors
G	3	Survey of student literacy level in e- tools and proper usage
H	1	Both of them
I	1	Topic 1, Topic 2 and topic 5 raised above
J	1	1-4 Can be undertaken as joint research efforts
J	2	5 is a local research activity that may not benefit from collaborative research
K	1	Course Sharing and Re-use
K	2	Mentorship through E-Learning
K	3	E-learning Accessibility and Digital Libraries
L	1	Topic 2: Identification of the parameters or indicators that could contribute to characterise, to evaluate and to follow the evolution of water resources, in view of modelling water resources evolution in the context of climatic change
L	2	Topics 5: Determination of extremes events related to the indicators of water resources, precipitation and temperature, and level and return time, in view to prevent for negation impacts on populations
L	3	Topic 4: Determination of trends on precipitations and temperature in different climatic zones, and modelling their evolution in 21 first century in view of adaptation of type of agricultural culture
M	1	Role of Private and Public Sector partnerships in promoting access to ICT'S in Africa
M	2	Developing institutional repositories to capture institutional memory
M	3	Solar powered e-learning projects
N	1	Topic 1 - teacher beliefs on the value of educational ICT
N	2	Topic 3 - projects too focused on technology
N	3	Topic 4 - designing curriculum for 21 century
O	1	Models for 100% schools broadband connectivity
O	2	Low cost devices, leveraging power of mobile
O	3	Scenarios and technology for the future of learning
P		Research on approaches to improve quality learning outcomes
P		Approached that worked and can be replicated
P		Combination of e-learning and m learning in education

Q8: Could you explain concisely what would be the particular African and/or European interests and benefits deriving from the researchable topics identified in question 6 above?

Respondent ID.	Response No.	Response
E	1	The adoption of a nation-wide policy for the implementation of eLearning will lead to more economical development thus closing the gap between Africa and Europe
E	2	Building quality standards will lead to quality eLearning services

E	3	Assessing teachers' needs before designing any training will lead to a type of training based on realistic realities of Africa
F	1	Supporting African nations achieve the MDGs with respect to education
F	2	More knowledgeable citizens with minimal cost - that serves the continent and beyond
F	3	For the European, be able to gain fertile ground of educated man power but less costly
G	1	With quality instructors, graduates of World class quality will Be produced who will go out to improve the social and economic value of the system.
G	2	Many of the e-fraud being practiced will be drastically reduced
G	3	Lack of adequate energy has resulted in many unrealised dreams and goals, with resultant frustration which is passed to all one way or the other
H	1	e-Learning is gaining in popularity and reach, even among well-established universities. There is clearly a need for both European and African (and other) partners to ensure that it is delivered in the most effective way possible.
I	1	European: testing models and approaches used in Europe in a different context; technological innovations and newer insights especially cultural dimensions
I	2	Africa: know-how and knowledge transfer; a different form of regional and Continental collaborations
J	1	All the activities would promote demand (among African and European interests) for both learning and investment by the governments, learning institutions and the private sector
J	2	Knowledge derived in all the areas would be of interest as a guide for engagement (by European governments) in ICTs when creating new projects in developing economies. Developing country governments would know where and why to direct investments
J	3	Private sector and learning organizations would find reason for investing their resources in given areas and activities
K	1	Staff exchange
K	2	Infrastructure Support
K	3	Information Sharing
L	1	Exchange of experiences and adaptation of competences since both are concerned by the problems
L	2	Adaptations of solution to the context: some solutions could exist already somewhere in Europe or Africa and need only to be adapted to a particular context
L	3	Solution could be found easily since different competences and experiences will work together
M	1	Sharing experience
M	2	Resource sharing
M	3	Joint projects
N	1	Topic 2 - challenges 2 and 3 are specifically African - all other topics apply to both Africa and Europe
O	1	Research on schools networking would help extend the reach to all schools, improve affordability and suggest appropriate models that are applicable in Africa and Europe

O	2	Education has not really benefited from the power of ICT for the majority of learners in Africa. Harnessing this revolution could allow Africa to overcome chronic poverty and under development.
O	3	Education is likely to radically transform over the next 10 to 20 years. We need a better understanding of how it will change and where these changes need to be sped up.
P	1	Europeans have done research on these and sharing best practice with Africa could improve teaching and learning for both
P	3	Africa has a large population accessible m-technology and experimented with this in education, Europe has experimented with e-learning combining best practice could enhance learning in both continents

Q9: Are there, in your opinion, any key technologies or their applications which, if adopted, adapted, developed or brought to market, would significantly contribute to addressing one or more of the challenges you have previously identified?

Respondent ID.	Response No.	Key technologies or their applications
E	1	Educational animation, simulation, and games
E	2	Mobile technology
E	3	Learning Management Systems
E	4	Web 2.0 tools
E	5	nComputing
F	-	-
G	1	Grassroots mobilisation of e tool usage and assessment
G	2	Solar energy harnessing to complement existing sources that have been grossly inadequate since the solar energy is not exactly man developed.
G	3	E- assessment of instructors on regular basis with some incentive that encourages embracing the scheme
H	1	For eLearning modalities, not really
H	2	For availability of courses, not really
H	3	For access - ensuring general access to the internet and sufficient bandwidth. There is also the question, in Africa, of whether eLearning courses can be provided sufficiently effectively via the mobile phone, as more people have access to these devices than to computers.
I	1	Open standard learning platforms and standards (link Moodle)
I	2	m-Learning and web2 technologies
I	3	Simulation, visualization and other domain-specific instructional and learning technologies
I	4	Wireless, satellite-based technologies
I	5	Wind and solar based power systems
J	1	Cloud computing
J	2	Use of wireless communication
J	3	Use of solar energy to support infrastructure
J	4	Use of Web 2.0 technologies for collaboration and knowledge sharing
J	5	Use of shared platforms paid for as a service accessed on mobiles rather than computers

		alone
K	1	Mobile learning
K	2	Courseware development
K	3	Infrastructure Installation
K	4	Digital Warehousing
K	5	Library Digitisation
L	1	Mainly for African countries, the normal ICT are not really available in so many institutions. An effort is necessary to help people or scientists for African countries for accessibility to ICT. This includes computers and internet accessibility.
L	2	In my opinion, some work stations could be necessary mainly for African scientists in their institutions.
M	1	Use of ICT' driven adaptive and assistive technologies for the physically and visually disadvantaged to access information
M	2	e-Learning technologies
M	3	Solar powered e-learning
M	4	e-Health /telemedicine through mobile phones
N	1	This survey is falling into the trap of most planners and project implementers. My point is that the technology itself is largely irrelevant and each country or initiative can select the most appropriate for their needs
O	1	NREN like schools networks with open access fibre backbones
O	2	Wireless last mile connectivity
O	3	Open mobile platforms, operator-less networks
P	1	Integration of m- applications into African educational systems
P	2	e-learning combined with m-applications can close the gap between the 'haves and have-nots'

Q10: Can you explain how, in your opinion, the technologies or their applications you have mentioned above could be adopted or developed? Please try to provide a concise explanation for any of the technologies you have listed.

Respondent ID.	Response No.	Response
E	1	Give support for teachers to build interactive modules
E	2	Mobile technology will allow students to learn any place any time
E	3	Platforms to build courses
E	4	Free tools that could used by teachers
E	5	More tools for students to use
F	-	-
G	1	Introduction of e- learning in the curriculum from the very beginning of education
G	2	The solar panels appear to be the major challenge in using this source of energy. A definite drive involving the end users in the fabrication, testing and use of these panels will not only create jobs, it will give a drive to continue instead of the hand down so far which many are living on.

G	3	Regular assessment of instructors with attached impact of assessment on advancement in the academia
H	-	-
I	1	Content management systems and learning management systems that are tested and used widely can be adopted in the workspace and learning environments
I	2	Mobile systems which are expanding need to be customized for local languages
J		Releases heavy investment unless one needs to use it.
J		Wireless is useful where the terrain is poor yet line of sight can be easily established between points
J		Most of Africa has many challenges as regards power yet there is plenty of sunshine...solar is the best source of solar in such cases
J		Knowledge capture and storage mainly where human resource supply is low can provide recorded data for use when needed
J		Use of Cisco WebEx as an example and use of 'Moodlerooms' for training could provide the much needed linkage between computers and mobile phones with content visible if the right phones are in use thereby reaching people in remote areas as has happened with money in Kenya
K	1	Innovation
K	2	System Development
K	3	Diffusion
K	4	System Analysis and Development
K	5	System Support
L	1	There are several African institution where the internet connexion are just to read Emails. I think that the problem could have a solution through the research project that could also support financially the internet or ICT infrastructure for scientists in some African institution
M	1	Research, inter-institutional research and public and private sector partnerships
N	1	There is such a large range of technologies available and in a short time going to be so many more with such vast capabilities that the most appropriate ones must just be selected
O	1	1- needs pilots and test-beds that are scales to national level resulting in toolkits capturing best practice and skills to implement such networks
O	2	Collaboration between leading African and European researchers in wireless domain tougher with educational experts and authorities as well as experts from NREN world - should include Future Internet and IPv6
O	3	Africa - EU Collaboration on the future of networking - Future Internet
P	1	m- Applications can be used to develop the capacity of end users and familiarise them with the use of ICTs

Q11: In your opinion, are there any constraints in the innovation system which are currently hindering or constraining any of the key technologies you have listed? Please briefly and concisely describe any constraints, indicate how they operate, indicate the technologies to which they apply.

Respondent ID.	Response No.	Constraints
E	1	Sanctions on Sudan---NComputing ¹⁰
E	2	High cost of support services-Learning Management Systems
E	3	Low income -mobile technology
E	4	Slow internet connectivity- web 2.0tools
E	5	High cost of the software/sanctions on Sudan-Educational animation, simulation, and games
F	-	-
G	1	The government policies which do not appear to have any definite focus.
G	2	Up unto now, donations and hand-outs have been what is available.
H	1	Mobile phones are still designed for the major markets (USA, Europe etc) and not for Africa and not for eLearning applications.
I	1	Underdeveloped culture of innovation and technology adaptation/adoption
I	2	Governance: monopolization of services and prohibiting regulatory framework in ICT and telecommunications sector
I	3	Lack of access and knowledge about technological developments and their application
I	4	Underdeveloped research and development environment
J	1	The critical challenge in the organized innovation systems that are organizations is their leadership...they do not appreciate change and are slow therefore to approve that which they do not understand...
J	2	The other constraint is capital. Studios to create shared 'moodlerooms' may not be available. Learning on mobile is still a new thinking that has not been rested but with call-back systems as promote by some technology vendors, this will not be a challenge for long
J	3	Lack of technologies to make chargeable batteries near enough to users constrain solar power implementation
J	4	Lack of coordinated team effort and desire for personal recognition makes collaboration a challenge in making coordination possible
K	1	Infrastructure
K	2	Technologies
K	3	Technical Skills
K	4	Political Support
K	5	Policy
L	1	In my opinion there is not at all constraints in the innovations systems which are currently hindering or constraining the ICT technologies. My problem is on the difficulties that some African scientists have difficulties with the ICT. So I suggest that the research project could

¹⁰ Author comment; Meaning unclear. Is it a typographic error on the part of the respondent?

		also support financially the internet or ICT infrastructure for scientists in some African institution
M	1	Research grants
M	2	Inter-institutional collaboration
M	3	Use of appropriate technologies
M	4	Need for more science centres
N	1	Obviously in Africa we are more limited that in Europe - by 1. Access 2. Use 3. The benefits to learners
N	2	Lack of connectivity is obviously a constraint and the associated lack of offline availability of many resources
N	3	Cost is one of the greatest constraints in all areas for implementation in Africa
O	1	Technology bottlenecks
O	2	Spectrum regulation
O	3	Government approaches to schools networking
O	4	Actions of dominant network operators
P	1	The constraint is that by developing e-learning programmes and initiatives does not necessary mean that these are available to people who must make use of them
P	2	The technology which is accessible to the majority of people are usually not considered when developing educational programmes using ICT
P	3	The capacity of people at the receiving end of our e-learning projects are not necessary considered which leads to unsuccessful implementation

Q12: What would be required for these constraints in the innovation system to be overcome? The answer might refer to research, or to policy, to incentive schemes, to credit availability, etc. Please try to provide a concise explanation. Use a different box for each different suggestion you may have. Indicate the constraint to which they refer.

Respondent ID.	Response No.	Overcoming constraints
E	1	Educational tools should not be under sanctions/Sanctions
E	2	Support of students from lower classes of the society or marginalized groups/low income
E	3	Increase of internet connectivity/ slow internet connectivity
F		
G	1	Introducing policies that go beyond history on the pages of paper.
G	2	The availability of the technical know-how and expertise
H	1	Research could be directed towards the development of a (cheaper) device specially designed for eLearning requirements rather than for leisure as most phones are today.
I	1	Awareness creation and education
I	2	Establishment of flexible governance and regulatory system that open up engagement of private sector in value-added services
I	3	Creation of forum for south-south and north-south partnership and collaboration for knowledge and experience sharing
I	4	Creation/adaptation of technologies that best fit to African context

J	1	More online sharing, identification of resourceful people not by the size of their organization but rather their contribution
J	2	Knowledge management systems being put in place to support externalization of tacit knowledge
J	3	Creation of local knowledge hubs
K	1	Incentive schemes
K	2	Credit availability
K	3	Support: Exchange
K	4	Policy support
K	5	Research and Development
L	1	For these constraints the research project could also support financially the internet or ICT infrastructure for scientists in some African institution
M	1	Provision of research grants
M	2	Cooperation at both regional and international level
M	3	More research / applied research
M	4	Funding development of science centres
N	1	Innovative resources from the developed world still need to be made available offline for African schools
N	2	Serious overhaul of educational policies need to be in place before change will take place - consider the introduction of a school leaving requirement that is the submission of a digital portfolio instead of a traditional examination - this is going to happen in Ireland as from 2017
N	3	Exposure of research conducted by Sugata Mitra in the Child driven educational and self-organising learning environments
O	1	Technology R&D, piloting and demonstration as well as modelling future end state.
O	2	Technical workshops, policy dialogue, pilots, demonstrators
O	3	Technical workshops, policy dialogue, pilots, demonstrators, capacity building in regulator and educational environment
P	1	Implement and integrated approach which address: making the technology available, developing the capacity of all (users and developers) and consider the sustainability of the programmes and skills
P	2	Make use of a combination use to technology to capitalise on what is available, accessible and easy to use and adapt

Q13: Are there opportunities for Africa-Europe cooperation to address these constraints? Please explain any the opportunities as you perceive them.

Respondent ID.	Response No.	Africa-Europe cooperation opportunities
E	1	Joined workshops for addressing policy issues (should involve policy makers)
E	2	Joined workshops for designing standards suitable to African needs
E	3	Projects to assess teachers training needs as to design a training manual that could be used in many countries in Africa

F		
G	1	Provision of the technical know-how to adequately educate and,
G	2	Many of the previous assistance had only allowed so much. there is a need to totally educate so that, the taught can sufficiently stand when the tutor moves on to address other issues
H	1	Such a device would require the development/design of new hardware and software that would have great potential in the world market, especially Africa where the markets are expanding
I	1	Joint technology adaptation (transfer)
I	2	Comparative studies in Africa and Europe
I	3	Joint educational and awareness creation programmes
J	1	There is need for knowledge exchange, and for investment to be made by governments, organizations and the private sector
K	1	Joint Project
K	2	Technical Support
K	3	Capacity Building
L	1	Yes , through Africa -Europe Projects
M	1	Promoting research
M	2	Development of appropriate technologies
M	3	Cooperation
N	1	Greater teacher / lecturer exchanges to explore possibilities with educational ICT
O	1	Possibilities exist at all levels to learn from each other experiences
O	2	Possibilities to collaborate on solutions that are applicable in Europe and Africa
N	1	Yes, especially when you consider the sharing of experiences and innovation - learning from each other through collaborative learning and research

Q14: Considering the challenges you have suggested, what would be the impact if the researchable topics, the technologies or the constraints you have identified could be implemented or addressed? Think especially about the population(s) or the system(s) which would benefit and the scale of the impact. What would be required to extend the geographic or social scale of impact?

Respondent ID.	Response No.	Impact
E	1	Institutions of Higher Education (Private and Public)
E	2	General Education (schools)
E	3	Vocational Training
F		

G	1	The greater the input the greater the expected output.
G	2	With alternative energy sources being embraced, production increases as ideas are not abandoned in frustration. Establishment of fabricating sheds all over with quality assurance unit attached
H	1	Social scale of the impact would increase if cheaper devices were available.
H	2	Wider availability of training courses would also enable the development of a larger number of skilled people in a variety of fields
I	1	Contextualized implementation level case studies with
I	2	Sensitization and awareness creation
J	1	Use the cloud and mobile and you will reach scale before you can imagine
J	2	The impact of knowledge? Ability to make informed decisions at all levels and increased efficiency
K	1	Universities
K	2	Students
K	3	Research Community
L	1	The management of water resources will integrate populations at different levels
L	2	The soil resources and their evolution will be known for better decision to be taken.
L	3	The planning of the management of soil resources
M	1	The digital divide could be broken through use of solar powered e-learning projects
M	2	Use of ICT powered appropriate technologies would bring about an e-inclusive society
M	3	Regional cooperation in ICT 's within SADC would help to end poverty
N	1	Government to government partnerships and agreements which could specify expected norms
N	2	UNESCO's Curriculum Framework for Teachers attempts to provide guidance on accepted norms - governments need to engage with the framework and provide evidence of how they are striving towards its implementation
O	1	In principle solutions to schools networking and related issues can impact on several 100 million people in Africa
P	1	Data will be available on what works, under what conditions and the impact on population of both continents
P	2	Approaches that others can use are developed, avoiding duplication of efforts and using resources on what has already been studies
P	3	Baseline information available ion which to further build reach and learning activities

Q15: Can you identify any measurable indicators of impacts?

Respondent ID.	Response No.	Impact of your suggestions
E	1	Increase of income
E	2	Reach to more remote regions

E	3	Decrease of illiteracy rate
F		
G	1	World class, tested and proven outputs
G	2	With adequate and sufficient energy the spate of incomplete and abandoned projects will be reduced.
H	1	Nos. of graduates of various courses and their geographical distribution (away from traditional centres of learning)
H	2	Follow-up surveys could evaluate increased earnings.
I	1	Specific to higher educations: the level of blending learning integrated in teaching and learning
I	2	the number of shared programs and collaborative works conducted to improve technological adoption/adaptation
J	1	Access to internet accounts
J	2	Number of mobile phones used for data rather than M-Pesa
J	3	Number of blogs, websites, online workshops, registered online students...
K	1	Students able to learn at their homes
K	2	Increased number of enrolment
K	3	Innovations increased
L	1	The numbers water resources points available for populations following the density of populations and water resources projection.
L	2	The numbers of type of agricultural plants selected following climate projection,
L	3	The numbers of type of agricultural plants selected and the quantities of products, following soil resource available,
M	1	80% of rural Zimbabwe would benefit from access to ICT'S whether solar or electrically powered
N	1	Development research should be the type to be used - to determine how effective technologies are in improving learning and in facilitating learning communities among teachers
O	1	Number/percentage of schools connected
O	2	Uptake and use of educational content and services running over schools networks
O	3	Improvement in educational outcomes
P	1	Number of approaches developed for specific area
P	2	Number countries/universities that can access and use such approaches
P	3	Availability of baseline data in specific area

Q16: Are there any specific networks or organisations which, to your knowledge, have the capacity to address the challenges, technological issues or innovation system constraints?

Respondent ID.	Response No.	Networks or organisations
E	1	No
F		-
G		Microsoft, Apple, European Union
G		e-Learning Africa, Department of Science and Technology, Republic of South Africa
G		United Nations, World Bank, Multinationals located all over the continents. Oil companies (Chevron, Mobil, Shell Petroleum Development Company)
H		Again, I'm not a technical person with knowledge of where such activities are carried out
I	1	EFQUEL, European Foundation for Quality in e-learning
I	2	Association of African Universities
I	3	InfoDev
J	1	Telecentre Europe
J	2	Cisco Entrepreneurs Institute network
J	3	NetAfrica, VACID Africa knowledge network of service providers
K	1	Forum of Universities in Uganda
L	1	In my opinion the "Euroafrica-ICT" has the capacity to address these challenges
L	2	"EuroAfrica-ICT"
M	1	PAERIP/EURO-AFRICA FORUM
M	2	SADC/ PALIACT-ZIMBABWE/ZULC
M	3	UN
N	1	The Open University UK
N	2	GESCI
N	3	SRI International http://www.sri.com/
O	1	CSIR Meraka Institute is working with a range of partners on schools networking issues and in addressing the challenges of rural schools
P		Research units at Universities, Government directorates for research and ICT

9.2.3 m-Applications responses (Q5-16)

Q5: What, if any, in your opinion, are the key challenges in your domain which hinder or constrain its contribution to social and economic development. Briefly describe up to five key challenges:

Respondent ID.	Challenge No.	Description of challenge
Q	1	The dominance of existing social networks - hindering the opportunities to offer alternatives

Q	2	Funding - to establish new products and services during gestation, prototyping and piloting stages pre-sustainability
Q	3	Trust - developing trusted content
Q	4	Access to 3G in rural communities - challenges with third party infrastructures
Q	5	Geographical distances in implementing mobile applications in rural communities in different parts of the country
Q	6	Access - providing improved access to broadband infrastructure including free services - to stimulate economy
Q	7	Local Economic Integration - improving the linkages between economic parties through access to information
Q	8	Trust - enhancing the trust in online content [same as 3]
Q	9	Content - developing of local content down to the village level
Q	10	Capacity - developing capacity to use modern phones and tablets effectively
R	1	Bandwidth
R	2	Infrastructures
R	3	Adoption of model of services
R	4	Costs of equipment
S	1	Mobile application for e-Governance not available
S	2	Mobile application for MARPS (prostitute, commercial sex workers, gays, prisoners) not fully developed
S	3	Mobile application for tracking students
S	4	Mobile application for e-learning
S	5	Trading of stocks in the market
T	1	Partnership between development actors and universities
T	2	Support of telecom operators
T	3	Establishment of mLab at universities

Q6: Among these challenges, can you identify specific researchable topics which would contribute to resolving the challenge?

Respondent ID.	Challenge No.	Description of researchable topic
Q	1	NOTE: These are topics we are currently researching on a self-funded basis: (Challenge 1/4/5) Multilingual access to mobile content, adapting to user needs, improving usage of indigenous language and reversing loss of cultural identity
Q	2	Challenge 2: Small-scale, localised mobile webs for small towns - small-scale funding opportunities with measurable outcomes
Q	3	Challenge 3: Measurable levels of trust for mobile content [copy]
Q	4	Challenge 4: Shared content systems across rural boundaries - distributed problem identified and shared solutions and lessons
Q	5	Challenge 5: Moving towards a tablet-only mobile future
Q	6	Challenge 6: policy development for government broadband support for rural communities - Free Basic Information Initiative (part of our existing policy developments)
Q	7	Challenge 7: improving local economic development through improved information access

Q	8	Challenge 8: how to measure trust, accuracy and authenticity in online content
Q	9	Challenge 9: developing local knowledge systems through mobile technologies
Q	10	Challenge 10: reversing the wisdom of the ages: how can we use children to teach technology to their parents
R	1	The use of optical fibre can solve the problems of bandwidth
R	2	Adoption of Models that bring solutions to the unavailability or low infrastructure capacities, and access to the remote area by using for example Mobile Cloud Computing Model's solutions
R	3	Train to make people aware of the importance of business models like Cloud Computing on Mobile
R	4	Make technology devices free of taxes to boost their expansion and use. With time, slowly, price are going down.
S	1	Challenge 1: M-Governance in the Administration of essential services
S	2	Challenge 2: Mobile Application for MARPS:
S	3	Challenge 3: M-Application for Student track Records
S	4	Challenge 4: Mobile Content Development for e-learning
S	5	Challenge 5: M-Stock trading
T		Challenge 1: Meetings between development actors and Universities identified the possible ways of collaboration.
T		Challenge 2: Support of telecom operators to mLabs.
T		Challenge 3: Introduce new training programs oriented mobile application development.

Q7: Among the topics listed [above], are there any which, in your opinion have both African and European interest and which could therefore benefit from being addressed as joint research topics?

Respondent ID.	Topic No.	Topics with African and European interest:
Q	1	Topic 1: multi-lingual mobile content
Q	2	Topic 3: measurable levels of trust for mobile content
Q	3	Mathematics delivery on mobile devices: MathML and SVG
Q	1	Topic 1: highly localised knowledge structures - using Information Society to reverse globalisation economics
Q	2	Topic 3: measurable levels of trust for mobile content
Q	3	Topic 5: tourist support systems through mobile devices (NOTE: this is our largest R&D project)
R	1	Infrastructures
R	2	Bandwidth
R	3	Adoption of model of services
S	1	M-Governance in the Administration of Essential Services
S	2	M-Application for MARPS
S	3	M-Content Development for e-learning platforms
T	1	Topic 3

T	2	Topic 1
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Q8: Could you explain concisely what would be the particular African and/or European interests and benefits deriving from the researchable topics identified in question 6 above?

Respondent ID.	Response No.	Response
Q	1	These are shared and universal problems with common benefits
Q	2	Benefit for Africa in levelling the playing field through rapidly addressing the digital divide through access to information that makes a different for social and economic development
Q	3	Improved local economic development in rural areas
R	1	The experience of countries
R	2	Remote access
R	3	Power purchase power
S		Improved governance in Africa
S		Improving health for MARPS
S		Improving e-learning delivery and administration
T		Take advantage of mobile penetration in Africa to reach the maximum of people through services developed by local actors which are listening local people
T		The solutions developed may be low cost

Q9: Are there, in your opinion, any key technologies or their applications which, if adopted, adapted, developed or brought to market, would significantly contribute to addressing one or more of the challenges you have previously identified?

Respondent ID.	Response No.	Key technologies or their applications
Q	1	Localised peer-to-peer networks for access and sharing of information
Q	2	WiMax or similar for all rural communities
Q	3	"free basic information" - end to end free access and content - which is a recommendation from our policies development for government
Q	4	Pen-based tablets and improved input systems for mobile devices
R	1	Wireless technologies for mobiles
R	2	Handsets
R	3	Mobile Cloud Computing
S	1	Health issues on Mobile MARPS can be adopted/developed
S	2	Content Development for M-application for e-learning can be adopted
S	3	M-Application on e-Governance can be adopted/Developed
T		Mobile Web
T		SMS
		Voice in local language

Q10. Can you explain how, in your opinion, the technologies or their applications you have mentioned above could be adopted or developed? Please try to provide a concise explanation for any of the technologies you have listed.

Respondent ID.	Response No.	Response
Q	1	Technology 2: local government to provide funds to develop the information networks in their cities and towns
Q	2	Technology 3: national government funding of roll out - we have developed this through years of research and are deploying this at present
R	1	Implementing
R	2	
R	3	
S	1	m-Application on MARPS: The health indicators can be adopted. Data gathering can be conducted using the mobile. The gathered data would be sent via mobile to a workstation where they can be stored in an excel worksheet. The data in the excel can further be analysed using database and feedback send to various hospitals and relayed back to affected MARPS
S	2	Study to customize the M-application on e-learning can be conducted showing relevancy in the African content
S	3	m-Application on e-Governance services such as birth certificates, police abstract, legal notifications etc. can be adopted to suit African environment
T	1	Develop services relevant and accessible populations by reducing the cost for accessing mobile Internet
T	2	The production of an SMS services should be as simple as a website. And the cost of SMS must be greatly reduced
T	3	Develop the field of computational linguistics in Africa

Q11: In your opinion, are there any constraints in the innovation system which are currently hindering or constraining any of the key technologies you have listed? Please briefly and concisely describe any constraints, indicate how they operate, indicate the technologies to which they apply

Respondent ID.	Response No.	Constraints
Q	1	Slow funding cycle
Q	2	Difficulty of access to funding for SMEs - including access to smaller grants
		Slow government policy cycle and changing government priorities
		Too little on-the-ground research in the rural communities themselves - theories will not create jobs
		Research is too focused on the progression of knowledge systems and too little on applied research and implementations as acceptable research practise
R	1	Costs
R	2	Difficulties to access funds
S	1	Limited expertise in Mobile Application Developers
S	2	Security issues in the M-Application for Mobile e-Governance

T	1	Mobile web - The multitude of mobile web browser that does not yet support the HTML 5 which is the great for multiplatform web development
T	2	SMS - grow cost of sms
T	3	Research in the field of computational linguistics in Africa is poor

Q12: What would be required for these constraints in the innovation system to be overcome? The answer might refer to research, or to policy, to incentive schemes, to credit availability, etc. Please try to provide a concise explanation. Use a different box for each different suggestion you may have. Indicate the constraint to which they refer.

Respondent ID.	Response No.	Overcoming constraints
Q	1	Constraints 1/2: research funding portal - access to all fund and grant information from a single place - with a front-end utility to direct you to the right mix of funds for a proposal
Q	2	Constraint 3/4: inter- and intra-government coordination of research funding and development policies: rural development, agriculture, communications, arts & culture (libraries), local government, tourism, health : should all be linked through the local government structures
Q	3	Constraint 3/5: prioritisation of research with measurable and short-term impacts for rural communities and poverty alleviation
Q	4	Constraint 2/5: research projects portal - access to all projects ongoing with information on how to combine and collaborate work
Q	5	Constraint 5: changing research policy to accommodate practical programmes with follow on research rather than research followed by development
R	1	Access to funds
R	2	Adoption of services models
S	1	Training of Mobile application developers. We need Mobile Application incubators in several centres.funds should be made available
T	1	Constraint 3 - Establish national policies in the field of computational linguistics

Q13: Are there opportunities for Africa-Europe cooperation to address these constraints? Please explain any the opportunities as you perceive them.

Respondent ID.	Response No.	Africa-Europe cooperation opportunities
Q	1	Both EuroAfrica-ICT and IST-Africa provide the networking and partnering opportunities - would like to see these extended as continuous structures rather than the focus on workshops and conferences
Q	2	Greater involvement of and participation by the NCPs to help to find and link up partners in different countries
R	1	Collaborative joint venture projects
S	1	Provide expertise/ Identify experts and engage them
S	2	Provide funding
S	3	Provide forum for discussion

T	1	Transfer of skill in the field of computational linguistics
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Q14: Considering the challenges you have suggested, what would be the impact if the researchable topics, the technologies or the constraints you have identified could be implemented or addressed? Think especially about the population(s) or the system(s) which would benefit and the scale of the impact. What would be required to extend the geographic or social scale of impact?

Respondent ID.	Response No.	Impact
Q	1	Improved income multiplier within the small towns and rural communities - greater local wealth
Q	2	Improved interfaces to government and bi-directional communications between government and the people
Q		Moving informal businesses into the Information Society and reaping the benefits (this is a specific impact we are working towards at present)
R	1	Population could benefit
R	2	Administrations
R	3	Schools
S	1	Improved health
S	2	Improved Governance
S	3	Improved e- Learning awareness
T	1	People could easily access to digital information through their mobile phones
T	2	Illiterate people could also access information via the mobile phone

Q15: Can you identify any measurable indicators of impacts?

Respondent ID.	Response No.	Impact of your suggestion
Q	1	% of local spending spent on local products and services (income multiplier) as opposed to spent outside the local region
Q	2	% of SMMEs as a fraction of the total population
Q	3	% unemployment
R	1	Number of users in different areas
S	1	Improved health on HIVD/AIDS
S	2	Improved Governance services
S	3	Improved distance learning
T	1	The number of users

Q16: Are there any specific networks or organisations which, to your knowledge, have the capacity to address the challenges, technological issues or innovation system constraints?

Respondent ID.	Response No.	Networks or organisations
Q	1	European: not known
Q	2	African: We are currently addressing these issues: we see a tie up with Living Labs as a useful collaboration
Q	3	Other:
R	1	European (?): the optical fiber projects that are to be operational in the country
R	2	African (?) sensitization of public services
R	3	Other (?) adoption of cloud and mobile business models
S	1	European: EuroAfrica
S	2	African: LIWA network in Kenya
S	3	Other: Bill Gate foundation
T	1	African: Union Economique et Monétaire Ouest Africaine (UEMOA)

9.3 Expert Group Meeting Participants: 15 November 2011

Title	Family Name	Given names	Position	Institute	Country
Prof	Mbangwana	Moses Atezah	Research Program Manager	ERNWACA	Mali
Prof	Suri	Neeraj	Professor & Chair	TU Darmstadt	Germany
Mr	Mosiea	Tshepang	Project Manager	Meraka Institute of CSIR	South Africa
Dr	Foko	Thato	Senior Researcher	CSIR	South Africa
Mr	Layton	Roger	MD	RLA	South Africa
Mr	RUSAGARA	Innocent	University of Witwatersrand, South Africa	PhD student	South Africa
Ms	Hinz	Sarah	Programme Officer	ACU	United Kingdom
Mr	Kūlahci	Erol	In Charge of the Relations with the EU	AUF	Belgium
Dr	Halasali	Mohammed Nur			
Dr	Omdele	Eletta			
Dr	McGrath	Peter	Programme Officer	TWAS	Italy

9.4 Bibliography

Sandro Bazzanella & Jean-François Le Bihan. Support for Harmonization of ICT Policies in Sub-Saharan Africa: Implementation Strategy. Available at: http://www.itu.int/ITU-D/projects/ITU_EC_ACP/hipssa/

Key priorities for ICT policy are identified - these were already included in the online survey and interview framework as specific topics

ASICTONLINE. International conference on ICT in Africa.

Available at <http://asiconline.org/images/stories/2010ICIAReport.pdf>

Key priorities: Identifies several key areas where further research is required - Open Education Resources;
Key research priorities include: ICT and Agriculture; Accounting Information Systems; ICT and Climate Change

International Telecommunication Union. Information Society Statistical Profiles-Africa, 2009.

Available at: http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-RPM.AF-2009-PDF-E.pdf.

Key priorities: Useful recommendations in policy and implementation areas; not much on research

Victor W. A. Mbarika et al. The Neglected Continent of IS Research: A Research Agenda for Sub-Saharan Africa.

Available at: <http://chitu.okoli.org/images/stories/bios/pro/research/ictdev/Mbarikaetal2005JAIS.pdf>.

Key priorities: Telemedicine, online learning, e-commerce

OECD. Innovation and ICT in Africa.

Available at: http://www.oecd.org/document/28/0,3343,en_2649_15162846_41713244_1_1_1_1,00.html

Key priorities: Numerous ICT areas covered - including mobile, satellite technologies, public policies

International Energy Agency. Technology Roadmap: concentrating solar power.

Available at: http://www.iea.org/papers/2010/csp_roadmap.pdf

Key priorities: Looks at alternative energy resources- South and North Africa high potential for this technology due to proximity to Europe.

BMI-Techknowledge. South Africa goes its own way at 2.6 GHz.

Available at: <http://www.bmi-t.co.za/?q=content/south-africa-goes-its-own-way-26ghz>

Key priorities: Perspective on WiMAX - LTE

World Bank. E-Transform initiative -Harnessing the Transformational Power of ICTs for Development in Africa.

Available at: <http://www.devex.com/articles/world-bank-and-partners-launch-push-to-maximize-technology-s-potential-for-development>

Key priorities: e-government as 1st phase; major industry players involved - France and South Korea as well as Gemalto, IBM, L-1 Identity Solutions, Microsoft and Pfizer

World Bank. Information and Communications for Development 2009: Extending Reach and Increasing Impact.

Available at: <http://go.worldbank.org/NATLOH7HVO>.

International Telecommunication Union. Information Society Statistical Profiles 2009. Africa.

Available at: <http://www.itu.int/publ/D-IND-RPM.AF-2009/en>

Key priorities: 1. Fixed and mobile telephony. Overview and market summary, penetration data. Competition as a driver. 2. Internet and broadband. Overview and market summary. 3. Benchmarking. 4. Policy challenges/recommendations: Enhance liberalization and privatization and strengthen regulatory agencies.

Promote infrastructure sharing. Lower costs. Promote wireless broadband. Incorporate mobile cellular into universal access policies. Better use of Universal Access and Service Funds. Expand public Internet access. International Telecommunication Union. Report on East Africa Regional Information Infrastructure: Proposed Institutional and Strategic Framework – Volume I. Available at: <http://www.itu.int/publ/D-LDC-ICTEARII-2007/en>
Key priorities: Sectoral challenges: Regulatory divergence; Poor rural communications; Lack of backbone infrastructure; The high tariffs.

Gillwald, A. & Stork, C. Towards Evidence Based ICT Policy and Regulation: ICT access and usage in Africa. Available at: <http://www.researchictafrica.net/index.php/ria-publications>
Key priorities: Fixed and mobile phone and internet. Policy focus. (Seems to be very similar to reference Bazzanella & le Bihan)

International Telecommunication Union. ICTs for e-Environment - Guidelines for Developing Countries, with a Focus on Climate Change. Available at: http://www.itu.int/dms_pub/itu-d/opb/str/D-STR-ENV.CLIMATE-2008-PDF-E.pdf.
Key priorities: ICT technologies' impact on the environment, and ICT as a tool to mitigate environmental damage. Lists general challenges to greater ICT penetration in developing countries - same as refs 1, 2, 3

African Union Commission. African Regional Action Plan on the Knowledge Economy (ARAPKE). A plan for action. Available at: <http://www.uneca.org/aisi/docs/ARAPKE%20doc1.pdf>
Key priorities: Key areas in the framework: Enabling environment, infrastructure and access, e-Strategies and Policies, Information Society Indicators, capacity building, research and development, internet governance, Women and the Information Society, Parliamentarians, Youth, Media, Harnessing the Digital Diaspora, African languages, persons with disability, Resource Mobilization & partnership. Each key area has a list of action lines. That's followed by an extensive log frame for each key area. It's intended that action lines should be implemented by proposals from partnerships.

African Union Commission / European Commission. AUC-EC book of projects.
Key priorities: A list of specific priority projects / programmes In ICT for funding under the umbrella of the 8th partnership of the JAES: - Africa connect - The African internet Exchange System - The African Leadership ICT Program - African Virtual Campus - Harnessing information & Knowledge for Youth Development.

European Commission. ICT - INFORMATION AND COMMUNICATION TECHNOLOGIES. A Theme for research and development under the specific programme "Cooperation" implementing the Seventh Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities. Work Programme 2009-10: version 08-10-08.
Available at: http://www.iotvisitthefuture.eu/fileadmin/documents/researchforeurope/ICT_WP_2009-2010.pdf

Anon: A planet of civic laboratories: THE FUTURE OF CITIES, INFORMATION, AND INCLUSION.
Available at: http://iftf.me/public/SR-1352_Rockefeller_Map_reader.pdf

ShivanuShukla, July 2010. Leading ICT Trends in 2010.
Available at: http://ncstechconnect.com/files/2_ICT_Trends_by_Frost.pdf
Gartner. ICT trends & Innovatives.
Available at: http://icttrends.weblog.nl/ict_trends_innovaties/files/gartner_2009.pdf
Key priorities: Gartner Identifies the Top 10 Strategic Technologies for 2009

Graham Vickery, OECD Sacha Wunsch-Vincent, OECD. R&D and Innovation in the ICT Sector: Toward Globalization and Collaboration.
Available at: <http://www.tubisad.org.tr/Tr/Library/Analizler/Toward%20Globalization%20and%20Collaboration.pdf>