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## Executive summary

An e-Infrastructure is an environment where available resources such as hardware, software and data can be seamlessly shared and accessed amongst users from around the world to facilitate improved and more effective scientific research. e-Infrastructures can play an important role in the advancement of knowledge and technology by allowing communities of practice to conduct high-quality collaborative research in their respective fields. As the goals of e-Infrastructures are of great importance, the European Commission (EC) provides increasing support to both sustain and further develop them.

Accordingly, the eI4Africa project has previously studied the level of adoption of e-Infrastructures in Africa (see D3.1 'State-of-the-art study of African e-Infrastructure applications'), identifying a range of different domains of applications across the continent. Natural and Health Sciences, for example, see many African countries in the process of already developing applications of e-Infrastructures, while many others have recognized the need to start planning for their adoption. Being able to examine the impact of e-Infrastructure applications in Africa is now necessary, as it will help developers and decision-makers understand the potential benefits of their adoption to the society, economy and the environment.

In this context, eI4Africa has performed an impact analysis on 34 applications that have been identified by applying a methodology that has been based on ERINA+ and guidelines by the EC. The analysis performed has highlighted a number of key observations and findings that are consistent with previous similar assessments at the European level:

- A uniform impact assessment methodology that would be applicable to all types of e-Infrastructures or scientific domains does not yet exist;
- The analysed applications interpret e-Infrastructures in Africa as an important enabler of social innovation and sustainable growth in terms of employment opportunities, cross-border collaborations, relationship with third countries, and training opportunities;
- The opportunity to improve productivity was highlighted by many applications mainly related to enhancing the quality of work by performing tasks and achieving results faster, creating new knowledge and skills, and enhancing services;
- The effect on economic growth was identified as an important, but indirect, impact of the adoption of e-Infrastructures, as was the opportunity offered to increase the global competitive position of African organisations, and support the efforts for macroeconomic stabilization;
- The environmental benefits of the studied applications correlated to the efforts to improve the African climate, air quality, energy needs, and biodiversity.

As a result of its activities, the eI4Africa project brings forward a set of recommendations and guidelines to developers and decision-makers addressing the following four topics:

- Emphasise the need for African scientists and researchers to join forces with their counterparts in other parts of the world;
- Continue raising awareness and supporting dissemination activities in order to both communicate on and promote the potential of e-Infrastructures in Africa;
- Provide continuous and consistent programmes on skills and capacity building; and
- Improve collaboration opportunities and sustain Euro-Africa cooperation.

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## 1 – Introduction

The present document is a deliverable of the eI4Africa project (Grant Agreement #312582), funded by the European Commission's Directorate-General for Communication Networks, Content and Technology (DG CONNECT), under its 7th EU Framework Programme for Research and Technological Development (FP7). The eI4Africa project is divided into Work Packages (WP), each of them being sub-divided into Tasks (T). Work Package 3 "e-Infrastructure applications in Africa: a state-of-the-art study" of the project consists of two tasks (Task 3.1: Data Collection and Task 3.2: Analysis and Findings) aiming to collect and analyse data on established and emerging e-Infrastructure applications in Africa.

Carrying on from the state-of-the-art study conducted within D3.1, the present deliverable (D3.2 – Recommendations for African e-Infrastructure development), prepared by Brunel University, describes the activities undertaken by the eI4Africa partnership to prepare a set of recommendations to e-Infrastructure developers to facilitate e-Infrastructure application development. In order to fulfil these activities, the partnership has developed a data collection methodology based on previous work and guidelines provided by the European Commission (EC), with an aim to reach out to e-Infrastructure application proposers (identified within D3.1) and investigate their perceptions on the impact of their current or planned application(s) in Africa and in future e-Infrastructure development best practice.

Accordingly, the outcome of the aforementioned deliverable is twofold:

- an impact assessment of the 34 identified e-Infrastructure applications;
- a set of recommendations to e-Infrastructure developers to facilitate e-Infrastructure application development.

### 1.1 – Context of the study

e-Infrastructures are essential drivers of scientific innovation and there is a strong potential to advance development in Africa in this context. This is notably highlighted by the many innovative applications that have been developed locally in numerous scientific domains. For example, users from different countries can utilize e-Infrastructure and have access to high quality services such as data repositories in health sciences and scientific instruments for environmental studies. e-Infrastructures can therefore play an important role in the advancement of knowledge, and a key role in the development of an efficient scientific research environment.

It is thus anticipated that e-Infrastructures have a unique potential to facilitate African development. Specifically, it is expected that they can have a huge and rapid impact in all socio-economic sectors and can positively affect the ways scientific research is carried out in various domains such as healthcare, agriculture, or environment management, amongst many others. In order to better exploit the concrete opportunities e-Infrastructures can offer, it is important to consider African local research needs so as to make such technological developments both relevant and exploitable.

Accordingly, the eI4Africa project has investigated the above expectations by producing a study that assesses the impact of the identified applications of e-Infrastructure in society, economy and the environment within the African continent. Findings have been compiled together with a set of recommendations to e-Infrastructure developers related to e-Infrastructure application development in Africa.

## 1.2 – Objectives of the deliverable

Given that the identified e-Infrastructure applications represent heterogeneous scientific domains spanning various countries, research practices and technologies, the objectives of this deliverable are to:

1. Assess the broader value added to society, as well as the economic and environmental benefits of the development of the applications;
2. Produce a set of recommendations to e-Infrastructure developers to facilitate e-Infrastructure application development in the form of:
  - Major trends, success factors and barriers to development of e-Infrastructure applications;
  - Opportunities for global Virtual Research Community (VRC) development to encourage collaboration between relevant European and African research projects.

Accordingly, the first objective will be addressed in Part C of this document, while the second objective will be discussed in Part D (see Figure 1).

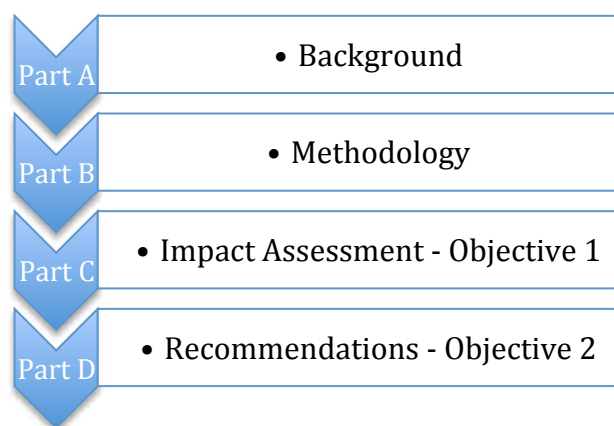


Figure 1 Structure of the present deliverable

## 1.3 - Scope and target audience of the deliverable

The focus of this deliverable is to facilitate the understanding of the current e-Infrastructure scene, and its impact in Africa and in future e-Infrastructure development best practice. It will, therefore, be vital in understanding the benefits of the identified e-Infrastructure applications in Africa and will contribute towards the sustainable development of future e-Infrastructures and their applications. Additionally, this deliverable will allow contributing to the project activities depicted in Figure 2 below by identifying a number of VRCs or Communities of Practice (CoPs) that are ready or could potentially participate in collaborations for future European projects.



Figure 2 Virtuous circle of eI4Africa activities

The findings that are described will be of particular interest to the following audiences:

- Developers that have already implemented, or are in the process of implementing e-Infrastructures and related applications in Africa;
- Scientific communities in different regions of Africa that could benefit from the potential of collaborative use of e-Infrastructures;
- Global VRCs in order to encourage collaboration between relevant European and African research projects.

#### 1.4 – Structure of the deliverable

The deliverable is organised in four main sections with final conclusions drawn in a dedicated section at the end. The first section presents the background to this deliverable and related work, while the second section provides information about the methodology followed to address the above objectives. The third section looks at the main findings resulting from the impact assessment, and the fourth puts forward recommendations to African e-Infrastructure developers. A conclusion section concludes this deliverable.

## 2 – Part A: Background and Related Work

An e-Infrastructure is an environment where available resources such as hardware, software and data can be seamlessly shared and accessed amongst users from around the world to facilitate improved and more effective scientific research. Such environments integrate hardware, software and middleware components, networks, data repositories, and all kinds of supporting elements so enabling VRCs to flourish globally<sup>1</sup>. e-Infrastructures can play an important role in the advancement of knowledge and technology by allowing communities of practice to conduct high-quality collaborative research in their respective fields. It is claimed that e-Infrastructures are powerful key enablers of global collaboration and sustainable development, and may contribute to the prevention of 'brain drain' (Bird et al, 2009).

These resources can be accessed via easy to use web portals, or Science Gateways, needed to help VRCs to easily access e-Infrastructure facilities and through these collaborate with VRCs across the world. Science Gateways form a key part of the European Grid Initiative's Strategic Plan (*EGI Strategic Plan – Seeing New Horizons: EGI's Role in 2020*<sup>2</sup>) and many are being rapidly developed and deployed. To meet researchers' needs, TeraGrid<sup>3</sup> have developed several such portals (Wilkins-Diehr, Gannon, Klimeck, Oster and Pamidighantam, 2008) demonstrating how effective Science Gateways are key to e-Infrastructures.

This shift towards e-Infrastructure, therefore, can have positive benefits and a strong impact in scientific output and in African society as a whole. As the goals of e-Infrastructures are of great importance, the EC provides increasing support to both sustain and further develop them. Consequently, being able to assess the impact of the numerous applications of e-Infrastructures is a valid and relevant issue, and is also of considerable importance to the society and economy of a country. Accordingly, in this section the various theories and models typically used to assess impact are presented, and previous work related to the utilization of these towards the impact assessment of e-Infrastructures in Europe is illustrated.

### 2.1 Why is an impact assessment necessary?

In order to understand the importance of assessing the impact of the identified e-Infrastructure applications, one has to first establish why it is necessary. The EC defines impact assessment (IA) as *"a set of logical steps to be followed when you prepare policy proposals. It is a process that prepares evidence for political decision-makers on the advantages and disadvantages of possible policy options by assessing their potential impacts."*<sup>4</sup> Building upon this definition, in doing an IA of the applications of e-Infrastructures a number of questions can be answered:

- What are the views of the CoPs concerned?
- What are the likely (direct and indirect) economic, social and environmental impacts? and,
- Who is affected (including outside Africa) and in what way?

However, determining the impact of research activities and advances is typically not a straightforward process. In many cases the reason is that the raw data produced might not be available for analysis, while in others it is challenging to identify a uniform methodology that would be applicable to all types of e-Infrastructures or scientific domains. While such a

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<sup>1</sup> EC-endorsed definition <http://cordis.europa.eu/ictresults/index.cfm?ID=90825&section=news&tpl=article>

<sup>2</sup> <http://go.egi.eu/EGI2020>

<sup>3</sup> [www.teragrid.org](http://www.teragrid.org)

<sup>4</sup> [http://ec.europa.eu/smart-regulation/impact/commission\\_guidelines/docs/iag\\_2009\\_en.pdf](http://ec.europa.eu/smart-regulation/impact/commission_guidelines/docs/iag_2009_en.pdf)

methodology does not yet exist, it is accepted that a set of several other valid approaches and models can be adopted for this purpose.

## 2.2 Theories, models and tools towards impact assessment

Manieri and Nardi (2012) in their work present an informative brief overview of the theories and models of assessment methodologies within the landscape of assessing the impact of e-Infrastructures, which are summarized in this section. Based on their work, while several models seem to currently exist, the majority of the approaches typically employed for impact measurement mainly focus on the 'input, output, outcomes, and impact' model. Within this model, the four key variables and their relation involved in an IA are the following:

- **Inputs** are the investments made in, or the resources required to, produce a product or develop/undertake an activity;
- **Outputs** are the products or services provided (e.g. number of grids/networks created, papers published, events held, etc.);
- **Outcomes** are the immediate changes resulting from an activity – these can be intentional or unintentional, positive or negative (e.g. employment, increased connectivity, etc.);
- **Impacts** are the net difference made by an activity after the outputs interact with society and the economy (e.g. transformational research enabled by the project, which would otherwise would not have occurred or occurred as fast enabling EC-funded researchers to be world-leading).

Accordingly, a significant number of IA studies are available in the literature that aim at either identifying expected impacts (ex-ante studies) or at measuring and evaluating real impact during or after the end of a project (monitoring or ex-post studies). These are presented below according to the aforementioned work by Manieri and Nardi (2012).

### 2.2.1 Ex-ante impact assessment

An ex-ante assessment typically focuses on on-going and/or finished initiatives. The methodologies that are normally employed in an ex-ante evaluation of programs and investment policies are summarized in Figure 3 below and typically include:

1. Foresight studies that allow anticipating social, economic and technological development opportunities in policy planning by employing:
  - **Case studies** for an in-depth analysis of real cases, investigating for the expected results;
  - **Broad surveys**: asking a large number of experts, examining an issue in less detail;
  - **Data collection methods**: analysis of documents, interviews, questionnaires, peer reviews, focus groups, expert panels that can be applied to the evaluation of economic, as well as social impacts.
2. Modelling and simulation techniques, where econometric modelling is used both at micro (network analysis, statistical based model) and macro (input/output tables, Social Accountability Matrices and General Equilibrium) levels, and;
3. Cost-efficiency and cost-benefit techniques, where the costs and benefits are quantified in monetary terms to establish whether the benefits exceed the costs. A programme could hence be considered as 'efficient' or 'cost effective' if its set objectives are achieved at the least cost, or if its desired impact is maximized at a given level of resources.

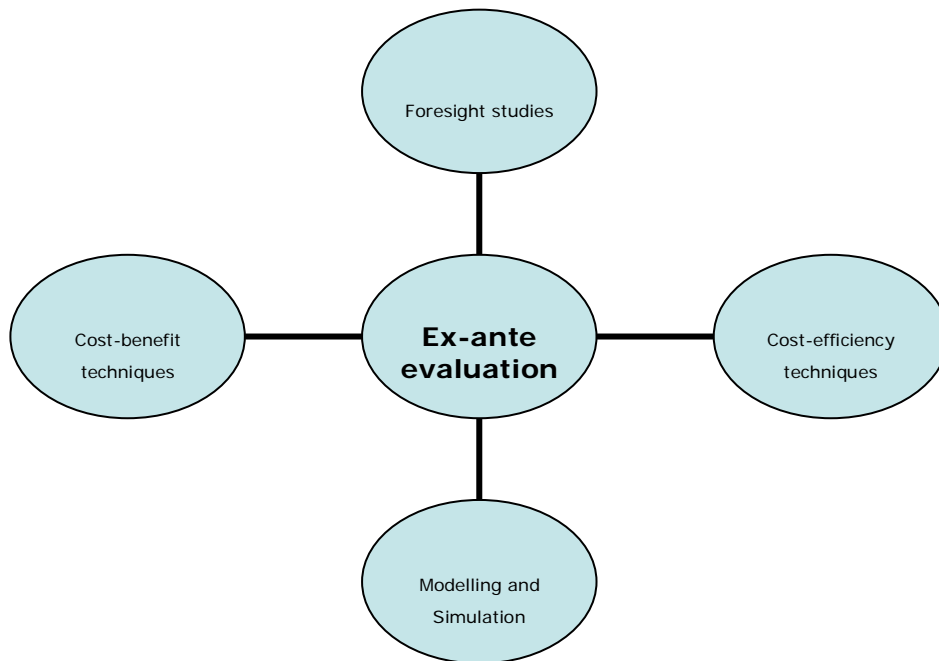


Figure 3 Ex-ante evaluation methodologies

### 2.2.2 Ex-post impact assessment

On the other hand, an ex-post impact evaluation typically focuses on four main activities:

- Determining the efficiency and efficacy of the intervention (e.g. productivity studies);
- Providing a quantitative estimation of the impact of the intervention (e.g. microeconomic evaluation studies);
- Quantifying the various dimensions in which returns should be considered within a defined framework;
- Assessing environmental sustainability and wealth issues (e.g. cost-benefit analysis), organizational impact (e.g. case studies, network analysis, innovation studies) and strategic impact (e.g. foresight).

Accordingly, the methodologies employed to address the above are summarized in Figure 4 and include:

1. A number of statistical data analysis techniques, such as:

- **Innovation Surveys** that provide basic data to describe the innovation process, summarized using descriptive statistics;
- **Benchmarking** that allows to perform comparisons based on a relevant set of indicators across entities providing a reasoned explanation of their values.

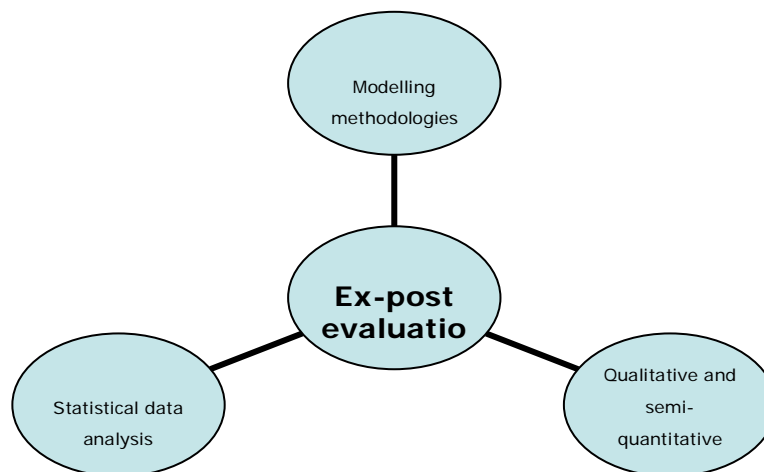


Figure 4 Ex-post evaluation methodologies

2. Various modelling methodologies, including:

- **Macro-econometric** modelling and simulation approaches that allow estimating the broader socio-economic impact of policy interventions;
- **Micro-econometric** modelling that permits to study the effects of policy intervention at the level of individuals or firms;
- **Productivity analysis** that permits to assess the impact of R&D on productivity growth at different levels of data aggregation. This is particularly relevant to analyse the broader effects of R&D on the economy;
- **Control group** approaches that allow capturing the effect of the programme on participants using statistically sophisticated techniques.

3. Qualitative and semi-quantitative methodologies that involve:

- **Interviews and case studies** that use direct observation of naturally occurring events to investigate behaviours in their indigenous social setting;
- **Cost-benefit analysis** that allows establishing whether a programme or project is economically efficient by appraising all its economic and social effects. The approaches to quantify the socio-economic gains of a policy instrument include contingent valuation studies, simulating the existence of a market for a non-marketed good;
- **Expert Panels/Peer Review** that measure scientific output relying on the perception scientists have of the scientific contributions made by other peers. Peer review is the most widely used method for the evaluation of the output of scientific research;
- **Network Analysis** that allows analyzing the structure of co-operation relationships and the consequences for individual's decisions' on actions providing explanations for the observed behaviors by analyzing their social connections into networks;
- **Foresight/ Technology Assessment** that is used to identify potential mismatches in the strategic efficiency of projects and programmes.

### 2.2.3 The European Commission impact assessment guidelines

The EC has similarly put together a set of guidelines for impact assessment<sup>5</sup> (EC SEC 2009/92) as part of their efforts to equip staff preparing impact assessments. These guidelines provide

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<sup>5</sup> [http://ec.europa.eu/smart-regulation/impact/commission\\_guidelines/docs/iag\\_2009\\_en.pdf](http://ec.europa.eu/smart-regulation/impact/commission_guidelines/docs/iag_2009_en.pdf)



specific information on what IA is, the key actors involved, the process for preparing, carrying out and presenting an IA, and finally guidance on the various steps to follow.

Based on these guidelines, when performing an analysis of impacts one should try to take into consideration not only the likely economic and social impacts, which the aforementioned theories and models are only addressing, but also any environmental and potential trade-offs and synergies. In support of this, the EC has included in the guidelines three tables with a set of questions that have been designed as a useful basis to help develop an impact analysis (see section 8.2 of the guidelines document). For the purpose of this deliverable, these questions have been summarized under the following types of impacts:

#### **Economic:**

- Internal market and competition;
- Consumers and households;
- Third countries and international relations;
- Operating costs and conduct of business;
- Innovation and research;
- Macroeconomic environment;

#### **Social:**

- Employment and labour;
- Social inclusion and equality treatment;
- Public health and safety;
- Culture;
- Social impacts in third countries;

#### **Environmental:**

- Climate;
- Use of energy;
- Biodiversity, water and soil quality;
- Renewable or non-renewable resources;
- Environmental risks;
- International environmental impacts.

A set of annexes is also available as part of these guidelines that contains more detailed material and a number of tools that can further help with the analysis of impacts.

## **2.3 Previous related work**

A number of initiatives and projects have explored in the past the methodologies and tools described in the previous section with the aim of widely spreading the importance of impact assessment in the e-Infrastructure domain. Manieri and Nardi (2012) have also put together a useful list of these research programmes (see Table 1) that are briefly described in the remaining of this section, and which were co-financed by the EC for the purpose of investigating ways to develop a holistic methodology for the impact assessment of this complex environment.

Table 1 EU projects on impact assessment in e-Infrastructures

<b>Project Abbrv.</b>	<b>Project URL</b>	<b>Programme</b>	<b>Duration</b>	<b>Status</b>
Ri-Impact	<a href="http://www.ri-impact.eu/ri-impact/index.php">http://www.ri-impact.eu/ri-impact/index.php</a>	FP7	2010-11	Completed
ERINA+	<a href="http://www.erinaplus.eu/">www.erinaplus.eu/</a>	FP7	2010-12	Completed

e-FISCAL	<a href="http://efiscal.eu/">http://efiscal.eu/</a>	FP7	2011-13	Completed
eNventory	<a href="http://www.enventory.eu/">http://www.enventory.eu/</a>	FP7	2010-12	Completed
iMENTORS	<a href="http://www.imentors.eu/">http://www.imentors.eu/</a>	FP7	2012-14	Ongoing
RI-FI	<a href="http://rifi.gateway.bg./">http://rifi.gateway.bg./</a>	FP7	2009-11	Completed

### 2.3.1 Development of Impact Measures for e-Infrastructures (Ri-Impact)

The Ri-Impact project aimed at developing a holistic framework that would allow for the assessment of the broader socio-economic impact of e-Infrastructures on the basis of five main characteristics of a project - accessibility, efficiency, sustainability, innovativeness, and transformability. Building upon the analysis of the socio-economic impact of 21 e-Infrastructure projects, Ri-Impact additionally provided a set of recommendations that outline the contribution of e-Infrastructures to the European Research Area and to the realization of the EU policy aims. RI-Impact's final recommendation was to put together a toolbox that would allow for a comprehensive impact assessment of projects. The proposed components of this toolbox would be: (1) an inventory of e-Infrastructures, (2) user survey and assessments, and (3) support of bibliometrical analysis to identify the impact on research excellence.

### 2.3.2 Socio-Economic Impact Assessment for e-Infrastructures Research Projects (ERINA+)

The ERINA+ project, largely based on the experiences of its predecessor - the ERINA study, was launched with a similar aim to develop a holistic methodology that would allow for the assessment of the societal and economic impact of various e-Infrastructure projects. Variables that were taken into consideration in the evaluation included the efficiency (usage of time or effort with respect to the intended purpose) and effectiveness (capability of producing an effect in: competitiveness and excellence of research; innovativeness of research; cohesion) aspects of the examined projects. On its completion, ERINA+ was able to facilitate the assessment of the socio-economic impact of e-Infrastructure projects by allowing for projects to carry out a self-evaluation through a set of web tools that are available on the ERINA+ platform<sup>6</sup>.

### 2.3.3 Financial Study for Sustainable Computing e-Infrastructures (e-FISCAL)

The aim of the e-FISCAL project was less broad than the aims of the two previously discussed initiatives, as its main and only focus was the economic assessment of e-Infrastructures projects, leaving out from its activities any societal aspects. Specifically, the project attempted to provide a method that would allow for the comprehensive analysis of the costs and related structures of the European High-Throughput and High-Performance Computing (HTC and HPC) e-Infrastructures on the basis of a comparison with cloud computing offerings. The findings from this study would be of immediate interest to the various stakeholders dealing with their usage and service provision.

<sup>6</sup> <http://platform.erinaplus.eu>

### **2.3.4 The European e-Infrastructures Observatory (eNventory)**

The eNventory project aimed to carry out a study that would provide the design decisions and means to develop a European e-Infrastructures Observatory that would serve as a data warehouse storing the state-of-the-art of European e-Infrastructures, accessible via an interactive web-based user interface. This platform would allow both for the monitoring and assessment of their impact at regional and national level across the European Union and beyond. The main result produced from eNventory includes a set of monitoring indicators related to e-Infrastructures development.

### **2.3.5 e-Infrastructure Monitoring, Evaluation and Tracking Support System (iMENTORS)**

iMENTORS is a one-stop-shop data warehouse on all e-Infrastructure development projects of Sub-Saharan Africa. By mapping e-Infrastructure initiatives, their aim is to help scientists, universities, research and education networks as well as policy-makers and international donors gain valuable insights on the gaps and progress made in the region and to enhance the coordination of international actors involved in ICT initiatives in this part of the world. iMENTORS is equipped with advanced Geographic Information and Visualisation Systems along with a robust decision-support system drawing public data from many online databases to assist provide policy support and assist programme planning and implementation.

### **2.3.6 Research Infrastructures: Foresight and Impact (RI-FI)**

Perhaps the least far-reaching initiative amongst the six projects of Table 1 is the RI-FI project. While this project's main target was to contribute to the advancement of previous or ongoing impact studies through the development of a holistic methodology to assess the socio-economic impact of future research infrastructure projects, its final product – the FenRIAM (Foresight enriched RI Impact Assessment Methodology) tool - was mainly focusing on the impact assessment of single-sited research infrastructures. This means that research e-Infrastructures were not the primary focus of the project's activities, and their systematic monitoring was not considered, as opposed to the previous projects.

## **2.4 What eI4Africa seeks to accomplish**

One of the main outcomes of the eI4Africa project to date was the identification of 44 potential or current applications of e-Infrastructures in Africa. While these applications constitute a great achievement in terms of demonstrating the current state of e-Infrastructure uptake in the continent, what have not been investigated are the intended benefits of the identified applications to the African society.

It is evident that an important deal of work exists in measuring the impact of e-Infrastructures in the European level, as demonstrated by the five projects described in the previous section. Africa is currently behind in these developments, but as the UbuntuNet network, which is being implemented by the AfricaConnect<sup>7</sup> project, continues to unroll, it is expected that an increasing amount of attention will be put on similarly measuring the benefits that will be brought by these advancements in the African level. Building on the experiences of these European projects and based on guidelines produced by the EC, the eI4Africa project seeks to contribute to this need by performing an assessment and evaluation of the intended impact in

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<sup>7</sup> <http://www.africaconnect.eu/Pages/home.aspx>

society, economy and the environment coming from the 44 identified e-Infrastructure applications.

Finally, distinctively different from the aforementioned five projects, eI4Africa does not seek to develop a framework or methodology for measuring impact; rather, the study results that were produced using the methodologies established within these projects have been used towards the development of a set of guidelines and recommendations to e-Infrastructure developers to facilitate e-Infrastructure application development. Accordingly, the project hasn't carried out an individual impact assessment for each identified application, as in ERINA+; rather, a holistic evaluation was performed per scientific domain that these applications belong to. Lastly, as opposed to previous work, in this deliverable eI4Africa also attempts to deliver an assessment of the environmental impact of the applications in addition to a socio-economic evaluation.

## 3 – Part B: Methodology

### 3.1 – Brief background

The prerequisite to the present deliverable is a survey that was carried out in order to examine the state-of-the-art in e-Infrastructure application uptake in Africa. This survey, which has already been described in D3.1, produced 328 responses (131 complete; 197 incomplete; 39.9% response rate) in a set of questions related to gathering information about a current or planned application, its users, and its technical requirements. Responses arrived from several African countries (n=30), as well as from other world regions including Europe (n=20), North America (n=1), South America (n=1), and Asia (n=2).

Analysis of these responses revealed that the current identified state-of-the-art in Africa consists of **44 current or planned e-Infrastructure applications** spanning a good range of domains, including education and skills development (e.g. learning portals), natural sciences (e.g. environment, water resources, farming), life sciences (e.g. fishery, healthcare), governments (e.g. human migration), as well as the industry (e.g. customer provision).

Identifying the current uptake of e-Infrastructures and who their early adopters and beneficiaries are, however, constitutes only half of the picture, with the other half being the investigation and understanding of their impact in Africa and in future e-Infrastructure development best practice. In response to this, the activities that followed D3.1 aimed at evaluating the 44 aforementioned applications for the value added to society by their development, as well as their economic and environmental impact. Information about the above impacts will be sought from the various involved stakeholders (users and VRCs, projects, and other key stakeholders) and/or application proposers.

Accordingly, this section presents the key elements of the developed methodology that was employed to address the two deliverable objectives. We specifically focus on the impact assessment study design and the methodological decisions around developing the proposed recommendations for e-Infrastructure developers in Africa.

### 3.2 – Study design

The methodology developed to assess the impact of each of the identified e-Infrastructure applications was based on previous work by the ERINA+ project and the EC's Impact Assessment Guidelines (EC SEC 2009/92), both described in the previous section. Accordingly, assessing the impact typically involves two main steps:

- (1) Identification of social, economic, and environmental impacts; and
- (2) Identification and assessment of the most important impacts.

The approach followed to identify the three aforementioned impacts of step (1) involved a combination of ex-ante and ex-post assessment, as it was necessary to focus both on actual real impact, if any (as recorded by the application proposers) and on any expected impacts. This approach was considered as appropriate for capturing the complete span of application effects.

The sources of information and data needed to fulfil the above two steps vary and include available expertise, desk reviews of existing research, studies and evaluations, possibly enriched by involving outside experts, and through consultations with stakeholders. In this study, data were collected through consultations with the involved stakeholders, as it was

needed to understand their perspectives when it comes to exploring the impact of their proposed e-Infrastructure applications.

### 3.2.1 Step 1: Identification of social, economic, and environmental impacts

The method employed to identify perspectives about the three examined types of impact was an online survey on the SurveyMonkey system, which was chosen as the preferred data collection procedure due to its economy, the rapid turnaround in data collection, and its advantage of identifying attributes of a large population from a small group of individuals (Creswell, 2009: 146).

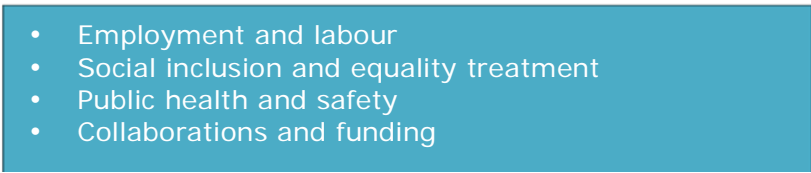
The survey consisted of a self-administered questionnaire containing 28 mixed-type questions used to collect information in 4 main areas: (1) the proposer's background information, (2) the societal impact, (3) the environmental impact, and (4) the economic impact of the proposer's application. An introductory page was also presented to the participant briefing him/her about the scope of the study and reminding him/her of the concept of e-Infrastructures.

The design of the survey questions was informed on the basis of previous work by ERINA+ described in their D3.5<sup>8</sup> and on the EC's Impact Assessment guidelines, as follows:

#### Social impact questions

The questions about the societal impact of the identified e-Infrastructure applications were designed in accordance to the below four variables and included questions from the four sub-impact categories (see section 2.3.3) mentioned in the below box:

- **Efficiency.** Efficiency of the e-Infrastructure applications on other projects and society;
- **Competitiveness.** Defined as the "visibility" of a research output; the capacity of researchers to produce scientific outputs that can compete with other countries outside Africa;
- **Innovation.** Innovativeness of research and transfer outside the domain; capacity to transfer the knowledge produced from the scientific research domain to a wider public (e.g. industry and society);
- **Cohesion.** Capacity to stimulate networking between researchers within and between African countries, as well as beyond African boundaries.

- 
- Employment and labour
  - Social inclusion and equality treatment
  - Public health and safety
  - Collaborations and funding

#### Environmental impact questions

As set out in the EC's guidelines, one of the tools commonly used in assessing environmental impacts is the *Life-cycle Assessment (LCA)*. This is the process of evaluating the effects that a product has on the environment over the entire period of its life. Consequently, the questions used to evaluate this type of impact were designed in order to study the environmental loads, e.g. the energy and raw materials consumed, the emissions and wastes generated, and the

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<sup>8</sup> [http://www.erinaplus.eu/index.php/documents/cat\\_view/2-public](http://www.erinaplus.eu/index.php/documents/cat_view/2-public)

emissions of air pollutants related to land use and to energy generation and use by either a product or the function the product is designed to perform.

In addition, the questions also took into consideration Green IT, which could be broadly associated with technologies and techniques for improving the energy efficiency of data centres, for reducing the environmental impact of IT operations, and the use of IT as an enabler of organisational-wide green initiatives. The benefits of Green IT on an IT application have been investigated and include cost efficiency, increased flexibility, energy efficiency, improved business efficiency, and reduced carbon emissions.

Accordingly, the questions about the environmental impact of the identified e-Infrastructure applications were designed in accordance to the above and included questions from the five sub-impact categories mentioned in the box below:

- Climate and air quality
- Biodiversity, water and soil quality
- Use of energy and renewable resources
- Environmental risks
- Adoption and use of Green IT

### **Economic impact questions**

The questions about the economic impact of the applications were designed according to the fundamentals of "Cost-Benefit Analysis", with some additional features coming from the "multicriteria analysis". These are considered as appropriate for measuring the economic efficiency of an application, which can be carried out in two different ways:

- By calculating the "offered" efficiency, by asking the projects to describe the technological advances brought by the project output (service) to the underlying e-Infrastructure and to its users; or
- By calculating the "perceived" efficiency, by asking the project output(s) users to describe the benefits they actually experience by using the service/product offered by the project.

It has to be noted at this point that due to the nature of the proposed applications being either a current or planned initiative, it was decided that a monetary estimation of the impacts would not be possible and measuring the offered efficiency would not be representative. Consistent with the principles of multi-criteria analysis, when such estimation is not possible, it is better to express the impacts in the most suitable metric, providing a multidimensional, disaggregated description of project performance. As such, for the purposes of this deliverable, the questions examining the economic impact were formed in order to address the more multidimensional perceived efficiency of an application and included questions from the four sub-impact categories mentioned in the box below:

- Internal market and competition
- Operating costs and conduct of business
- Government and public authorities
- Individual users and Macroeconomics

All of the above questions were then compiled to the survey instrument that was available on [https://www.surveymonkey.com/s/eI4Africa\\_ImpactAssessment](https://www.surveymonkey.com/s/eI4Africa_ImpactAssessment) (last accessed 16/06/2014), and is shown in Appendix B of this deliverable document.

### **3.2.2 Step 2: Identification and assessment of the most important impacts**

The last step in the impact assessment process involved analysing and assessing the available data. Data were collected by sending email invitations to the identified application proposers that had a direct link to the above online survey. Out of the 44 identified applications, 4 were excluded from the study as it was decided that they would not directly benefit from the eI4Africa activities. Accordingly, the invitation email was sent to the 40 selected participants' provided email addresses and included a brief introduction of the follow-up study's aim and objectives, as well as information about the opportunity to participate in the development of their application and/or increase the visibility of their current activities through their participation in the study. To ensure that the best possible response rate was achieved, two follow-up reminders to fill in the survey were sent to all of those who were invited, but not responded, one and two weeks after the initial email invitation, respectively. Data collection took place between February and April 2014.

The assessment of the identified impacts was generally quantitative and consisted of the subsequent following activities:

1. Summarisation of the impacts for all applications by impact type (social, economic, environmental);
2. Graphical illustration of aggregated results in quantitative terms for all applications and/or impact type that this is feasible;
3. Summarisation of the impacts for all applications by scientific domain and user communities;
4. Presentation of the above impact assessment (#3) through an 'impact matrix' that consists of the identified scientific domains or user communities (columns of the matrix) and the main types of impacts (rows of the matrix);
5. Assignment of the magnitude/importance of each impact (low/medium/high);
6. Identification of the most important domain(s) in which the current or planned application(s) is expected to produce benefits or negative impact.

In doing the above, the collected data were summarized and made available in a consolidated Microsoft Excel file provided by the SurveyMonkey platform. The file was automatically organized according to the 28 survey questions, allowing for better analysis of the presented data. Initially, a data cleansing phase was followed in order to ensure that duplicate responses, if any, and any information that could not be considered in the analysis were removed. It was decided that in the case where any provided information was not usable, the response was deemed as not usable and was consequently not considered in the analysis. The analysis consisted of analysing the data on a per question basis, which involved reviewing the data that were collected for each question separately and then graphically summarizing them for an easiest interpretation of the findings. All these are presented in section 4 of this deliverable.

## **3.3 Methodological decisions for proposing the recommendations**

The second objective of this deliverable is to produce a set of recommendations to e-Infrastructure developers to facilitate e-Infrastructure application development. The intent of these recommendations is to encourage rigor and consistency when developing applications of e-Infrastructures in Africa, as well as to foster development of application with high impact; therefore, it is imperative that the recommendations should provide a set of development



guidelines describing a strategy that could be followed for this purpose, as this has been identified from our experiences.

In adopting the above, developers of the new generation of e-Infrastructure applications will be able to both improve their implementations, as well as narrow the gap between an application and the actual benefits that it can provide to its intended end communities of practice. Accordingly, the recommendations need to be responsive to the broader interests of the various communities of practice, while ensuring that they can provide practical support to e-Infrastructure developers. The audience of the recommendations are, therefore, both developers and the communities of practice using e-Infrastructure applications.

Finally, the selected 44 e-Infrastructure applications that have been identified within eI4Africa should not only provide the main context based on which these recommendations will be developed, but they should also serve as practical examples toward which these can be oriented and applied. In order to do so, these applications need to be part of the proposed recommendations and should be made publicly available. This would also help facilitate opportunities for global VRC development and encourage collaboration between relevant European and African research projects.

## 4 – Part C: Impact Assessment Results

### 4.1 – Overview

This section presents the results produced from the analysis of the survey responses. Out of the 40 email invitations that were sent to the identified application proposers, 37 responses (34 complete; 3 incomplete; response rate 92.5%) were received, of which 34 responses (response rate 91.9%) were deemed as usable and were consequently considered in the analysis. A list of all 34 identified e-Infrastructure applications that responded to this survey is provided in Appendix A.

The 34 responses were received from 17 different countries; 13 (76.5%) were African and the remaining 4 (23.5%) were European that were involved in activities related to African development. The distribution of the respondent’s affiliations varied, with 32.3% being education institutions, 23.5% research institutions or centres, 23.5% Non-government organizations (NGOs) and/or Non-profit organizations (NPOs), 11.7% private companies, 5.8% research programmes or projects, and 2.9% government or government organizations (GOs). Figure 5 below graphically presents the list of these countries and the number of the responses that have been received from each.

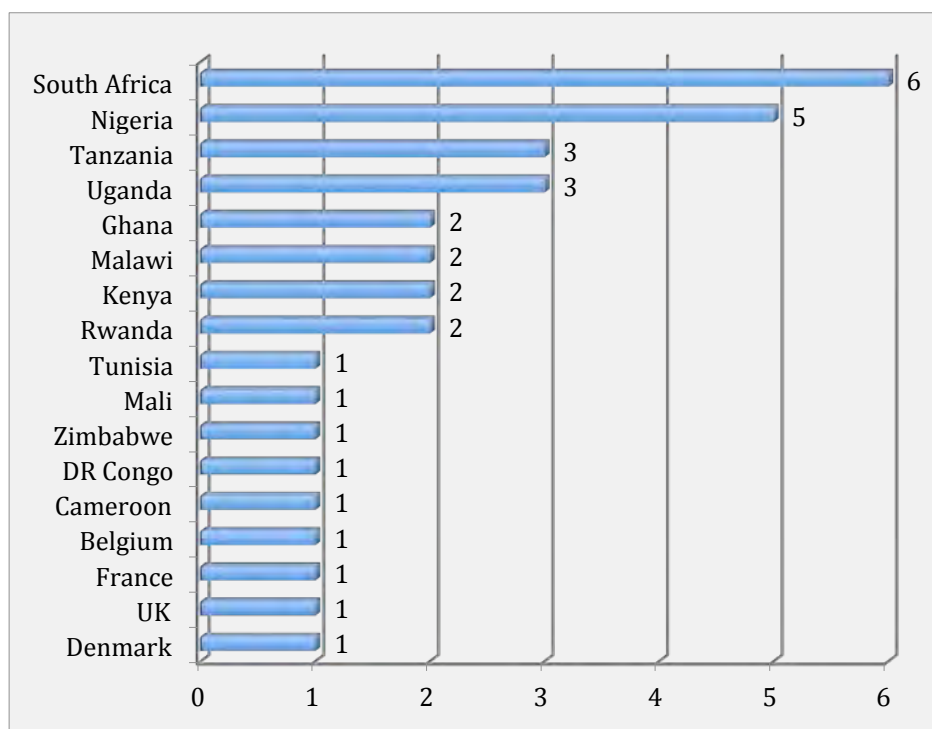


Figure 5 Countries and number of responses for each

Furthermore, the current or planned e-Infrastructure applications that were identified from the 34 responses broadly fall within one of the five scientific domains illustrated in Figure 6 below, with the top three being Natural sciences, Life sciences and Digital resources. The current or planned users of these applications varied, with 47% being a mixture of different users, 20.5% specific Virtual Research Communities, 11.7% Research units or Universities, and 2.9-5.8% were individual/group of researchers, healthcare providers/patients, projects, staff or internal users, and the public. The remaining results are summarised in the following three subsections formed in accordance with the three main types of impacts addressed by the survey.

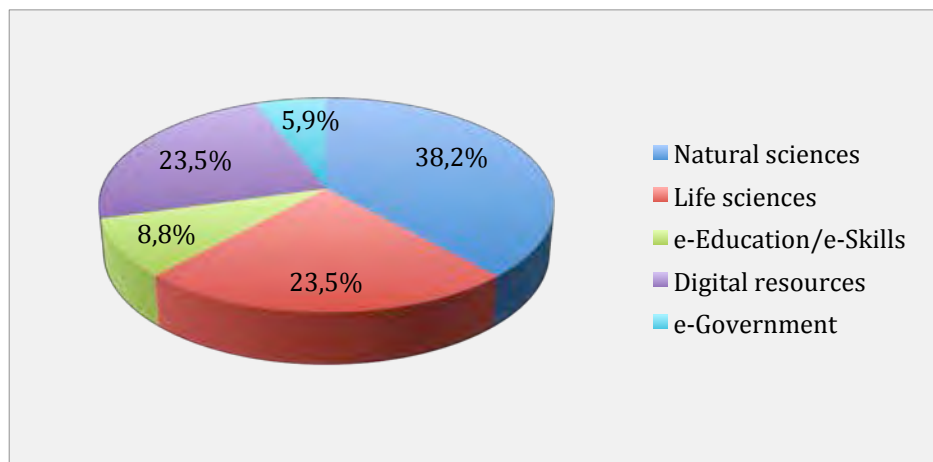


Figure 6 Scientific domains of applications

## 4.2 Impact on society

This section includes the results from the analysis related to the impact of the 34 applications on the society. The findings are presented with respect to the overall impact on society, the impact per application domain, and the impact per user community.

### 4.2.1 –Overall Impact on society

The 34 application proposers were asked to provide their perspectives on the actual or expected societal impact of their current or planned e-Infrastructure application. The survey questions focused on identifying their views on four different aspects of social impact, for which the results of all responses are summarised in the following subsections.

#### 4.2.1.1 EMPLOYMENT AND LABOUR

The effect of the proposed applications on employment and the labour markets in Africa was investigated by asking the respondents to indicate whether they agree or disagree with a series of expected outcomes (Figure 7). The majority of the respondents agreed (94.1%) that their application could enable the creation of new services, new products (87.5%) or new processes (88.2%) (related to the domain of the applications), while facilitating the creation of new jobs (91.1%) appeared to be another important area that the applications could contribute to according to the majority.

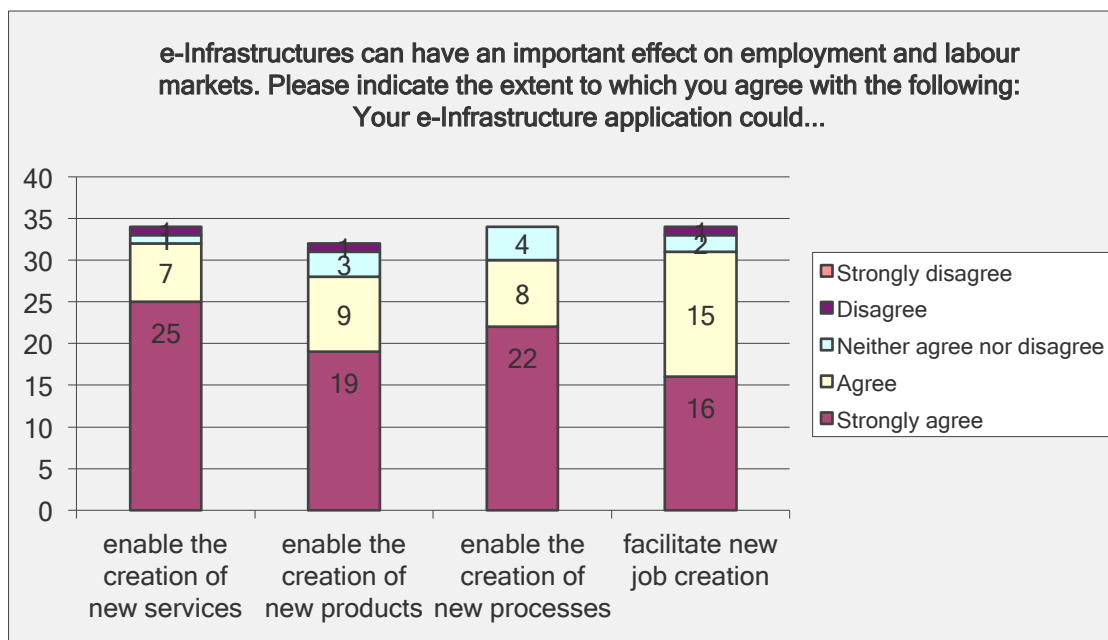


Figure 7 Employment and labour markets

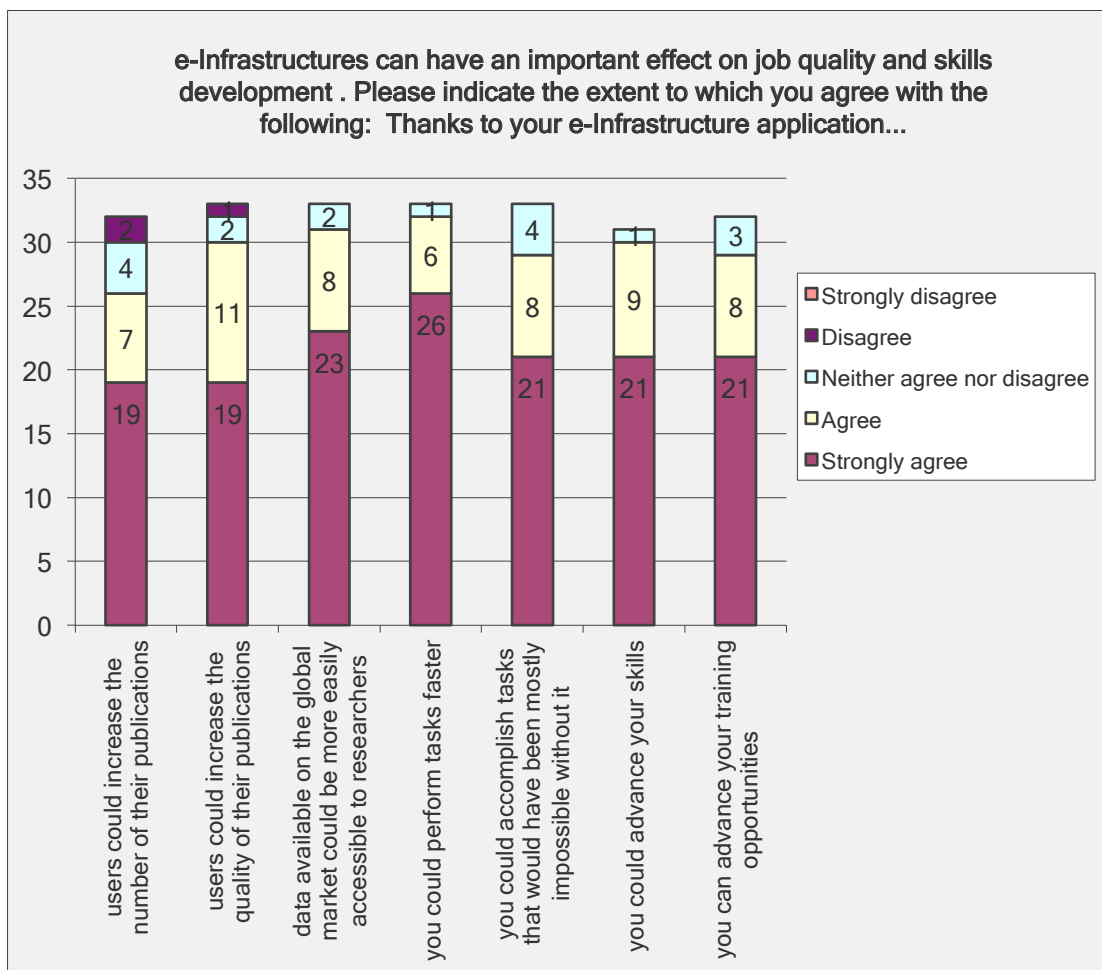


Figure 8 Jobs quality and skills development

Other reported expected impacts of the applications were allowing for the development of new management thinking and reduction of the operating costs thereby improvement of profitability. The majority of the respondents also strongly agreed that the applications could have an important effect on increasing the quality of jobs and improving skills development (Figure 8). Specifically, most of the respondents believed that with the applications one could perform tasks a lot faster (94.1%) than in the past, and could so by having more easy access to available data (91.1%) that would help accomplish tasks that were mostly impossible without (85.2%). Consequently, respondents were confident that both the number (81.2%) and quality (90.9%) of their scientific publications would increase. Advancing one’s skills (93.7%) and/or training opportunities (87.8%) were also equally embraced as expected impacts by the respondents, while other reported outcomes involved the reduction of costs and the ability to scale-up capacity building.

**4.2.1.2 SOCIAL INCLUSION AND EQUALITY TREATMENT**

When it comes to the impact of the applications to sensitive social issues such as the equal treatment and inclusion of vulnerable groups in scientific activities, respondents were mostly positive that their applications could have a positive effect. Around 69.6% indicated that the inclusion of groups at risk of discrimination (e.g. race, disability) could be supported by their applications and that they would not negatively affect any particular age groups of users (66.6%). On the contrary, respondents appeared to believe that through their applications users could get equal access to available technology (88.2%), services (90.9%) or goods (63.6%). Figure 9 below summarises these results.

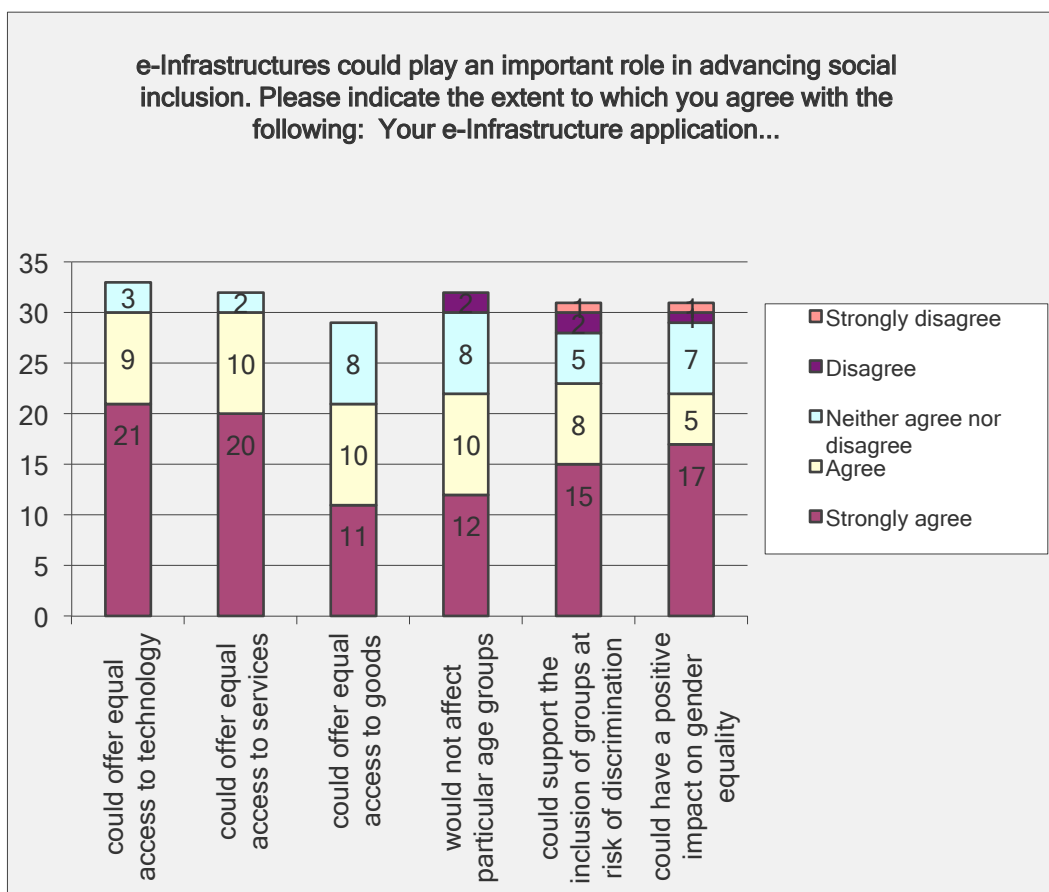


Figure 9 Social inclusion and equality treatment

#### 4.2.1.3 PUBLIC HEALTH AND SAFETY

In anticipation that the proposed e-Infrastructure applications could have an impact on African public health, respondents were asked to indicate if they believed that their applications could indirectly contribute to reducing the effects of certain environmental concerns. Responses revealed that most of the applications are not applicable (75%) or don't produce outcomes that are related to public health; however, the remaining answers indicated that the most important aspects that could benefit from these applications are the disposal of waste (15.6%) and the reduction of harmful substances (12.5%) (Figure 10).

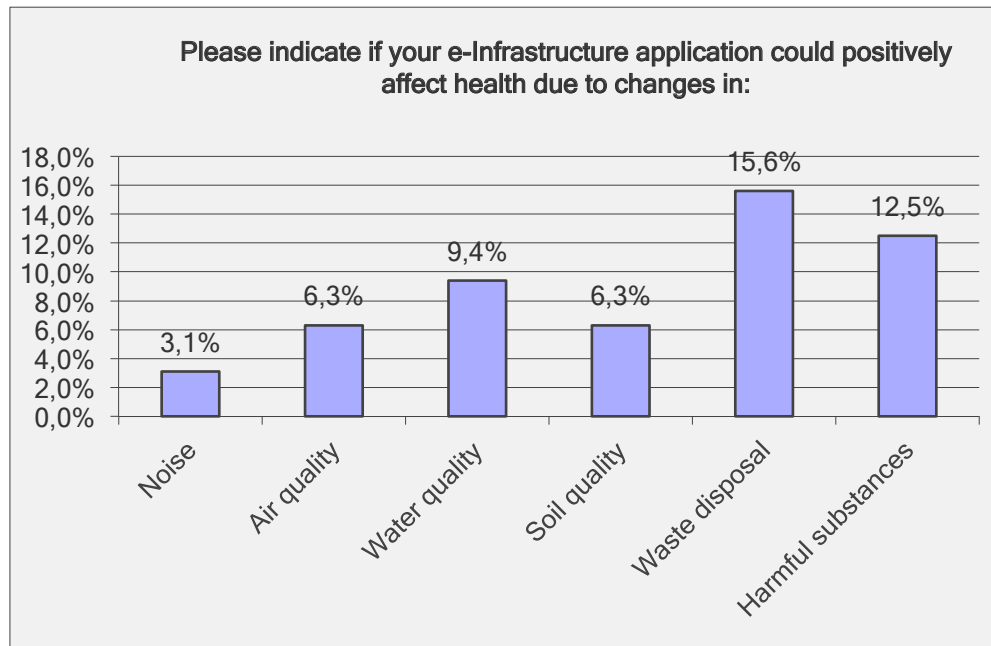


Figure 10 Public health and safety

The impact, whether direct or indirect, of the proposed applications on the safety of individuals was similarly investigated (Figure 11). Respondents were asked if they believed that any safety concerns that might exist within different settings could benefit through their applications. Similarly to the previous question, the answers revealed that most of the applications are not applicable (46.9%) or don't produce outcomes that are related to improving safety; nevertheless, it was also found that the proposed applications could help improve the safety of individuals in two important areas: in the education setting (37.5%) and the individual's natural environment (31.3%).

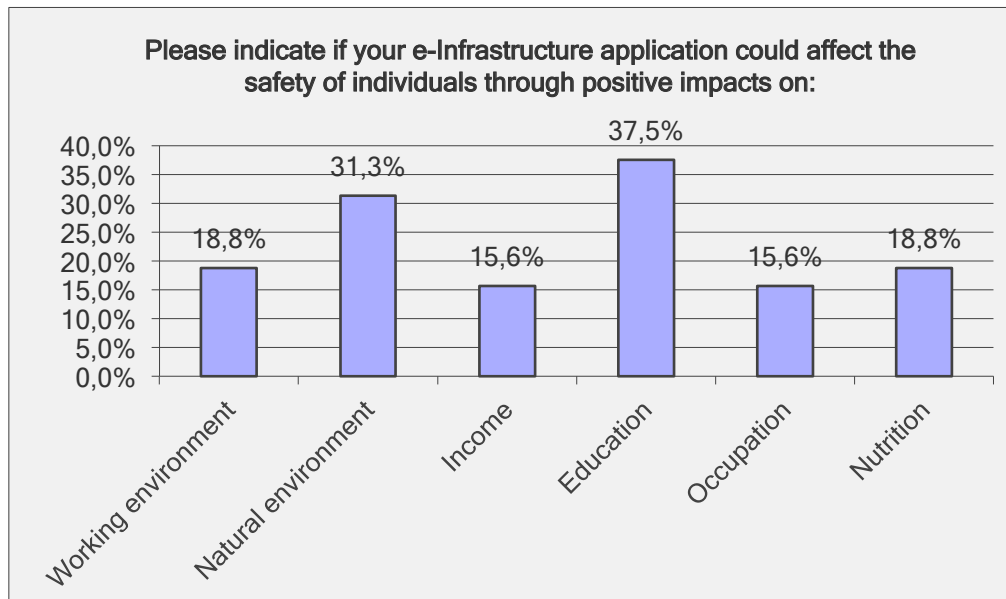


Figure 11 Safety of individuals

#### 4.2.1.4 COLLABORATIONS AND FUNDING

It is expected that investments in developing e-Infrastructures and their applications would naturally yield an increase in the number of collaborations and the ability to attract further funding. Accordingly, with this survey it was examined whether the selected 34 applications have had such an impact in Africa (Figure 12); 96.9% of the respondents indicated that the applications could allow them to expand the geographical range of their interdisciplinary activities and pursue research agendas that would not be possible without their existence (81.8%). As a result, the 90.9% naturally revealed that the applications enabled them to create new funding opportunities.

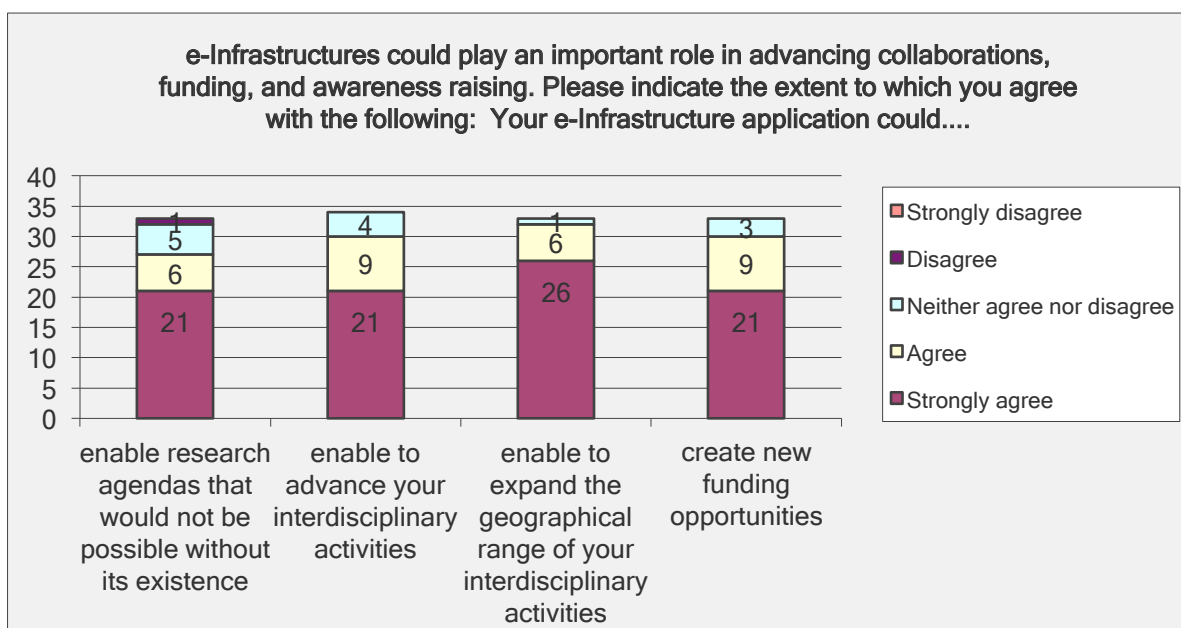


Figure 12 Collaborations, funding, and awareness raising

#### 4.2.2 Impact on society by scientific domain

As previously mentioned in section 4.1, the 34 identified applications have been broadly grouped into five scientific domains, namely Natural sciences, Life sciences, Digital resources, e-Education/e-Skills, and e-Government. In this section, we explore what is the impact of the applications by the scientific domain that they address on the different aspects of society described in section 4.2. For ease of representation, the results are presented in a tabular format and are color-coded to illustrate the significance of the impact. Table 2 below summarises the results based on the available responses.

Table 2 Impact on society by scientific domain

		Applications by scientific domain				
		Natural sciences(13)	Life sciences(8)	Digital resources(8)	e-Education/e-Skills(3)	e-Government(2)
Social aspects	Employment & Labour	High	High	High	High	High
	Social inclusion & equality treatment	High	High	High	High	High
	Public health & safety	Low	Low	Low	Low	Low
	Collaborations & funding	High	High	High	High	High

High: Strongly agree/agree; Medium: Neither agree, nor disagree; Low: Strongly disagree/disagree

#### 4.2.3 Impact on society by individual user communities

Along the same lines, the impact on the selected aspects of society was examined by taking into consideration the identified user communities that the applications target as current or potential users; for instance, what is the effect of the applications that target VRCs on collaborations and funding. As a note, a 'mixture' of users includes any of the identified user



categories plus SMEs, and decision or policy makers. The findings are summarised in Table 3 below.

Table 3 Impact on society by user community

		Applications by user community							
		Public(1)	Internal users(2)	Projects (1)	Mixture (16)	Other VRC(7)	Researchers (2)	Health providers/patients(1)	Research units/university/school(4)
Social aspects	Employment & Labour	High	High	High	High	High	High	High	High
	Social inclusion & equality treatment	High	High	Medium	High	High	High	High	High
	Public health & safety	Low	Low	High	Low	Low	Medium	Low	Medium
	Collaborations & funding	High	High	High	High	High	High	High	High

High: Strongly agree/agree; Medium: Neither agree, nor disagree; Low: Strongly disagree/disagree

#### 4.2.4 Societal benefits and areas for improvement

The overall findings of the impact analysis performed on the selected aspects of the society indicate that the 34 applications could play an important role and have a positive effect on the African society. Areas that would significantly benefit involve the creation of jobs and new services, the improvement of productivity, equal access to technology, and the increase in the collaborations and funding.

These findings are also supported by the analysis performed per scientific domain and targeted user community of the applications. As the tables in the previous two sections illustrate, all examined aspects of the society would directly or indirectly benefit from the applications irrespective of scientific domain or targeted user community; however, as it stands out, an area that would need improvement is the public health and safety, where the impact of the applications seems to be quite low and would not have any benefits. Therefore, future efforts might need to take into consideration developing e-Infrastructure applications that would similarly produce a positive impact on the health and safety of the African public.

### 4.3 Impact on the environment

This section includes the results from the analysis related to the impact of the 34 applications on the environment. The findings are presented with respect to the overall impact on the environment, the impact per application domain, and the impact per user community.

#### 4.3.1 – Overall Impact on the environment

The environmental impact of the 34 applications was similarly measured by examining the perceptions of the proposers on five basic aspects of the environment. These are summarised in the following subsections.

#### 4.3.1.1 CLIMATE AND AIR QUALITY

One of the most important effects that a technology could have in the medium-term is on climate and the quality of air. On these grounds, respondents were asked to share their beliefs on whether their applications could have such an impact on the environment (Figure 13); 53.1% indicated that their applications would not increase the emission of greenhouse gasses into the atmosphere over time, however, responses were more balanced when it comes to their capacity to reduce the emission of ozone-depleting substances. Respondents were also confident that their applications would not indirectly affect human health and lead to a deterioration in the environment through any negative impact to the climate and air quality; on the contrary, they believed that health would be improved (65.6%), while several respondents believed that crops and buildings would not be affected in any way.

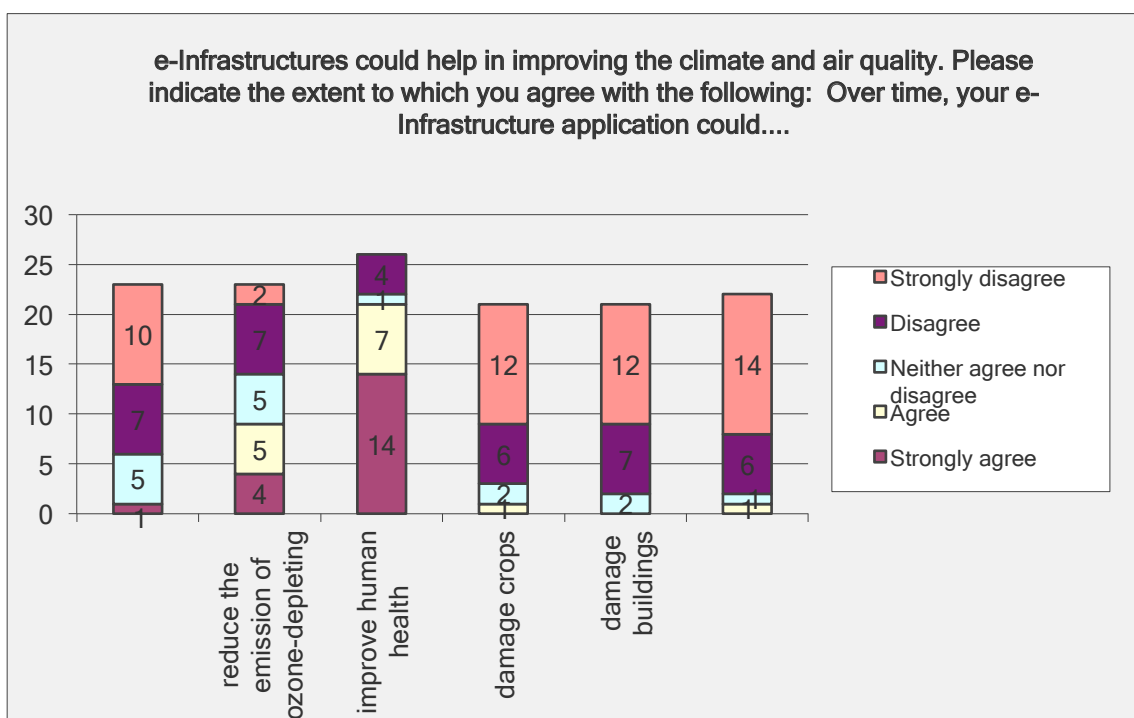


Figure 13 Climate and air quality

#### 4.3.1.2 BIODIVERSITY, WATER AND SOIL QUALITY

The impact of the applications on animals and the biodiversity over time was similarly measured as shown in Figure 14 below. The majority of the respondents indicated that their applications would not have a negative effect on animal welfare (59.3%), but they were less certain that they would be able to positively contribute to protected/endangered species (34.3%) and ecologically sensitive areas (43.7%).

When it comes to the quality of water and the availability of water resources, responses were similarly on the positive side; indicatively from Figure 15, a number of respondents reported that their applications would help increase the quality of waters both in coastal (interface areas between land and sea) and marine (areas where wildlife is protected) areas, and would play an important role in saving both freshwater (45.1%) and groundwater (48.3%) with no negative impact on their quality.

Their effect on land use was examined by trying to identify whether the applications could help bring new areas of land into use for the first time, with only 33.3% believing that their applications could have such an effect on land use. The responses for their impact on soil quality were similar with 81.3% indicating that their applications were not applicable for this matter; nevertheless, a small minority of 18.8% did mention that their applications could help with the soil erosion rates, while only 12.5% believed that they can have a positive impact both on the acidification and contamination of soil.

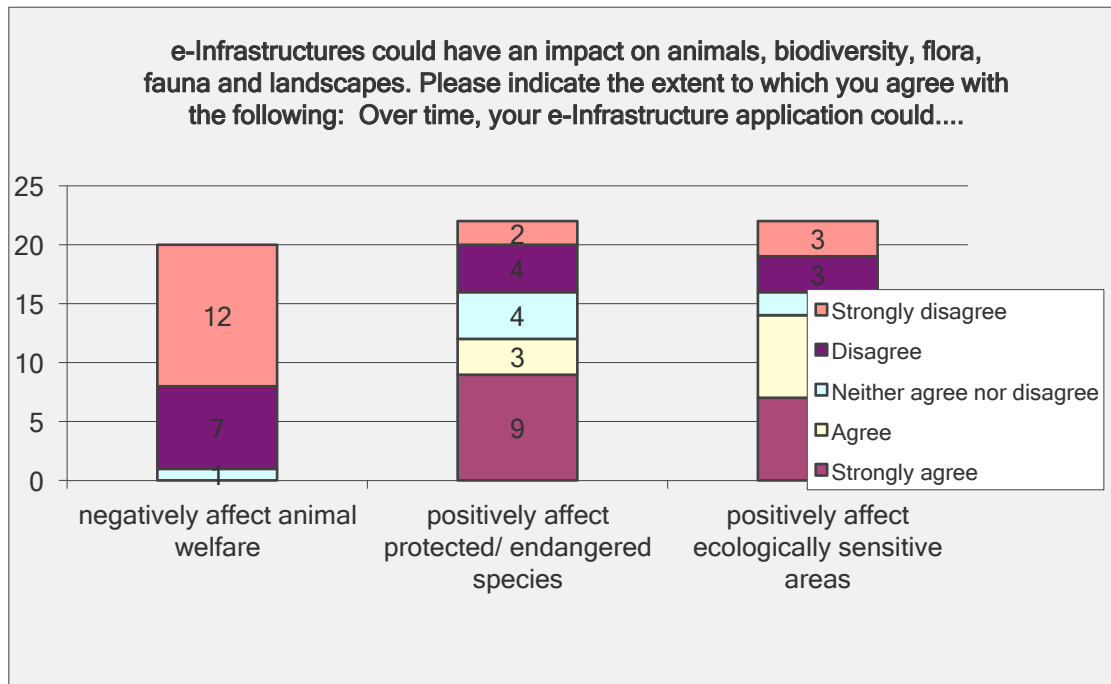


Figure 14 Animals, biodeversity, flora, fauna, and landscapes

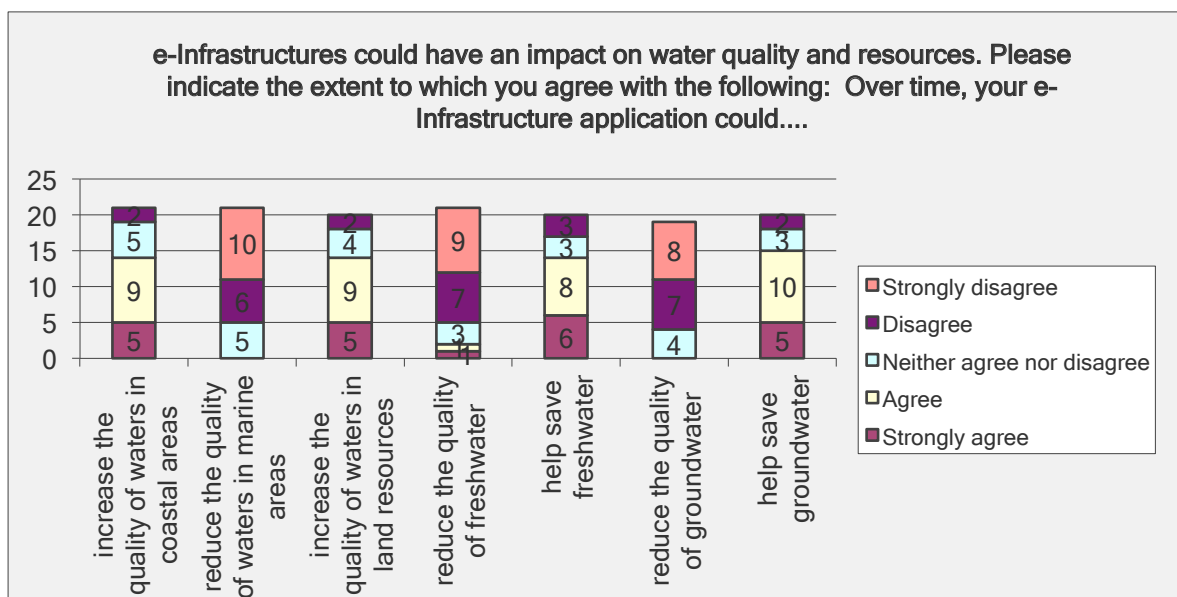


Figure 15 Water quality and resources

### 4.3.1.3 USE OF ENERGY AND RENEWABLE RESOURCES

The use of energy is without an argument one of the most important concerns in Africa. In this respect, it was imperative that respondents were called to indicate whether their applications could have a positive impact on the conservation of energy and the use of alternative resources over time. The consent in the case of the applications helping to increase the use of renewable resources was mostly positive with several respondents (46.8%) reporting that their applications could help in this respect. Similarly, some of the proposers seemed to mostly believe that over time their applications could help reduce energy consumption (46.8%); however, respondents were uncertain whether they will lead to an increase in energy needs or in the use of non-renewable resources (Figure 16). In fact, two respondents indicated that their applications would most probably increase energy needs due to the increased usage of their applications and the increase in productivity.

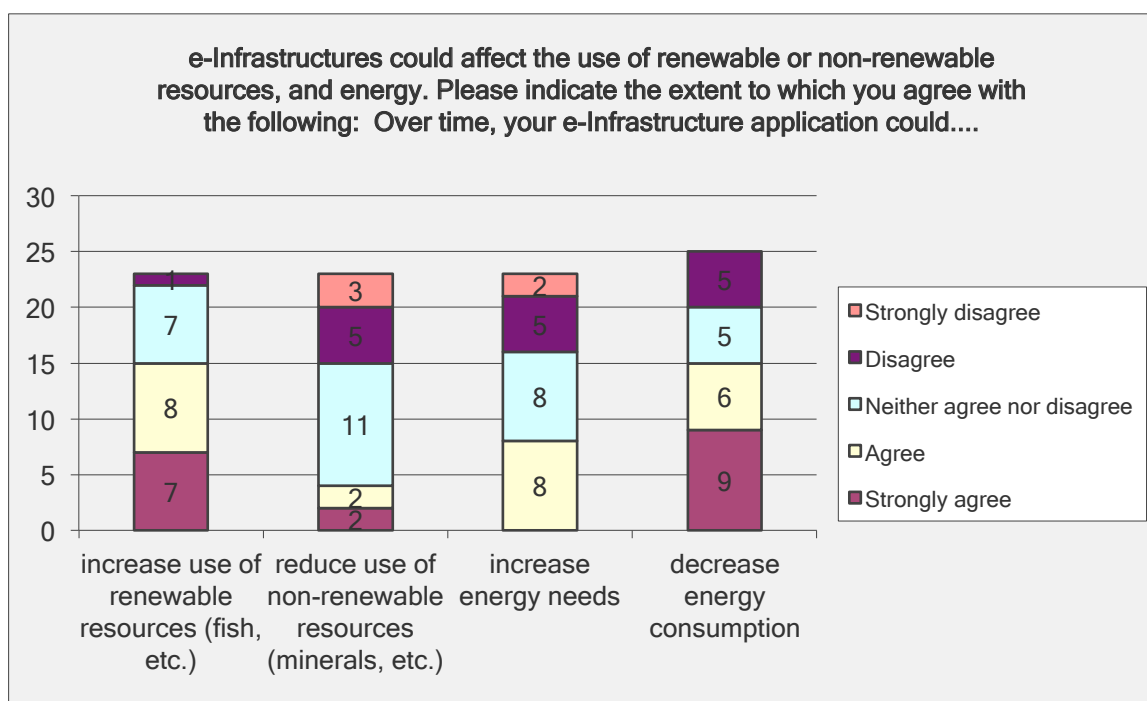


Figure 16 Renewable or non-renewable resources

### 4.3.1.4 ENVIRONMENTAL RISKS

The environmental risks associated with the use of a new technology pose an important issue for application developers and users alike. Along these lines, proposers reported that their applications not only they will not produce such risks, but they will also have a positive impact on how these are reduced over time. Such is the case of waste (industrial/household waste, toxic waste, etc.) management, which nearly half of the respondents appeared to be confident that their applications would help with in terms of their capacity to positively contribute in the efforts for waste disposal (43.8%) and recycling (40.6%).

From another point of view, several respondents indicated that their applications could further positively contribute to the prevention of environmental disasters, particularly with the prevention of droughts (37.5%) and floods (34.4%). The majority, however, seemed to believe that their applications would not have any such impact.

**4.3.1.5 ADOPTION AND USE OF GREEN IT**

The last part of the environmental impact assessment involved measuring the readiness of the proposers’ applications to adopt and use Green IT. Respondents were particularly asked to provide their input with respect to the extent to which they are aware and interested about the environmental concerns related to the use of their applications. Around 62.5% of the respondents reported that their applications was developed by taking into consideration its impact on the environment, and that they were very aware of the power consumption that they use (68.7%); however, one third of the respondents (31.2%) revealed that they were not aware of any subsequent Green House Gas emissions that their applications might create.

Being aware of the potential environmental risks, the 66.6% of the respondents reported that they are very concerned about reducing their applications’ power consumption, and more than half (53.1%) indicated that the issue of Green IT that would allow them to do so is on their applications’ radar. However, about 40% of the proposers do not think that they will have a Green IT budget allocated in the next three years, mainly due to the lack of such types of budget in their organisation (37.5%) or lack of people and expertise (28.1%).

Finally, with respect to any more environmentally effective (greener) technologies that proposers have adopted for their applications, the majority (42.2%) indicated that they have implemented a power shutdown policy, while other popular methods include the use of renewable energy sources, server consolidation, and virtualisation (Figure 17).

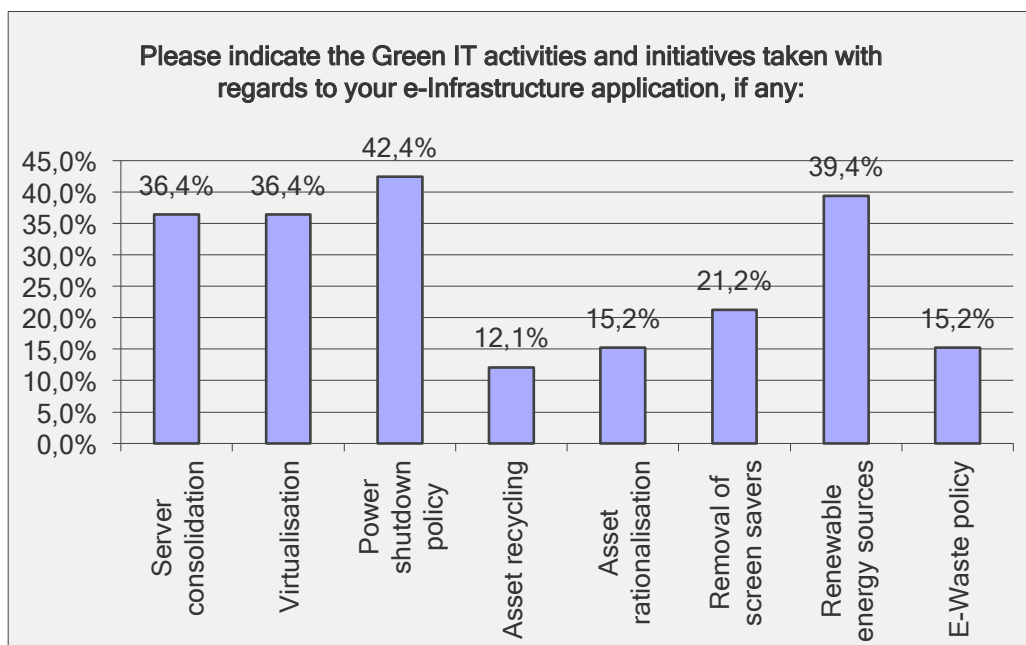


Figure 17 Green IT activities and initiatives

**4.3.2 Impact on the environment by scientific domain**

The impact of the 34 applications on the environment was also examined by taking into consideration the scientific domain they belong too. Table 4 below summarises this analysis based on the available responses.

Table 4 Impact on the environment by scientific domain

		Applications by scientific domain				
		Natural sciences(13)	Life sciences(8)	Digital resources(8)	e-Education/e-Skills(3)	e-Government(2)
Environmental aspects	Climate & air quality	High	High	High	High	Low
	Biodiversity, water & soil quality	Medium	High	High	Low	Low
	Use of energy & renewable resources	High	Medium	Medium	High	Low
	Environmental risks	Medium	Medium	Medium	Low	Medium

High: Strongly agree/agree; Medium: Neither agree, nor disagree; Low: Strongly disagree/disagree

#### 4.3.3 Impact on the environment by individual user communities

Similarly, the impact of the applications on the environment per user community that they target was explored and is presented in Table 5 below.

Table 5 Impact on the environment by user community

		Applications by user community							
		Public(1)	Internal users(2)	Projects (1)	Mixture (16)	Other VRC(7)	Researchers (2)	Health providers/patients(1)	Research units/university/school(4)
Environmental aspects	Climate & air quality	High	High	Medium	High	High	High	High	High
	Biodiversity, water & soil quality	High	Low	Medium	High	High	High	Low	High
	Use of energy & renewable resources	High	Low	Medium	Medium	High	High	Low	High
	Environmental risks	High	Low	Low	Medium	Low	Low	Low	High

High: Strongly agree/agree; Medium: Neither agree, nor disagree; Low: Strongly disagree/disagree

#### 4.3.4 Environmental benefits and areas for improvement

The findings from the impact analysis indicate that the benefits of the applications to the African environment appear to be less significant than to the society. In particular, it appears that the majority of the applications were either not addressing the environment or that they do not have any known effects on it. From the available responses, however, it was found that the remaining relevant applications were reported as environmental-friendly in terms of Greenhouse gasses emissions, and that their outputs do not negatively affect, irrespective of scientific domain or users, the welfare of the important African biodiversity.

Besides their positive impact on the African climate, air quality, and biodiversity, their contribution to the improvement of the environment was less important even from applications that directly address the Natural sciences. Future work on e-Infrastructure applications development needs to ensure that the environment would benefit from their outputs, particularly in respect of their positive effects on *reducing environmental risks and energy needs*. On the positive side, this lack of initiatives is balanced out by the reported awareness of the proposers for the need of alternative energy resources to reduce their applications power consumption, and the increasing adoption of Green IT activities.

## 4.4 Impact on the economy

This section includes the results from the analysis related to the impact of the 34 applications on the economy. The findings are presented with respect to the overall impact on the economy, the impact per application domain, and the impact per user community.

### 4.4.1 – Overall Impact on the economy

This section concludes this part of the deliverable by summarising the results of the economic impact assessment for the 34 identified e-Infrastructure applications, which are presented in the following subsections.

#### 4.4.1.1 CAN WE TALK ABOUT IMPACT IN MONETARY TERMS?

Quantifying the economic impact of the identified applications is a complex exercise and the data collected so far does not fully support such analysis. Due to the complexity of many applications and rarely foreseen internal economic factors, a precise quantification of the applications' economic efficiency and economic impact could not be produced in this deliverable. The lack of internal self-assessment methodologies is a limit that is commonly found in similar European projects, but this needs to be considered and possibly overcome in the near future. Having said that, however, this deliverable does provide a preliminary, qualitative description of direct and indirect economic impact on four different economic aspects that are discussed next.

#### 4.4.1.2 INTERNAL MARKET AND COMPETITION

The impact of the applications on the internal market was examined by asking respondents to share their perceptions on how their applications could affect the functioning of the above economic aspect. The most important impact that the applications could have on the internal market was reported to be the better facilitation of the free movement of services (81.8%). Other less popular responses included the free movement of goods, capital or workers with which respondents appeared to mostly agree, but with a bit more scepticism (Figure 18). Finally, one respondent indicated that his/her application could also allow for the free movement of data.

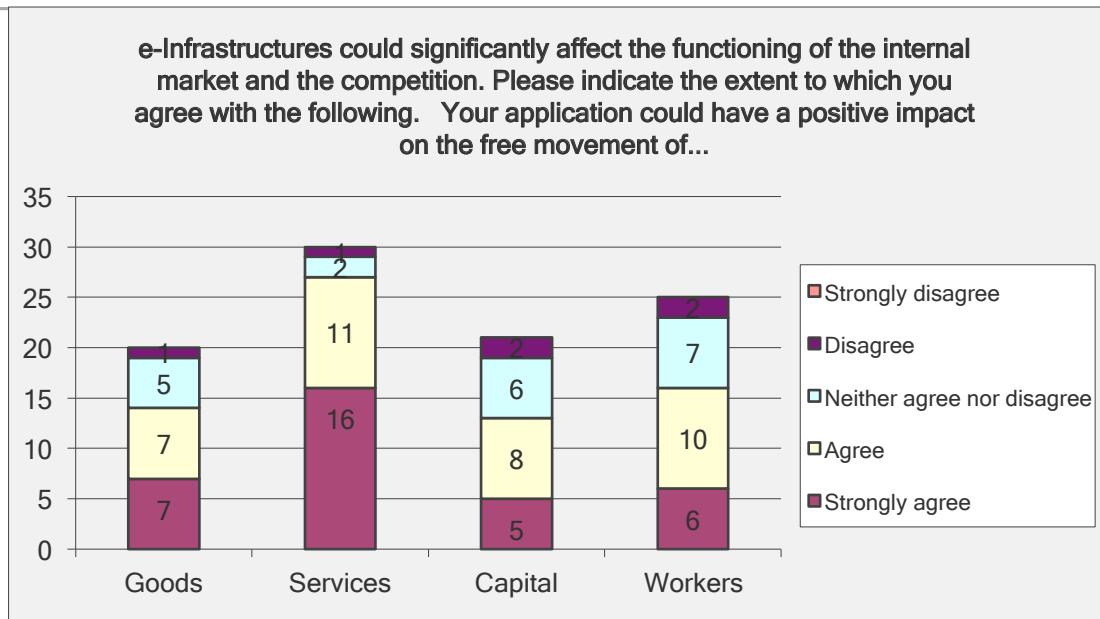


Figure 18 Internal market and competition

Perceptions about the effect of the applications on competition were also generally very good. The majority of the respondents believed that their applications don't or would not have any negative impact on aspects of market competition; specifically, Figure 19 shows that respondents strongly disagreed that their applications could potentially lead to higher prices, the emergence of monopolies or a reduction to user choice (ranged between 62.5% - 71.9%). On the contrary, a very small number of respondents (12.5%) seemed to believe that their applications could facilitate anti-competitive behaviour, while one respondent indicated that investment could similarly be enabled. Consequently, the general attitude appeared to be that the applications would have a positive impact on the global competitive position of African organisations (82.3%) and that cross-border investment flows could be better provoked (66.6%) as a result.

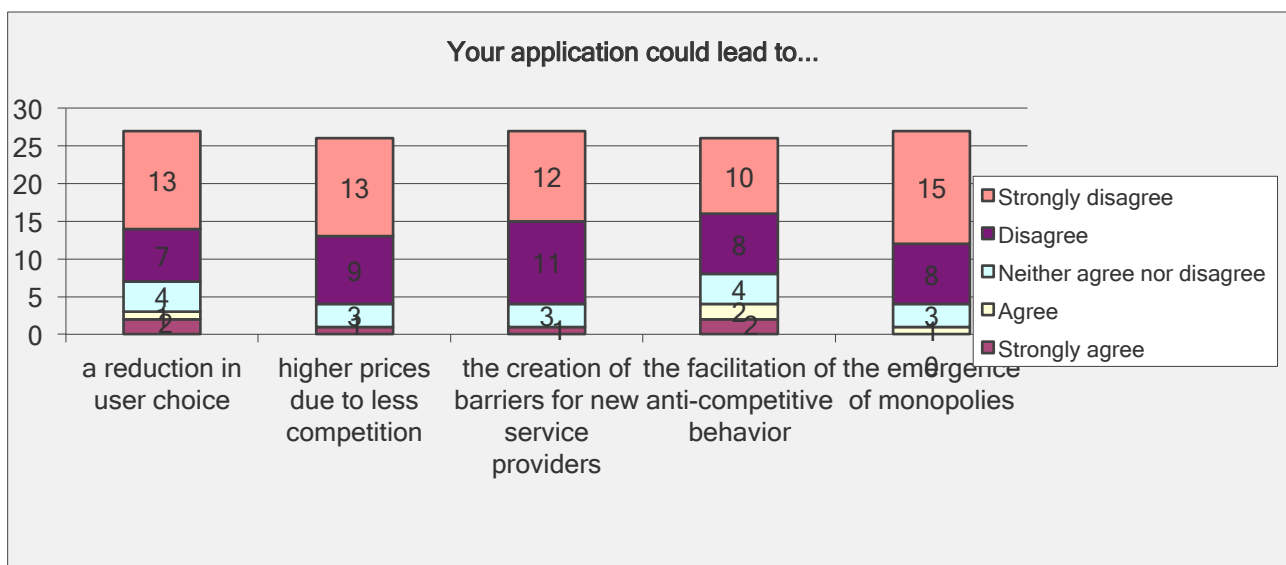


Figure 19 Competition and prices



#### 4.4.1.3 OPERATING COSTS AND CONDUCT OF BUSINESS

When it comes to the way that business (used as a generic term to represent different activities) is conducted, the consensus showed that it is expected that the applications would not negatively affect their organisation’s/institution’s operating costs or the resources that they require to carry out their activities. Respondents appeared to mostly disagree with the possibility that the applications could impose additional transaction costs (51.5%), even though a small number of respondents (n=8) were still a bit sceptical about it, while about 66.6% similarly disagreed that costs related to essential resources that are typically needed would increase (Figure 20).

The administrative activities of their organisation/institution would similarly not be affected according to the respondents, as 94.1% agree that the nature of information required (e.g. type of data, complexity of submission process) would instead benefit from their applications. Similarly, it was also agreed that the applications and their outcomes would not have any negative effects on any existing intellectual property rights (patents, trademarks, copyrights) (84.8%).

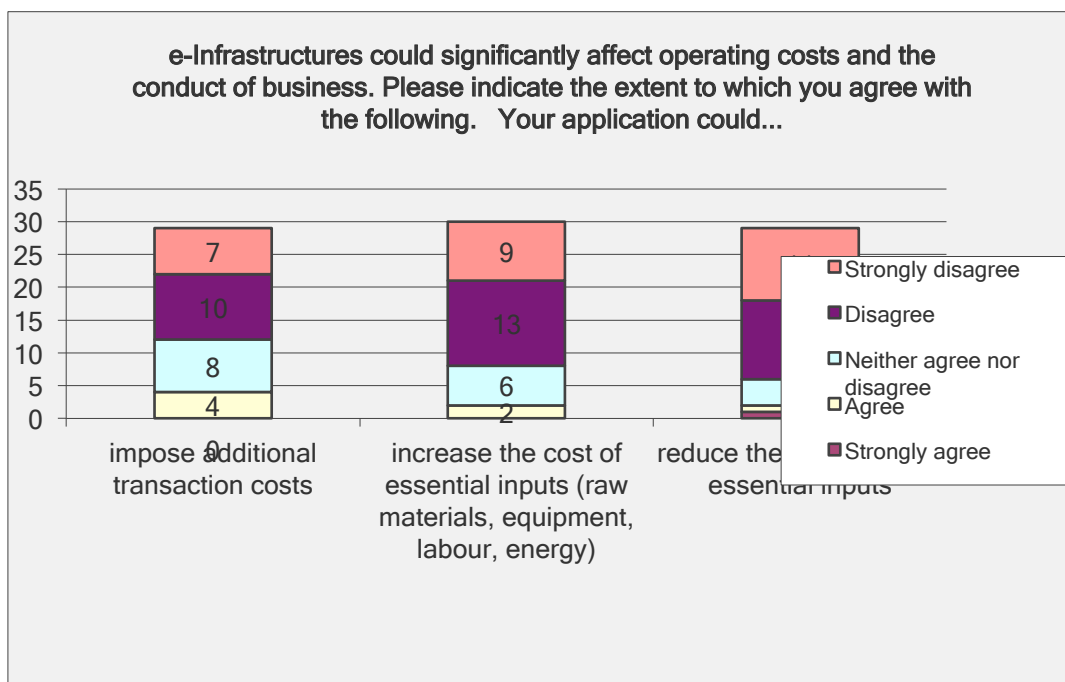


Figure 20 Operating costs and conduct of business

#### 4.4.1.4 GOVERNMENT AND PUBLIC AUTHORITIES

The relationship between the 34 applications and the government was also investigated by means of trying to identify whether the development or current use of the former could have any effect on public authorities. Accordingly, respondents were asked to indicate if they believed that their applications would bring any additional administrative burden to a government, with the majority (57.5%) disagreeing that this would be the case. Creating new public authorities as an indirect output of their applications was similarly not thought to be necessary (60.6%); however, an interesting finding was that respondents appeared to be not certain whether existing public authorities could be responsive to their needs, as indicated by their responses shown in Figure 21.

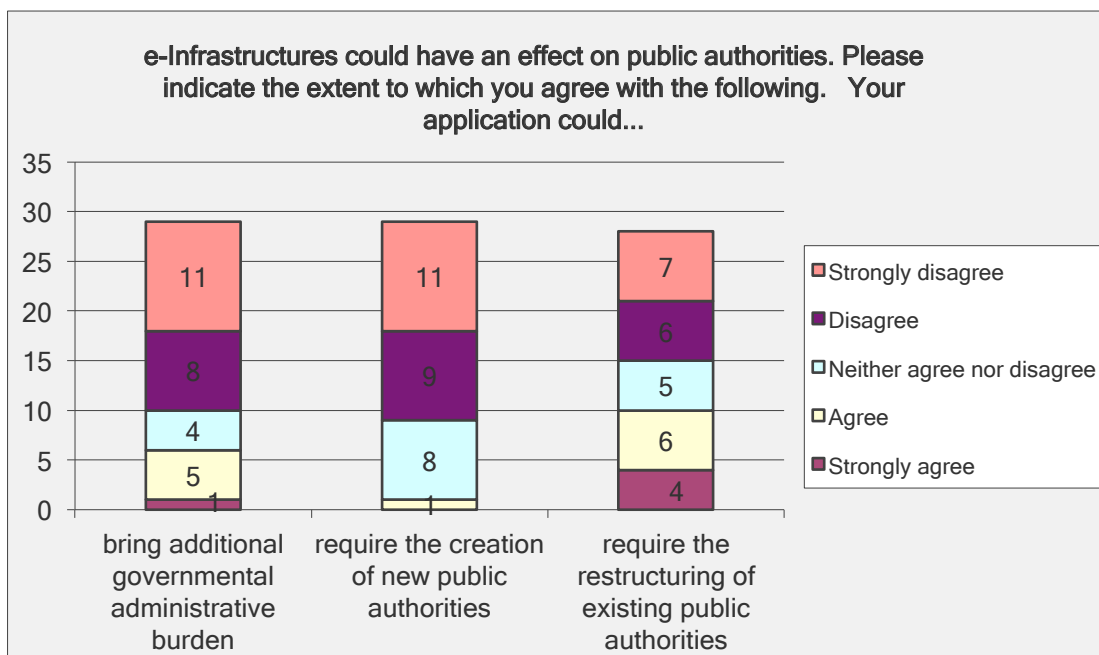


Figure 21 Government and public authorities

#### 4.4.1.5 INDIVIDUAL USERS AND MACROECONOMICS

Finally, the answers received with respect to the impact that the applications could have on the economic situation of individual users appeared to be quite positive, as (A) prices that users normally pay to get access to services would not increase (78.7%) and (B) the overall financial situation of users would not be negatively affected (81.8%), as a direct or indirect outcome of their applications. Overall, when looking at the impact of the 34 applications on the Macroeconomic level (i.e. the conditions that exist in the economy as a whole), respondents seemed to believe that their applications could have a positive effect both on the option for economic growth (61.3%) and the option for employment (54.8%), while at the same time they can positively contribute in the efforts for macroeconomic stabilization (54.8%) (Figure 22).

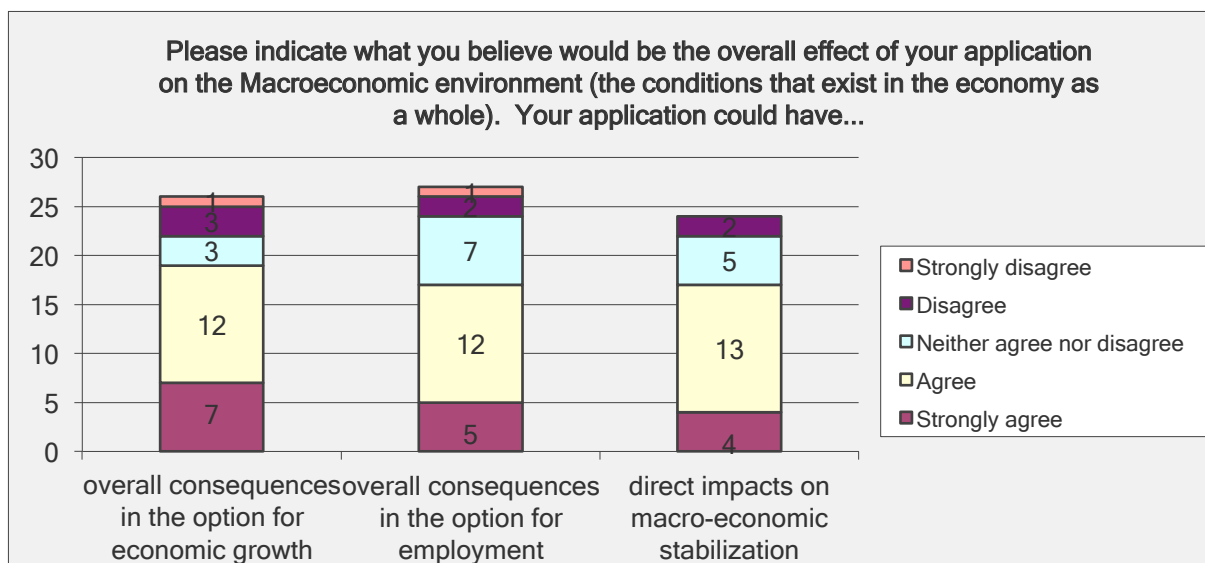


Figure 22 Macroeconomic environment

#### 4.4.2 Impact on the economy by scientific domain

The impact of the 34 applications on the economy in accordance to the scientific domain they belong to was similarly examined and is presented in Table 6 below.

Table 6 Impact on the economy by scientific domain

		Applications by scientific domain				
		Natural sciences(13)	Life sciences(8)	Digital resources(8)	e-Education/ e-Skills(3)	e-Government(2)
Economic aspects	Internal market & competition	High	High	High	High	High
	Operating costs & conduct of business	High	High	High	High	High
	Government & public authorities	High	High	Low	High	High
	Individual users & Macroeconomics	High	High	High	High	High

High: Strongly agree/agree; Medium: Neither agree, nor disagree; Low: Strongly disagree/disagree

#### 4.4.3 Impact on the economy by individual user communities

Accordingly, the impact of the applications per user community that they target was explored for the economic aspects shown in Table 7.

Table 7 Impact on the economy by user community

		Applications by user community							
		Public(1)	Internal users(2)	Projects (1)	Mixture (16)	Other VRC(7)	Researchers (2)	Health providers/ patients(1)	Research units/ university/ school(4)
Economic aspects	Internal market & competition	High	High	High	High	High	High	Medium	High
	Operating costs & conduct of business	Medium	High	Low	High	High	High	High	High
	Government & public authorities	Low	High	Low	High	High	High	Medium	High
	Individual user & Macroeconomics	High	High	Medium	High	High	High	Medium	High

High: Strongly agree/agree; Medium: Neither agree, nor disagree; Low: Strongly disagree/disagree

#### **4.4.4 Economic benefits and areas for improvement**

The overall picture that was produced from the analysis of the economic impact of the 34 applications shows that they appear to have generally good benefits to the African economy. Reportedly, the economy would benefit from these applications with respect to the increase in the free movement of services, the advancement in the competitive position of African organisations, and the overall economic growth in Africa. Not surprisingly, the applications within the e-Government domain have both a good impact on the economy; however, the application that directly addresses public users seems to need improvements in the ways it is operated and the role of the government in this.

Accordingly, the findings indicate that the area in need of most improvement concerns the nature of interaction and relationship between their applications with the local government and public authorities. This is particularly the case with the applications addressing the digitisation of resources and the application for health providers or patients. It seems rather imperative then that future e-Infrastructure application developers need to consider how to work together with local governments in order to maximise the operation and economic benefits of their applications.

#### **4.5 Comparison to previous work on e-Infrastructure impact assessment**

The projects presented in Section 2.3 are amongst the most prevalent initiatives in examining the impact of e-Infrastructures in the European level. These dealt with distinctive aspects of either direct or indirect impacts of e-Infrastructures, notably the evaluation of running costs (e.g. e-FISCAL), monitoring their usage (e.g. eNVENTORY), or examining their performance (e.g. ERINA+), which is also the most relevant aspect to this deliverable. As previously stated, eI4Africa does not seek to either develop a methodology or carry out an extensive impact assessment; rather, the aim is to use the experiences, knowledge, and outputs from previous well-established work in Europe, in order to similarly examine the performance, in terms of benefits and impact, of the identified 34 applications of e-Infrastructures in the African society. The goal is to identify whether their impact in Africa is similar to what has previously been reported in Europe, and further contribute to the available knowledge base with our experiences from African e-Infrastructure developments.

Our findings related to the impact of e-Infrastructure projects in the African society appear to be consistent with the findings reported by ERINA+ (in D3.1 'e-Infrastructures & Projects' Assessment<sup>9</sup>) for their counterparts in Europe. The answers show that Africans similarly appreciate the ability of e-Infrastructures to enable them to perform tasks and achieve results faster, to improve and support cross-border collaboration, and improve the quality of their work. As in Europe, there are economic benefits resulting from these developments in Africa that are seen as an indirect positive impact of e-Infrastructures.

The impact assessment findings in this deliverable also support the conclusions from a similar study carried out by Ri-Impact (see T. Leimbach & B. Engelstaetter - Presentation of Study results<sup>10</sup>). Their reported findings revealed that e-Infrastructures in Europe have made it possible to increase the quality of science while obtaining more accurate and faster results, which can have a positive impact on productivity and economic growth. Other reported results include the increase in employment opportunities through a demand for more skilled personnel, as well as an improvement in cross-country collaborations and relationship with

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<sup>9</sup> [http://erina.res.eng.it/index.php/documents/cat\\_view/2-public](http://erina.res.eng.it/index.php/documents/cat_view/2-public)

<sup>10</sup> <http://www.ri-impact.eu/ri-impact/content/documents.php>

third countries. The above findings also appear to be in line with the socio-economic impact assessment carried out in Africa within this deliverable.

The RI-FI project and its final product the FenRIAM tool identified a number of socio-economic impacts of research infrastructures<sup>11</sup> (including e-Infrastructures) in a European level that our findings in Africa also seem to be consistent with. The revealed benefits of research infrastructures supported by our results include the creation of new knowledge and skills (in terms of scientific papers), improvement in services and facilitation of new jobs, as well as advancement of training opportunities. Further to the socio-economic benefits, RI-FI was the only project out of the aforementioned that also examined the environmental benefits of research infrastructures; areas of impact involved energy, water, waste and biodiversity in line with our reported findings.

Finally, no comparison can be performed between the findings presented in this deliverable and e-FISCAL, iMENTORS, and eNVENTORY, as they're mainly focused on the economic assessment of e-Infrastructures or on producing e-Infrastructures Observatories that would serve as a data warehouses storing the state-of-the-art of e-Infrastructures, respectively. Accordingly, a comparison would be out of the scope of this deliverable.

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<sup>11</sup> <http://www.fenriam.eu/overview.html>

## 5 – Part D: Recommendations to e-Infrastructure developers in Africa

In the previous section, this deliverable presented the findings from the analysis of the socio-economic and environmental impact related to the adoption of e-Infrastructure applications in Africa. As a result of this activity, the el4Africa consortium now brings forward a set of recommendations to fully realise the identified potentials. These recommendations are presented in the following four subsections.

### 5.1 Why should Africa join forces?

The benefits of e-Infrastructures to researchers and the improvement to the ways scientific research is carried out are well known. While in Europe the investment in e-Infrastructures has been mainly led by advances in technology and by scientists involved in such activities, in Africa relevant initiatives are mostly focused on the benefits that such advancements and investments could have in the society as a whole, as well as on their direct impact on the population (i.e. Health services and education). In other words, e-Infrastructure development in Africa needs applications that will produce a direct impact in the countries' socio-economic value, and will prove to policy makers that it is worth supporting and sustaining the investment.

So, why should African countries invest in developing e-Infrastructures in Africa? The EC's 2007 Green Paper "The European Research Area: New Perspectives"<sup>12</sup> points out that investing in an e-Infrastructure application can have significant benefits to a country, as it can enable the long-term sustainability of e-Infrastructures, as well as facilitate both industry involvement and the added-value to society that comes with the technology mix, the diversity of users and the local economic and social conditions. On the international level, the EC suggests that such investments will additionally help respond to the increased complexity of science, will multiply the opportunities for the commercial sector, will increase the scientific and industrial cooperation, and finally will help reduce any technological constraints.

### 5.2 A 5-step approach to developing an e-Infrastructure application

Developing an e-Infrastructure application not only adds to the scientific activities of a VRC, but it also improves the value and outreach of the VRC itself. It is imperative, therefore, that an application developer complies with previously successful strategies in developing an application, in order to ensure that it will have the maximum benefit to the community it addresses. The diversity of e-Infrastructures and their applications suggests the existence of a variety of development approaches that a developer could choose from; however, although the methodologies of implementing an application may vary, in most cases they tend to follow the traditional *systems development life cycle (SDLC)* (Satzinger et al. 2005), which involves five key stages in the design and development of a system: problem identification and planning, analysis and requirements definition, system design, implementation and testing, and deployment and maintenance.

Accordingly, through the various project activities and experiences, the el4Africa team has identified a number of trends, success factors and barriers to the implementation of e-Infrastructure applications that have been put together as a set of development guidelines.

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<sup>12</sup> [http://ec.europa.eu/research/era/pdf/era\\_gp\\_final\\_en.pdf](http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf)

These guidelines are brought forward as an empirical 5-step approach needed to develop a typical e-Infrastructure application, which is presented next.

### **STEP 1: AWARENESS-RAISING, VRCs IDENTIFICATION AND PLANNING**

e-Infrastructure applications are typically developed to enable scientific activities that were previously hampered by the lack of resources. Their design, therefore, must be produced in consultation with VRCs that will potentially take full advantage of their benefits. Raising awareness is one of the most common and cost-effective approaches to identifying and contacting those African VRCs that are interested in the advantages that an e-Infrastructure application has to offer to their members. The eI4Africa project through a series of four thematic workshops in Africa and the team's extensive list of contacts has succeeded in identifying a number of VRCs whose needs have been translated into e-Infrastructure applications hosted on the Africa Grid Science Gateway<sup>13</sup>. Similar and other relative activities need to be considered from African developers in order to raise awareness and engage VRCs in the development of an application. The main output of this step is a *commitment to develop a specific application and the identification of the interested VRC members*.

### **STEP 2: ANALYSIS AND REQUIREMENTS DEFINITION**

Once the application has been decided upon, the developer and the VRCs need to carefully analyse the application and define its requirements by employing the most appropriate methods, in order to ensure that it will have the needed functionality that would meet the requirements of a VRC and its members. The types of information that have been empirically identified as necessary to obtain from a VRC include:

- information related to the aim and rationale of the application;
- the various application modules needed to process and manage the functionalities;
- specific software and/or hardware required by the application to run;
- challenges for the implementation, if any

The information gathered from Step 2 will be fed to the next step where the underlying architecture of the application will be created. The output of this step is a living **plan document** that includes the application use case and its requirements.

### **STEP 3: USE CASE DESIGN**

The use case plan document is a plan that will be used to organise and design the underlying architecture of the application. The plan will help the developer to specify the user interface and the functionalities it will support, preferably down to the level of specific menus, submenus or webpages, and their content. Various software can be used to support the creation of an architecture, such as Microsoft Visio. The output of this activity is an **application design schema** similar to the one that the eI4Africa team has prepared for the Pharmacology Science Gateway (PSG) shown in Figure 22 below.

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<sup>13</sup> <http://sgw.africa-grid.org>



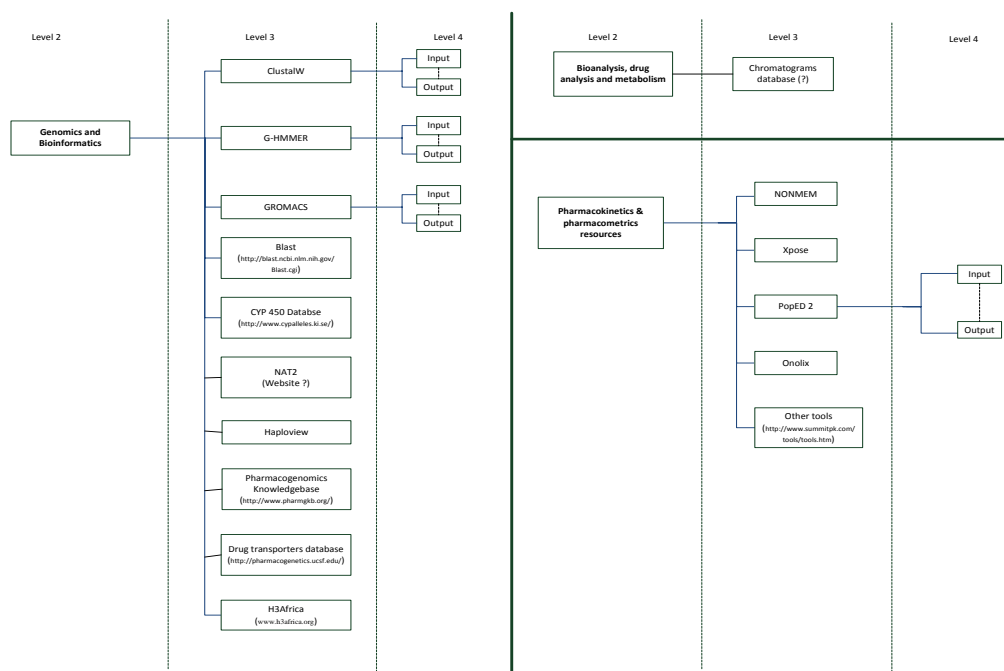


Figure 22 The PSG application design schema

#### STEP 4: APPLICATION DEVELOPMENT AND DEPLOYMENT

Developing the application includes transforming the application design schema into the end product. This step involves developing the different modules and functionalities that have been identified in the plan document and illustrated in the design schema, getting the application up and running on the e.g. Africa Grid Science Gateway or any other selected Science Gateway that could be developed to host the application and assist the VRC under consideration, and deciding on the network and hardware environments. One of the challenging steps in developing an application is connecting it to other available resources (e.g. Data Repositories, other applications) that could provide some of the required software as a free download. Once the application is developed, then it can be made available to the VRC and its members to test and use.

#### STEP 5: CAPACITY BUILDING AND APPLICATION MAINTENANCE

To ensure continuous and seamless usage, the application needs to be regularly maintained and updated to include, for example, new software that could be added to the available list or additional resources for the VRC members. In doing so, collaboration with the local NRENs is critical. Under the United Nations Development Programme 2008–2013 "Strategic plan for development"<sup>14</sup>, one of the most fundamental concepts is the idea of building the capacities of institutions in developing countries so they are able to independently contribute to development. According to the aforementioned plan, maintaining and improving an e-Infrastructure application in Africa should be a two-sided effort: (A) NRENs need to ensure that they engage into systematic capacity building activities to encourage participation by all those involved, support the outcome and sustainability of a development, and most importantly, bring in Cloud or Distributed Infrastructures to feed all development activities, and (B) developers and their institutions need to engage with NRENs to ensure the sustainability of their development, and allow them to see what areas are in need of additional skills development and support, what areas need to be prioritised, and in what ways capacity building could be incorporated into their development strategies.

<sup>14</sup> <http://www.gdrc.org/uem/undp-cb.html>



### 5.3 Collaboration opportunities for VRC development

It is widely known that e-Infrastructures change the way research is conducted, overcoming distance to support a growing multitude of VRCs across the globe<sup>15</sup>. Encouraging European and African communities of practice, therefore, to collaborate e.g. by working on proposals, can help these communities of practice to engage to collaborative research, as well as help build e-Infrastructure applications that could support the growth of scientific research and knowledge in African countries. The results of the impact assessment provided in the previous section demonstrate these opportunities for growth, as 96.9% of the respondents indicated that the applications could allow them to expand the geographical range of their interdisciplinary activities and pursue research agendas that would not be possible without their existence, as well as enable them to create new funding opportunities.

In support of this, the eI4Africa team has been building an online virtual “**Project Wall**” that will be made available on the project’s website and will be used to showcase the identified 34 e-Infrastructure applications to the broad community giving an insight into the current trends and development of e-Infrastructures in Africa. More information can be found in D6.3 ‘*Establishment of e-Infrastructure Services and Identification of e-Infrastructure Priorities – Final Report*’.

### 5.4 Recommendations to consider

The eI4Africa project has identified a promising potential for future developments in Africa through the 34 current or planned e-Infrastructure applications and their impact assessment. To fully release their potential, eI4Africa addresses the following four recommendations that have emerged from our experiences:

1. One of the most important elements in need of development is to identify and sustain dissemination activities in order to both communicate and promote the potential of e-Infrastructures in Africa. Our series of the four thematic workshops revealed that the audience was not fully aware of e-Infrastructures and the opportunities that they could offer for collaboration, funding, and sharing of expertise. An important action would therefore be to reach out to relevant communities of practice, funders, and stakeholders both in a national and an international level, and help them engage into collaboration activities with an aim to support social and economic growth;
2. The lack of awareness, knowledge, skills, and expertise in available technologies and best practices would need to be addressed through continuous and consistent programmes on skills and capacity building. The benefits of such initiatives would include more researchers and/or scientists becoming skilled in available instruments and resources, as well as facilitate independent and more effective research;
3. As the UbuntuNet network increasingly unrolls and improves connectivity in Africa, it is imperative that e-Infrastructure planning and development activities similarly accelerate to become readily available. In support of this, the 34 applications identified by eI4Africa can serve as ‘Lighthouse demonstrators’ of current or planned activities in the region, which will be used to showcase the impact and benefits of e-Infrastructures in the African society;
4. Finally, it would be extremely beneficial to fully utilise the European know-how and experiences in the e-Infrastructure domain (e.g. the EGI Applications Database) in order to advance developments in Africa. It is imperative, therefore, that European and

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<sup>15</sup> [www.eresearch2020.eu/eResearch%20Brochure%20EN.pdf](http://www.eresearch2020.eu/eResearch%20Brochure%20EN.pdf)

African communities of practice collaborate, similar to the twinning between established and emerging NREs organised by TERENA<sup>16</sup>. It was noted that in many cases African communities were not aware of the funding programmes (e.g. H2020) and collaboration opportunities that exist, receiving as a result a significant number of enquiries related to how to collaborate and apply through our thematic workshops.

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<sup>16</sup> <http://www.terena.org/>

## 6 – Conclusions

Communities of Practice across the globe collaborate and engage in scientific research by establishing VRCs and utilising the benefits of e-Infrastructures. For years, due to the lack of terrestrial infrastructure and a strong dependency on expensive narrowband satellite links, Africa has been behind in the development of such research networks.

Nowadays however, things have been rapidly changing and African researchers can have similar opportunities as their counterparts in other parts of the world. In this context, the eI4Africa project has studied the current or expected socio-economic and environmental impact of the adoption of e-Infrastructures in Africa with an aim to help both developers and decision makers alike understand the potential and benefits of adopting and investing in e-Infrastructures in Africa. The impact assessment was performed on 34 current or planned e-Infrastructure applications that the project identified by applying a methodology that was adapted by previous work and the EC's guidelines.

This deliverable presented the results from this activity and highlighted a number of benefits and areas of potential improvement. Amongst the most important findings were the opportunity offered by the e-Infrastructure applications to reach out to a larger number of users/beneficiaries and collaborators, to improve and even create new services and jobs, to lower costs, to advance the competitive position of African organisations, and to contribute to the overall economic growth in Africa. The analysed applications addressed important and various fields of research, demonstrating how e-Infrastructures can be an important enabler of innovation and sustainable growth; accordingly, our findings also suggested that future efforts need to ensure that they will have a similar positive impact on the health and safety of the African public and on reducing environmental risks and energy needs.

Finally, on the basis of the analysis and findings described in this deliverable, a set of recommendations for the development of e-Infrastructure applications was brought forward addressing mainly developers, but also the EC and member states, involved in the development of e-Infrastructures in Africa. These include the value added to African developers and their countries from participating in the development of such applications, an empirical 5-step approach to developing an e-Infrastructure application, and encouraging collaboration opportunities in order to facilitate the creation of sustainable VRCs.

Conclusively, the 34 applications that were analysed within this deliverable demonstrate an interesting socio-technical approach, in which an e-Infrastructure is not interpreted as an end-goal, but as an instrument for carrying out effective research targeting various aspects of society. Support is therefore needed next, in order to transfer to African developers the best-available knowhow and practices within the e-Infrastructure domain.

The findings presented in this deliverable are by no means exhaustive and are limited to the identified e-Infrastructure projects and their users/proposers; it is however, to the best of our knowledge, the first ever attempt to carry out an impact assessment of e-Infrastructure projects in Africa, and its findings could be useful in future similar endeavours.

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## Appendix A

<b>1. Mobile tele-psychiatry platform</b>	
Affiliation	The West African Health Informatics Fellowship Program
Country	Ghana
Purpose/problem	Improve healthcare delivery and/or education
Brief description	A Cloud-based OpenMRS/Open-Data-Kit/DHIS2 mobile tele-psychiatry platform that consists of an OpenMRS server on an AWS cloud with the DHIS2 installed. OpenMRS is an open-source Electronic Healthcare Record System. This clinical database is remotely accessible by any browser-enabled device PCs, laptops, mobile phones etc. Open-Data-Kit is an Android-based mobile application used to remotely access the clinical database from anywhere around the globe.
Resources needed	Medical scanners, Remote mobile cardiac monitoring, Remote video capture; Processors: Intel Xeon 5500 and 5600 series Quad and Six-Core, Memory: 8GB/16GB 1333MHz DDR3, c. Storage: Maximum Internal Storage: 1.2TB; RAID Controller, d.10Gb Ethernet: Dual-Port Intel 10Gb Enhanced Ethernet
e-Infrastructure benefits	It will be used on all continents by: 1. Mental health professionals in Ghana for community mental healthcare delivery (less than 10 psychiatrists for a population of 24million), 2. The large number of Ghanaian Diaspora mental health workers (about 50 psychiatrists) mostly based in the UK, Canada, USA, 3. Post-graduate training programs by the Ghana College of Physicians & Surgeons for training in rural psychiatry, 4. Mental health training charities based in the UK, but pay regular visits to medical schools and nursing colleges in Ghana will like to use the platform to provide mentorship and support for students from abroad.

<b>2. Integrated Virtual Private Network (IVPN) for manufacturing applications</b>	
Affiliation	Engineering Materials Development Institute (& NASENI)
Country	Nigeria
Purpose/problem	Access to resources for research and development
Brief description	A Network that would link all Advanced Manufacturing Technology Centres (AMTCs) in NASENI Institutes to the High Power Computing (HPC) laboratory at the headquarters to enhance capacity development in AMT, as well as making accessibility to other manufacturing facilities possible online. There will be integration of the various centres for the purpose of design, modelling, simulation and production of engineering components using highly specialized facilities that are located in its development institutes across Nigeria. It is also providing online access to research communities, SMEs, industrialists and university community.
Resources needed	Requires large storage and remote monitoring
e-Infrastructure benefits	It will enhance capacity development in AMT, as well as make accessibility to other manufacturing facilities possible online. There will be integration of the various centres for the purpose of design, modelling, simulation and production of engineering components using highly specialized facilities that are located in its development institutes across Nigeria. It is also providing online access to research communities, SMEs, industrialists and the university community.

<b>3. Nano Archive</b>	
Affiliation	University of Strathclyde
Country	Scotland
Purpose/problem	Access to resources for research and development
Brief description	Part of the ICPCNanoNet FP7 project, it is an online repository of open-access research papers that aims to provide wider access to published nano-science research and opportunities for collaboration between scientists in the EU and the International Cooperation Partner Countries (list of African partner countries available on <a href="ftp://ftp.cordis.europa.eu/pub/fp7/docs/icpc-list.pdf">ftp://ftp.cordis.europa.eu/pub/fp7/docs/icpc-list.pdf</a> ). This electronic archive of nanoscience publications has a simple interface for the deposit of full-text papers and incorporates facilities for retrieval by browsing or searching. It is freely

	accessible to researchers around the globe, making research papers and other scholarly publications widely available.
Resources needed	2 Mbps minimum broadband
e-Infrastructure benefits	It addresses difficulties in accessing nano-related research and publications, especially for ICP countries. It particularly helps researchers across the globe in nano, advanced materials and enabling technologies who wish to upload their own peer-reviewed papers, patents, conference proceedings, etc. and other researchers/academic community who wish to access these.

<b>4. e-documentation centre on Human Migration</b>	
Affiliation	Association Aide aux Familles et Victimes des Migrations Clandestines (AFVMC)
Country	Cameroon
Purpose/problem	Access to resources for research and development
Brief description	An e-documentation centre that will help future and potential migrants to know their rights and duties when they want to migrate in a foreign country, as well as provide migration documentation on gender, water, agriculture and breeding.
Resources needed	Access to scientific literature; storage; access to specialised High Performance Computing facilities; specialised instrumentation (scanner, video capture, photocopy, remote capture, etc.)
e-Infrastructure benefits	Worldwide access to migration documentation by migrants/refugees/families/women

<b>5. Online hosting of African scientific literature</b>	
Affiliation	African Journals Online (AJOL)
Country	South Africa
Purpose/problem	Access to resources for research and development
Brief description	A free online hosting of over 450 African-published, peer-reviewed scholarly journals, as well as training and hosting of the full publishing workflow online for selected journal partners. Most of the partner journals are not online anywhere else due to resource constraints. AJOL works to offset the inequitable flow of research information from North to South, and provides the largest collection of African published research journals in the world, and is used by hundreds of thousands of researchers around the world
Resources needed	Run faster; high quality scanner
e-Infrastructure benefits	Due to huge load of visitors (nearly 3.2 million unique visitors in 2012) it could benefit as the database is starting to get really big, and the site needs to run faster

<b>6. Indicator Progress Cards (IPCs)</b>	
Affiliation	War Child Holland
Country	Uganda
Purpose/problem	Skilling people for jobs/education/research
Brief description	IPCs are scorecards that assess outcome indicators at all stages of War Child Holland's activities in Uganda to empower young people. The scores help to determine the impact of their programmes and provide information on the general situation. This tool has been modernized into an online application that helps War Child Holland's field staff to deliver quality data with increased efficiency by using an online database with monitoring and evaluation tools on a tablet computer.
Resources needed	Cloud-based; additional tablets
e-Infrastructure benefits	Benefit the data-collection for the monitoring and evaluation processes, which is extremely demanding and time-consuming

<b>7. eLog software solution for the commercial fishing fleet</b>	
Affiliation	OLRAC SPS
Country	South Africa
Purpose/problem	Access to resources for research and development

Brief description	An on-board sophisticated, touch screen ready, generic, yet highly customisable data logging and reporting eLog software solution, capable of collecting, analyzing, plotting, mapping, reporting, tracing and transmitting all vessel-related data, specially customised for the commercial fishing industry
Resources needed	GPS receiver and SATCOM or GSM communication devices
e-Infrastructure benefits	Can benefit anybody in the world who needs to track and report the full spectrum of vessels activities.

<b>8. e-Work web-based application</b>	
Affiliation	Rwamagana District headquarters
Country	Rwanda
Purpose/problem	Access to resources for research and development
Brief description	A web-based application that aims to connect the Rwamagana District headquarters office to its 14 sectors offices; this application will facilitate in reporting issues, information sharing among the staff from sector level to district level by using an online system, and better keeping of the data in a safe place, and also generating backups.
Resources needed	Bandwidth; storage; remote monitoring
e-Infrastructure benefits	Both 235 staff users from all levels on the private side, as well as others like people around the country or the world will be able to access the system via the public side

<b>9. Network of Biodiversity data, GIS and digital libraries</b>	
Affiliation	Royal Museum for Central Africa
Country	DR Congo
Purpose/problem	Access to resources for research and development
Brief description	A network of Biodiversity data and digital libraries mainly with DR Congo similar to <a href="http://www.gbif.org">www.gbif.org</a> mirror.
Resources needed	High storage (several TB) for images storage, maps, 3D models; access to HPC for modelling, image processing, data mining, and analysis of logs; Scanner, 3D scanners, CT scanners, remote sensing, digital photography, videos, sound recordings; access to scientific literature
e-Infrastructure benefits	Enable digitalisation and encoding of not yet digitally available content, solve issue of intermittent Internet connection and the need for continuous training, some requests that need some indexing or processing (i.e. GIS can be very slow) need at least 1GB bandwidth and run into issues if have to download many satellite images from e.g. Nasa

<b>10. A GeoMIS platform</b>	
Affiliation	SPACEBEL SA
Country	Belgium
Purpose/problem	Access to resources for research and development
Brief description	A geospatial information management system with applications for food security, public safety, risk management, odour monitoring and forestry, targeting West African countries (e.g. Senegal, Mali)
Resources needed	N/A
e-Infrastructure benefits	Assist public authorities, 3rd parties (e.g. emergency services, crisis centres), citizens, industries, and forest managers in various world regions

<b>11. Solution for governance of water resources</b>	
Affiliation	University of Dodoma
Country	Tanzania
Purpose/problem	Access to resources for research and development
Brief description	Develop an innovative and integrated solution for governance of water resources in Lake Victoria Basin
Resources needed	Various sensors (currently in plans)



e-Infrastructure benefits	Assist multiple users at different scales: community, decision makers, enforcers of law or regulations, water resource managers, and policy makers
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<b>12. Electronic Medical Record Systems and Demographic Data Exchange</b>	
Affiliation	Baobab Health Trust
Country	Malawi
Purpose/problem	Improve healthcare delivery and/or education
Brief description	Applications to improve patient care delivery through appropriate medical informatics.
Resources needed	GIS systems; large disk capacity for nationwide patient level data; access to HPC
e-Infrastructure benefits	Assist various stakeholders including Ministry of Health professionals and policy makers, Public Health and Medical Researchers, Health Facility management

<b>13. National Digital Repository (NDR)</b>	
Affiliation	Malawi National Library
Country	Malawi
Purpose/problem	Access to resources for research and development
Brief description	The National Digital Repository (NDR) is the only repository in Malawi responding to the wider problem of poor research access and dissemination in Malawi. It serves the academic community and will soon be connected to the newly set up E-Government network, and the Malawi Research and Education Network (MAREN), to connect all research and higher education institutions in Malawi to each other and to global networks.
Resources needed	Faster bandwidth
e-Infrastructure benefits	It will dramatically increase access and availability to all national-level research on Malawi both for Malawians and for researchers globally. In addition, it will be part of the national plan for economic recovery in Malawi, it will make research available, and will provide skills for this goal

<b>14. A mobile learning portal for schools and business</b>	
Affiliation	Growing all through Education
Country	South Africa
Purpose/problem	Access to resources for academic development
Brief description	A portal to train and rest competency. It is a tool to address this need on a cost-effective basis. Material can be viewed on mobile handsets as well as on PC.
Resources needed	N/A
e-Infrastructure benefits	Will help provide education to 250,000 learners from all income levels and countries, will assist the medical Industry with training on how to use pharmacy software systems, as well as with training on medication specification

<b>15. A digital library for medical and allied health students</b>	
Affiliation	Global Health Candlelight
Country	Mali
Purpose/problem	Access to resources for academic development
Brief description	A planned e-library for Malian health students who currently rely on hard copies of books
Resources needed	High storage size and high graphical processing capabilities; access to HPC; video capture; GPS
e-Infrastructure benefits	Students rely only on hard copy of books. With the evolution of information technology an e-library that will be shared by many institutions and will be linked to biomedical databases worldwide, will help to deal with this issue

<b>16. A network of bio-banks for African food microorganisms</b>	
Affiliation	Danish Technological Institute
Country	Denmark



Purpose/problem	Access to resources for research and development
Brief description	There are currently no storage facilities in most African research institutions for microbiological culture, such as food microorganisms required for development of starter culture. The aim of the project is to establish a network of bio-banks for African food microorganisms that can be shared across borders.
Resources needed	Software for data management of microbial material; freezers; environmental sensors
e-Infrastructure benefits	Establish a network that can be shared by food research institutions and universities, specialised commercial microbiological laboratories, food producing enterprises and SMEs across borders

<b>17. A virtual platform for malaria diagnosis with microscopy and rapid diagnostic tests (RDTs)</b>	
Affiliation	University of Lagos
Country	Nigeria
Purpose/problem	Improve healthcare delivery and/or education
Brief description	This is a cost-effective and efficient platform for scaling-up diagnosis in the case-management of malaria in health workers (in both the public and private sectors) that manage malaria in over 180 million Nigerians. This platform will also be available for over 100 Universities, over 100 non-universities tertiary institutions and millions of students in Nigeria and overseas.
Resources needed	Access to HPC; storage; high speed computers and monitors; scanners; video capture; remote monitoring; microphone and ear pieces; external storage devices
e-Infrastructure benefits	Help to address low capacity and non-use of malaria diagnosis in Nigeria, as well as challenges associated with scaled-up malaria diagnosis such as the cost of conducting training for healthcare providers (in- service training/ pre-service training) and quality assurance.

<b>18. Mobile platform to support farmers</b>	
Affiliation	Foresight Generation Club
Country	Ghana
Purpose/problem	Access to services by public
Brief description	A mobile platform to support farmers in Ghana and other African countries to boost sales while preventing post-harvest losses.
Resources needed	Access to HPC; mobile phones
e-Infrastructure benefits	Farmers and young graduates in project catchment countries and communities to utilize the power of e-Infrastructures to boost local economies and improve economic situations in African communities.

<b>19. Plantisc application</b>	
Affiliation	University of Nigeria Nsukka
Country	Nigeria
Purpose/problem	Access to resources for research and development
Brief description	An application that simulates the micro-propagation of plant tissue culture in the field of plant biotechnology
Resources needed	N/A
e-Infrastructure benefits	Access to simulation facilities for researchers and students across Africa

<b>20. An e-Health tele-media application for patient management</b>	
Affiliation	Icon Frontiers Ltd.
Country	Uganda
Purpose/problem	Improve healthcare delivery and/or education
Brief description	In Uganda, Malaria, Malnutrition, respiratory tract infections, HIV/AIDS and Tuberculosis are the leading causes of morbidity and mortality. There is therefore a great need to deploy technologies like Speech Recognition, IVR, SMS and web applications in the health sector that will provide patients (especially out-patients)

	with real-time management of illnesses, reactions or side effects to prescribed medication, update patients on scheduled doctor patient appointments and make prescription reminders, provide survey data for medical research, facilitate access diagnosis from a physician and general medical assistance using a combination of a web services, speech recognition, IVR and SMS.
Resources needed	Access to HPC; voice/speech capture
e-Infrastructure benefits	Assist developing countries with challenges of providing health care services to its citizenry, delivering the medical services, and monitoring patients for progress and real-time data collection for research and development.

<b>21. CTA Cherenkov telescope Array project</b>	
Affiliation	IN2P3/CNRS
Country	France
Purpose/problem	Access to resources for research and development
Brief description	Namibia (supported by Southampton Africa) is one of the hostess candidate countries for CTA planning to deploy 100 Telescopes. CTA data issues are: big data collection; high- bandwidth intercontinental research network; distributed computing; scientific community Gateway; data open access
Resources needed	Parallel architecture and GPU; different Cloud paradigms; Lidar for atmospheric monitoring
e-Infrastructure benefits	Assist on data issues, such as big data collection and data open access. Also provide a high- bandwidth intercontinental research network, distributed computing, and a scientific community gateway

<b>22. Web-based data capture for fisheries research and management</b>	
Affiliation	Lake Victoria Fisheries Organization
Country	Uganda
Purpose/problem	Access to resources for research and development
Brief description	A web-based data capture application for fisheries research and management surveys (Frame survey; Monitoring, Control and Surveillance; Trawl, Catch Assessment, Fish Biology and Beach Management Unit (BMUs))
Resources needed	Storage (24TB); 4Mbps bandwidth; GIS; video capture; environmental sensors
e-Infrastructure benefits	Facilitate data capture and management across several countries and for various users, including fisheries research institutions of East Africa, fisheries management institutions, beach management units (1069), and the Lake Victoria fisheries organization secretariat

<b>23. A network of 50+ geophysical observatories (AfricaArray)</b>	
Affiliation	University of the Witwatersrand & Council for Scientific & Industrial Research (CSIR)
Country	South Africa
Purpose/problem	Access to resources for research and development
Brief description	A network of more than 50 geophysical observatories (seismometers, continuous GPS, meteorological sensors) situated in 20 sub-Saharan countries. Need to improve data acquisition, archiving, analysis and knowledge dissemination
Resources needed	N/A
e-Infrastructure benefits	Assist the community of users in 20 sub-Saharan countries to improve data acquisition, archiving, and analysis and knowledge dissemination

<b>24. A Pan-African bioinformatics network</b>	
Affiliation	University of Cape Town
Country	South Africa
Purpose/problem	Skilling people for jobs/education/research
Brief description	A network to develop skills in bioinformatics (computational biology) in Africa.
Resources needed	Storage; access to HPC; access to public databases
e-Infrastructure	Training and development of researchers across Africa

benefits	
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<b>25. A digital product for orphan crops</b>	
Affiliation	iHub User Experience Lab
Country	Kenya
Purpose/problem	Access to services by public
Brief description	A digital product that will boost the consumption of orphan crops in urban centres
Resources needed	N/A
e-Infrastructure benefits	Assist the urban middle to upper income earner across Africa to boost the consumption through information management and sharing

<b>26. Electronic support for clinical coding</b>	
Affiliation	South African Medical Research Council
Country	South Africa
Purpose/problem	Access to resources for research and development
Brief description	A tool to support the process of clinical coding
Resources needed	N/A
e-Infrastructure benefits	Enable available tools to be modified for national use, or specific national tools to be developed.

<b>27. Computer-aided diagnosis</b>	
Affiliation	SIIVA-RIADI Lab
Country	Tunisia
Purpose/problem	Improve healthcare delivery and/or education
Brief description	Computer-Aided Diagnosis based on Medical Images Analysis and Medical Reports Retrieval
Resources needed	Access to HPC; large bandwidth
e-Infrastructure benefits	Facilitate better image interpretation and segmentation across continents, enable to cross and to retrieve within large datasets in different countries

<b>28. Crop modelling and simulation</b>	
Affiliation	Sokoine University of Agriculture
Country	Tanzania
Purpose/problem	Access to resources for academic development
Brief description	Crop modelling and simulation
Resources needed	PC; weather station; Sensors for moisture content and temperature
e-Infrastructure benefits	Facilitate teaching and research, but also access to such an application for researchers and/or projects across countries

<b>29. Management of fisheries and aquatic resources</b>	
Affiliation	Kenya Marine & Fisheries Research Institute
Country	Kenya
Purpose/problem	Access to resources for research and development
Brief description	A platform for data storage, shared access to data collections, data analysis, computing resources for the purpose of managing fisheries and aquatic resources in Kenya.
Resources needed	N/A
e-Infrastructure benefits	Facilitate data storage, shared access to data collections, data analysis, and computing resources across various stations in the country, as well as projects attached to the organization. The community will benefit through shared information

<b>30. Multi-physics simulation</b>	
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Affiliation	University of Nigeria
Country	Nigeria
Purpose/problem	Access to resources for academic development
Brief description	Access to OpenFOAM software package for multi-physics simulation
Resources needed	N/A
e-Infrastructure benefits	Facilitate access to a simulation environment or to specific software from any location

<b>31. Agri-Business Services</b>	
Affiliation	Integrated Polytechnic Regional Centre
Country	Rwanda
Purpose/problem	Access to services by public
Brief description	An application used to: make a connection between farmers and investors, in marketing of agriculture`s production, and to generate more information about agriculture, like forecast, fertilizing, and weather.
Resources needed	Storage, video cameras, sound recorders
e-Infrastructure benefits	Marketing of agriculture`s production and easiest way for communication between farmers and investors in that sector

<b>32. TRODAN data repository</b>	
Affiliation	Centre for Atmospheric Research (CAR)
Country	Nigeria
Purpose/problem	Access to resources for research and development
Brief description	This online repository archives meso-meteorological data from Automatic Weather Stations at several locations in Nigeria. The purpose is to provide much needed but scarce meteorological data for the research community as part of CAR's commitment to understanding the atmosphere—the air around us—and the interconnected processes that make up the Earth system, from the ocean floor through the ionosphere to the Sun's core.
Resources needed	Storage (TBs), HPC, wireless sensors
e-Infrastructure benefits	the repository and portal is globally available to all researchers with research interests in the region, regardless of their location; data and products are made available at no cost to all interested users, individuals or groups, in the research community

<b>33. AiBST Pharmacology Science Gateway</b>	
Affiliation	African Institute of Biomedical Science & Technology
Country	Zimbabwe
Purpose/problem	Access to resources for research and development
Brief description	Will serve to promote and implement African medical science collaboration focusing on biomedical and pharmacological sciences and clinical trials for improving African healthcare. The key areas this application will focus on are: 1. Genomics and bioinformatics 2. Pharmacokinetics/pharmacometrics; 3. Bioanalysis, drug analysis and metabolism 4. Clinical trial sciences
Resources needed	several software; medical scanners; video capture and others to be defined by the community of users
e-Infrastructure benefits	The platform will effectively enable north-south and south-south capacity and capability strengthening as African researchers and their international collaborators can have a shared mechanism of interactions. The application will make accessible open sources software for study designs, biomedical data processing and facilities for sharing data and discussing scientific and technical topics of interest to network members.

<b>34. The Weather Research and Forecasting (WRF) Model</b>	
Affiliation	Dar Es Salaam Institute of Technology (DIT)
Country	Tanzania
Purpose/problem	Access to resources for research and development
Brief description	The WRF Model is a next-generation mesoscale numerical weather prediction system designed to serve both atmospheric research and operational forecasting needs. The model serves a wide range of meteorological applications across scales ranging from meters to thousands of kilometers. WRF allows researchers the ability to produce simulations reflecting either real data (observations, analyses) or idealized atmospheric conditions.
Resources needed	Access to HPC; bandwidth to upload big amount of data; SMS platform
e-Infrastructure benefits	WRF provides operational forecasting a flexible and computationally efficient platform, while offering advances in physics, numerics, and data assimilation contributed by the many research community developers.

## Appendix B



### eI4Africa: A Survey on Impact Assessment of e-Infrastructure Applications in Africa by the eI4Africa Project ([www.ei4africa.eu](http://www.ei4africa.eu))

#### 1. Welcome to our survey

Thank you very much for your participation in this survey organised by the eI4Africa FP7 European project ([www.ei4africa.eu](http://www.ei4africa.eu)).

We are very grateful for your kind participation and input to our previous survey that focused on identifying your current or planned e-Infrastructure application in Africa.

Building on this, the aim of this survey is to help us now understand the value added to society by the development of your proposed current or planned **e-Infrastructure application** in Africa, and its effect on, change or benefit to the economy, public policy or services, as well as on health, the environment or quality of life. Your response to this survey is very important to the eI4Africa project and will provide great value in both fulfilling the project's objectives, as well as in helping us understand and disseminate the impact of your proposed current or planned e-Infrastructure application.

A potential current or planned e-Infrastructure application might cover the need:

- for a more powerful computer to run an application
- for a great number of these computers to deliver results faster
- for access to specialised High Performance Computing facilities
- for access to large data sources
- for access to software not available locally (see examples at the Africa Grid Science Gateway <http://sgw.africa-grid.org/applications>)
- to collaborate with other scientists across the world
- for access to scientific literature resources
- to connect to specialised instrumentation for analysis
- to connect to sensors for data collection
- for access to these facilities via a web-based portal or mobile device

The survey is divided into **four main parts** and takes approximately **10-15 minutes** to complete.

If you would like assistance in filling in this questionnaire, or would like to discuss your current or planned e-Infrastructure application, then please get in touch with the eI4Africa team at [info@ei4africa.eu](mailto:info@ei4africa.eu).

Thank you again for your valuable participation!

The eI4Africa Partnership

Data protection policy: <http://sigma-orionis.com/legal/>



**2. Part 1: Personal Details**

This page contains questions about your background.

**\* 1. You Name:**

**\* 2. Organisation:**

**3. Tel (please update, if different than the one provided):**

**4. Email (please update, if different than the one provided):**

**3. Part 2: Social Impact Assessment (1/2)**

This page contains questions regarding your perceptions about the societal impact of your e-Infrastructure application over time.

**5. e-Infrastructures can have an important effect on employment and labour markets. Please indicate the extent to which you agree with the following:**

**Your e-Infrastructure application could...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
enable the creation of new services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enable the creation of new products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enable the creation of new processes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
facilitate new job creation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="text"/>					

**6. e-Infrastructures can have an important effect on job quality and skills development. Please indicate the extent to which you agree with the following:**

**Thanks to your e-Infrastructure application...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
users could increase the number of their publications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
users could increase the quality of their publications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
data available on the global market could be more easily accessible to researchers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you could perform tasks faster	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you could accomplish tasks that would have been mostly impossible without it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you could advance your skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
you can advance your training opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="text"/>					

**7. e-Infrastructures could play an important role in advancing social inclusion. Please indicate the extent to which you agree with the following:**

**Your e-Infrastructure application...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
could offer equal access to technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
could offer equal access to services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
could offer equal access to goods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
would not affect particular age groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
could support the inclusion of groups at risk of discrimination (race, disability, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
could have a positive impact on gender equality	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)						

**4. Social Impact Assessment (2/2)**

**8. Please indicate if your e-Infrastructure application could positively affect health due to changes in:**

- |  |   |
|--|---|
| <input type="checkbox"/> Noise         | <input type="checkbox"/> Waste disposal     |
| <input type="checkbox"/> Air quality   | <input type="checkbox"/> Harmful substances |
| <input type="checkbox"/> Water quality | <input type="checkbox"/> N/A                |
| <input type="checkbox"/> Soil quality  |   |

**9. Please indicate if your e-Infrastructure application could affect the safety of individuals through positive impacts on:**

- |  |                                     |
|--|-------------------------------------|
| <input type="checkbox"/> Working environment | <input type="checkbox"/> Occupation |
| <input type="checkbox"/> Natural environment | <input type="checkbox"/> Nutrition  |
| <input type="checkbox"/> Income              | <input type="checkbox"/> N/A        |
| <input type="checkbox"/> Education           |                                     |

**10. e-Infrastructures could play an important role in advancing collaborations, funding, and awareness raising. Please indicate the extent to which you agree with the following:**

**Your e-Infrastructure application could...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
enable research agendas that would not be possible without its existence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enable to advance your interdisciplinary activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
enable to expand the geographical range of your interdisciplinary activities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
create new funding opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)						



**5. Part 3: Environmental Impact Assessment (1/2)**

This page contains questions regarding your perceptions about the environmental impact of your e-Infrastructure application over time

**11. e-Infrastructures could help in improving the climate and air quality. Please indicate the extent to which you agree with the following:**

**Over time, your e-Infrastructure application could....**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
increase the emission of greenhouse gases into the atmosphere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reduce the emission of ozone-depleting substances into the atmosphere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
improve human health	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
damage crops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
damage buildings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
lead to deterioration in the environment (soil, rivers, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="text"/>					

**12. e-Infrastructures could have an impact on animals, biodiversity, flora, fauna and landscapes. Please indicate the extent to which you agree with the following:**

**Over time, your e-Infrastructure application could....**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
negatively affect animal welfare	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
positively affect protected/endangered species	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
positively affect ecologically sensitive areas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="text"/>					

**13. e-Infrastructures could have an impact on water quality and resources. Please indicate the extent to which you agree with the following:**

**Over time, your e-Infrastructure application could....**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
increase the quality of waters in coastal areas (interface areas between land and sea)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reduce the quality of waters in marine areas (areas where wildlife is protected)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
increase the quality of waters in land resources (e.g.rivers, lakes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reduce the quality of freshwater	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
help save freshwater	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reduce the quality of groundwater	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
help save groundwater	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<input type="text"/>					

**14. e-Infrastructures could have an impact on land use, and soil quality or resources. Please indicate the extent to which you agree with the following:**

**Over time, your e-Infrastructure application could....**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
have the effect of bringing new areas of land into use for the first time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
affect land designated as sensitive for ecological reasons	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<hr/>					

**6. Environmental Impact Assessment (2/2)**

**15. Please indicate if your e-Infrastructure application could positively affect over time:**

<input type="checkbox"/> the acidification of soil	<input type="checkbox"/> the soil erosion rates
<input type="checkbox"/> the contamination of soil	<input type="checkbox"/> N/A
<input type="checkbox"/> the salinity of soil	

**16. e-Infrastructures could affect the use of renewable or non-renewable resources, and energy. Please indicate the extent to which you agree with the following:**

**Over time, your e-Infrastructure application could....**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
increase use of renewable resources (fish, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reduce use of non-renewable resources (minerals, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
increase energy needs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
decrease energy consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<hr/>					

**17. e-Infrastructures could have an impact on waste production/ generation/ recycling. Please indicate if your e-Infrastructure application could positively affect over time how waste (industrial/household waste, toxic waste, etc.) is:**

<input type="checkbox"/> produced	<input type="checkbox"/> recycled
<input type="checkbox"/> treated	<input type="checkbox"/> N/A
<input type="checkbox"/> disposed of	

**18. e-Infrastructures could have an impact on environmental risks. Please indicate if your e-Infrastructure application could affect over time the prevention of:**

<input type="checkbox"/> fire	<input type="checkbox"/> droughts
<input type="checkbox"/> earthquakes	<input type="checkbox"/> heat waves
<input type="checkbox"/> tsunamis	<input type="checkbox"/> N/A
<input type="checkbox"/> floods	

## 7. Adoption and use of Green IT

This page contains questions regarding your perceptions about the adoption and use of Green IT initiatives within your e-Infrastructure application

### 19. Please indicate the extent to which you are aware and interested about the environmental concerns related to the use of IT and the role of IT in resolving environmental problems.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
Your application has been developed by taking into consideration its impact on the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The issue of Green IT is on your e-Infrastructure application's radar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You are aware of any subsequent Green House Gas emissions your application creates	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your application will have a Green IT budget allocated in the next three years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<hr/>					

### 20. Please indicate the reasons for not implementing practices to reduce the energy consumption of your e-Infrastructure application, if any:

<input type="checkbox"/> Waiting on corporate directive	<input type="checkbox"/> Lack of people/expertise
<input type="checkbox"/> Lack of money/budget	<input type="checkbox"/> N/A

### 21. Please indicate the extent to which your organisation has a green technological infrastructure or aims to acquire more environmentally effective (greener) technologies to build a green technological infrastructure

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
You are aware of the power consumption your application uses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You are very concerned about reducing your application's power consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your organisation has implemented other projects that have resulted in a reduction of power consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	<hr/>					

### 22. Please indicate the Green IT activities and initiatives taken with regards to your e-Infrastructure application, if any:

<input type="checkbox"/> Server consolidation	<input type="checkbox"/> Removal of screen savers
<input type="checkbox"/> Virtualisation	<input type="checkbox"/> Renewable energy sources
<input type="checkbox"/> Power shutdown policy	<input type="checkbox"/> E-Waste policy
<input type="checkbox"/> Asset recycling	<input type="checkbox"/> N/A
<input type="checkbox"/> Asset rationalisation	



### 8. Part 4: Economic Impact Assessment (1/2)

This page contains questions regarding your perceptions about the economic impact of your e-Infrastructure application over time.

**23. e-Infrastructures could significantly affect the functioning of the internal market and the competition. Please indicate the extent to which you agree with the following.**

**Your application could have a positive impact on the free movement of...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
Goods	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Capital	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Workers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**24. Your application could lead to...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
a reduction in user choice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
higher prices due to less competition	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
the creation of barriers for new service providers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
the facilitation of anti-competitive behavior	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
the emergence of monopolies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**25. e-Infrastructures could significantly affect competitiveness, trade and investment flows. Please indicate the extent to which you agree with the following.**

**Your application could...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
have a positive impact on the global competitive position of African organisations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
provoke cross-border investment flows	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**26. e-Infrastructures could significantly affect operating costs and the conduct of business. Please indicate the extent to which you agree with the following.**

**Your application could...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
impose additional transaction costs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
increase the cost of essential inputs (raw materials, equipment, labour, energy)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
reduce the availability of essential inputs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**9. Economic Impact Assessment (2/2)**

**27. e-Infrastructures could have an impact on the administrative activities of your organisation. Please indicate the extent to which you agree with the following.**

**Your application could...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
positively affect the nature of information required (e.g. type of data, complexity of submission process)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
negatively affect intellectual property rights (patents, trademarks, copyright)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**28. e-Infrastructures could have an effect on public authorities. Please indicate the extent to which you agree with the following.**

**Your application could...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
bring additional governmental administrative burden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
require the creation of new public authorities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
require the restructuring of existing public authorities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**29. e-Infrastructures have a direct impact on the economic situation of users and organisations. Please indicate the extent to which you agree with the following.**

**Your application could...**

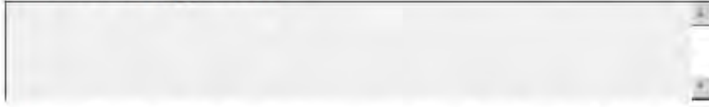
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
increase the prices users pay to get access to services, if any	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
have negative consequences for the financial situation of users, if any	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**30. Please indicate what you believe would be the overall effect of your application on the Macroeconomic environment (the conditions that exist in the economy as a whole).**

**Your application could have...**

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	N/A
overall consequences in the option for economic growth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
overall consequences in the option for employment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
direct impacts on macro-economic stabilization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify)	_____					

**31. Please use the box below to comment on issues related to this survey or your e-Infrastructure application**



**\*32. Please indicate if you would be happy for the eI4Africa team to share your details with the iMentors FP7 European project (<http://www.imentors.eu/>) for research purposes only**

Yes

No

Thank you for your valuable time and contribution!

The eI4Africa Partnership