Towards Digital Advantage: Roadmapping South Africa’s ICT RDI Future
Foreword by the Minister

Research and development activity in the information and communication technology (ICT) sector is important for the competitiveness of all economies. South Africa has ambitious growth targets and the 10-year ICT Research, Development and Innovation (RDI) Roadmap aims to strengthen the Department of Science and Technology’s role in the growth of the country.

Technology is driving change to business models and consumer experience faster than ever before. ICT has become, like electricity, an intrinsic part of everyday life in modern societies. In South Africa, according to the 2011 World Wide Worx Report, “the Internet economy is worth R59 billion and contributes some 2% to GDP”. ICT is also a powerful tool in addressing development outcomes in areas like education, health and poverty reduction, and in achieving the Millennium Development Goals.

The National Development Plan sees ICT by 2030 underpinning a dynamic, inclusive and prosperous information society and knowledge economy, in which a seamless information infrastructure will meet the needs of citizens, business and the public sector, providing access to a wide range of services required for effective economic and social participation at a cost and quality at least equal to South Africa’s competitors.

Such a situation, in which advances in ICT are used to strengthen economic competitiveness and enable an enhanced quality of life, is described as a “digital advantage”, and the ICT RDI Roadmap was developed by the Department of Science and Technology, in partnership with the CSIR Meraka Institute, to guide South Africa to this state of digital advantage.

Through intense consultations with stakeholders and experts, nationwide workshops and desktop research, the ICT RDI Roadmap has now matured into a framework for sophisticated planning and decision making for South Africa’s future investment in ICT RDI.

This ambitious vision speaks to all levels of our society. The ICT RDI Roadmap is aimed at making a significant contribution to satisfying national government priorities by supporting and enabling the mandates of other government departments.

I believe that this roadmap provides the required strategic direction to guide South Africa in planning, coordinating and managing its investment in ICT programmes of research, technology development and innovation activity over the next 10 years, and I take pleasure in presenting it to the South African nation.

DEREK HANEKOM, MP
MINISTER OF SCIENCE AND TECHNOLOGY
Introduction by the Director - General

The ICT Research, Development and Innovation (RDI) Implementation Roadmap is a plan to guide the implementation of national ICT research, development and innovation strategy. The Roadmap is driven by the potential to deliver socio-economic impact, and presents a sound case for increased public and private investment in ICT RDI.

With the right investments in our national ICT RDI capability, we can simultaneously harness significant socio-economic benefit for the nation and become more than a distribution market, by being bold and positioning ourselves to capture increasing value of the new digital value chain and by becoming smarter buyers.

The ICT RDI Roadmap will build ICT RDI capabilities focused primarily on local needs, with export potential in the longer term, by catalysing government and industry investment.

The vision of attaining Digital Advantage will be achieved by providing direction through prioritised market opportunities that are driven by local needs, and by means of systematic harmonisation: with key initiatives, such as the Square Kilometre Array radio telescope, and line departments, like the Departments of Communications and Health. Together with adjacent programmes, like Space, and through strategic engagement with Multinational Corporations, the vision is that much closer.

In the context of our ambition, we have benchmarked South Africa’s investment and performance to date against that of comparable countries. In this regard the Department of Science and Technology (DST) has built a research and development capability over the past ten years that supports government priorities, and has demonstrated how investments in ICT RDI can deliver both societal and economic impact. Key achievements of DST’s investment in ICT RDI, as at the end of March 2012, are:

- New technology and business models for sustainable broadband roll-out in rural areas were developed as a result of leveraging European Union funding for the wireless mesh research project called: “Broadband for All” (BB4ALL). This business model established 19 village operators in various rural communities to supply broadband to communities

- ICT in Education research investment led to Dr Math, a mobile tutoring platform now supporting 30 000 registered learners. In the Cofimvaba project, Dr Math and a range of other ICT interventions, are being tested in 26 Nciba district schools with 6 500 learners

- Geo-spatial research investment led to the development of the Advance Fire Information System (AFIS), now deployed operationally in Southern California, USA, and used by Eskom in South Africa
Investment in advanced human capital has led to 52 PhD and Masters degree graduates, providing the research leadership required for knowledge creation as well as the academic cohort that will teach the next generation of ICT engineers, scientists and technologists.

Significant research outputs to date includes 376.5 publication equivalents, 13 patent applications and 1 patent granted.

Against this context, an assessment of South Africa’s institutional ICT RDI landscape and human capacity, informed the identification, evaluation and clustering of 27 market opportunities of relevance to South Africa’s national interests, government priorities and strategic ICT RDI environment and trajectory. The resulting six clusters of opportunity are: Broadband Infrastructure and Services; ICT for Development; Sustainability and the Environment; Industry Applications, Grand Science; and the Service Economy.

The ICT RDI Implementation Roadmap provides a coherent, comprehensive and flexible ten-year implementation framework to coordinate and manage ICT research and technology development nationally, regionally and in relation to our international partners.

It serves as an anchor point for attracting increased public and private investment in ICT R&D, including from multi-national corporations. The Department of Science and Technology has already concluded agreements with Nokia, SAP and Microsoft, and are seeing significant value in the guidance it provides to identify and assess strategic options and ensure focused and aligned engagement.

Digital Advantage will enable South Africa to become a significant player in the global ICT RDI arena, provide more targeted engagement with industry, focused international collaboration, more comprehensive and transparent monitoring of investment and achieving impact, such as jobs and business creation, contribution to GDP, societal impact and positioning South Africa for strategic advantage.

I am proud to present the Ten Year ICT Research, Development and Innovation Implementation Roadmap.

DR PHIL MJWARA
DIRECTOR-GENERAL
DEPARTMENT OF SCIENCE AND TECHNOLOGY
Introduction

Information and communications technology (ICT) is widely recognised as a potent tool for socio-economic upliftment. As an industrial sector in its own right, as an enabler of solutions across almost all other domains and through the extensive use of ICT in society, it creates economic and social impact.

As the world evolves and technology permeates the fabric of all our lives, ICT has become the catalyst and underpinning of the knowledge economy. Its potential to contribute to South Africa’s intended growth path is therefore significant.

However, whilst the country spends close to 10% of GDP on ICT goods and services, most of these are imported. We must take control of our own destiny and leverage ICT for our own national advantage and to become more internationally relevant and competitive. To become a player, we must significantly increase and sustain levels of public and private investment in ICT Research, Development and Innovation (RDI).

This requires a clearly articulated vision and considered strategic direction.

- The DST, in partnership with the CSIR Meraka Institute and in conjunction with relevant stakeholders, embarked on a process to develop this vision and direction. This exploration has benefited from the participation of academic and research institutions, business and government departments.

- Roadmapping has been used to develop strategy in a variety of countries and industries. It is therefore an appropriate approach to develop an implementation strategy for ICT RDI in South Africa.

- The project took stock of current ICT RDI capabilities and initiatives, analysed trends from a national and global perspective, and from this, identified future directions and opportunity for the ICT RDI in South Africa.

- The resulting ICT RDI Roadmap is a strategic direction, plan and implementation framework to guide and manage investment over the next ten years.

- It comprises six key clusters of Opportunity - areas of significant and attractive market Need, in which we can feasibly, and with differentiation, respond by building on existing capability in order to deliver Impact; on the dimensions of wealth, society and national advantage.

- Our success in delivering the promise and impact of this opportunity relies on stronger and sustained engagement and collaboration across the national ICT RDI ecosystem.
Contents

2 Foreword by the Minister
4 Introduction by the Director - General
5 Introduction
7 Executive Summary and Vision
8 Strategy
10 Mapping South Africa’s ICT RDI Future
12 The Baseline Study
14 The 10-Year ICT RDI Roadmap
16 Market Opportunities Identified
16 Market Opportunities Evaluated
18 High-Level ICT RDI Roadmap
20 Investment and Impact
22 Progression Paths and Instruments
24 Opportunity Portfolio
39 Roadmap Execution: Investment Portfolio
40 Stakeholder Participation
42 Workshop Participation
43 Acknowledgements

How to Navigate this Document Set

Roadmap
The top-level document: summarises the project and its outputs

Opportunities
Provides an overview of the Market Opportunities we see, how attractive they are and what is required to realise them

Drivers
Describes the baseline research that set out the market context in which Opportunities were identified, as well as Global and National Trends driving the need for and adoption of ICTs

Capabilities
Maps the supply-side, in terms of current investment as well as the nature, availability and strength of ICT RDI capacity in South Africa

Roadmap Report
A document that describes the process, including the methodology in more detail
Executive Summary

The ICT Research Development and Innovation (RDI) Roadmap was developed through a structured process and with extensive participation as a means to guide the implementation of national ICT RDI strategy.

The driving Vision that underpins this Roadmap is for a South Africa that has created Digital Advantage.

Driven by the potential to deliver socio-economic Impact, the Roadmap presents a sound case for increased public and private investment in ICT RDI.

Further, it provides a strategic direction, a set of action-plans and an implementation framework to guide, plan, coordinate and manage South Africa’s portfolio investment for the next ten years in the associated programmes of research, technology development and innovation activity.

If we are to deliver the intended Impact, we must strengthen our national ICT RDI ecosystem through well-coordinated and -managed collaboration between research institutions, academic institutions, industry and government line departments. We welcome engagement with others as we extend these capabilities into the global ecosystem for ICT.

Vision

Our Vision is for a South Africa that has overcome the Digital Divide; by leveraging advances in ICT to address socioeconomic challenges, it has created Digital Advantage.

Through sound investment and effective coordination of ICT R&D and innovation activities, we have established these conditions:

- **Advanced human capital and strong and institutional capacity,** enabling critical mass for research in prioritised areas
- **An industry characterised by tight engagement with research communities,** as well as **fast uptake and promotion of research results and indigenous innovation**
- **A healthy innovation ecosystem,** in which research results flow unencumbered to government and industry to achieve impact in and for society
- **Advanced ICT infrastructure** connecting South Africa internally and with the world
- **Local content and applications** that address local needs and also create export opportunities
South Africa has taken control of its own destiny with respect to Research Development and Innovation in ICT. The basis of this new control is an investment portfolio approach that constantly, consistently and rigourously evaluates market opportunities in order to identify potential winners. This approach provides direction and a coordinating framework for attracting and optimising local and international investment, both public and private.

The key is to develop a balanced portfolio that builds strengths and leverages them further to deliver valued Outcomes and Impact.

Managing this portfolio well requires the capability to monitor changes in the market and respond in a timely way with specific course corrections for activity and investment.

In the initiation phase, there are six strategic prioritised areas:

- **Improved access** to ICT infrastructure enables individuals, society and the economy to move forward with pace. Leveraging local innovation in wired and wireless connectivity is the key to connecting South Africans with each other and with the world.

- **Sustainability and environment** challenges, addressed through the application of sensor technologies and networks, and the view from space, sometimes in tandem, will enable us to address critical resource and asset management issues, that also represent key development challenges, faced by many other nations too.

- Providing access to the digital world, frees individuals, households and communities from the past constraints of geography, resources and ability. **Development** is re-focused: firstly, on enabling individuals to acquire attitudes, knowledge, tools and skills that allow them to increase the value of their labour and secondly, on enabling them to manage sustainably the business or surplus that this enables or generates.

- **Mobile health** is a critical component in the drive to improve quality of life for all South Africans. The underpinning technology and offerings associated with e-services, payment solutions, mobile enablement and trust are integral aspects of this prioritised area.

- **Analytics** is focused on providing the information-based insight to optimise this decision-making.

- **In the Smart World**, where the physical and digital world converge, all decisions are becoming data-driven. Developing, deploying and managing robust, energy-efficient and self-configuring sensors and actuators in order to instrument the target environment is but the start of the challenge. The next is to integrate exponential volumes of structured and unstructured data from this multiplicity of heterogenous devices and sources. Data on customers and their behaviour, on processes, suppliers and employees has now replaced intuition as the basis for management decisions, in both private and public organisations.

And since the SKA project will address and solve precisely these challenges, leveraging these ICT advances concurrently will allow South Africa to build a new national capability focused on data science and management.
Strategy: Impact Pathways

The ultimate intention of R&D is to create impact for society: research only has relevance if it addresses need that exists at the individual, societal or economic level.

There are several “pathways” through which needs-based R&D delivers impact.

- Outputs from higher education and research institutions, including research papers and patents, technology, qualified people and expertise, can assist by influencing government policy and strategy and by supplying technologies that enable or enhance the delivery of government services to individuals and businesses.

- Similarly, these outputs may influence strategy and the value chain for industry, to create or enhance products and services that industry delivers to society.

The Roadmap is impact-driven: Market Opportunities are explicitly directed towards the satisfaction of the needs of Society. By providing a basis to direct and coordinate activities and actors, the Roadmap will foster closer collaborative relationships between these different players to help ensure that societal impact is achieved.

Society

- Improved quality of basic education
- A long and healthy life for all South Africans
- All people in South Africa are and feel safe
- Decent employment through inclusive economic growth
- A skilled and capable workforce to support an inclusive growth path
- An efficient, competitive and responsive economic infrastructure network
- Vibrant, equitable and sustainable rural communities with food security for all
- Sustainable human settlements and improved quality of household life
- A responsive, accountable, effective and efficient local government system
- Environmental assets and natural resources that are well protected and continually enhanced
- Create a better South Africa and contribute to a better and safer Africa and World
- An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship
Mapping South Africa’s ICT RDI Future: Method

Roadmapping is a tool used to define future market opportunities and, by matching these with existing capabilities, identifies whether and how these opportunities can be realised. The ICT RDI Roadmap involved five packages of work, which are presented graphically in Figure 2 - Roadmap Project Approach.

Context

The ICT RDI Implementation Roadmap is the means by which the national research and development and innovation (RDI) Strategy for ICT is translated into a coherent set of actionable plans.

The project purpose is firstly, to create a sound basis for a step-change increase in public and private investment in ICT RDI. It will achieve this by:

- Providing a mechanism to forecast technology developments in targeted areas
- Identifying critical areas that must be developed to meet SA’s socio-economic objectives
- Surfacing and demonstrating the research community and sector’s understanding and agreement on the trends, market potential, priorities and investment requirements
- Identifying ways to leverage R&D investments through coordinating research activities nationally and regionally

Secondly, the project provides a framework to plan and coordinate technology development both nationally and regionally; enable sophisticated decision-making in respect of the ICT RDI investment portfolio.

Approach

Participation: based on open and consultative dialogue with relevant stakeholders from academic institutions, research organisations, industry players and government departments; the engagement of Champions and experts.

WP1
- Purpose: identify current capability and strength at a national level in order to determine how well the South African ICT RDI sector can address current and future opportunities
- Process: Three regional landscaping workshops, built out with capability baseline research
- Output: Thorough understanding of the ICT RDI capabilities across the landscape and the strength of those capabilities in the form of a Capability Matrix

WP2
- Purpose: develop an understanding of the global and local context for ICT RDI, in terms of trends and drivers of technology demand, as well as the global ICT ecosystem
- Process: One national workshop
- Output: Identified drivers, trends
**WP3**
- **Purpose:** identify and complete initial qualification of a set of Market Opportunities - where the application of ICT can help respond to customer needs at the individual, societal or economic level
- **Process:** One national Workshop
- **Output:** Set of defined and qualified Market Opportunities

**WP4**
- **Purpose:** evaluate Market Opportunities consistently in terms of their Attractiveness and Fit, identify priority areas, begin to outline Interventions and the associated Impact
- **Process:** Substantiation with Champions and experts
- **Output:** Set of scored and qualified Market Opportunities, substantiated with outline Interventions

**WP5**
- **Purpose:** For each Market Opportunity: Articulate the proposed Intervention further in relation to RDI Activity, Enabling Infrastructure, Knowledge and Ecosystem; identify an indicative anticipated Impact; define the appropriate Progression Path and the related Instruments; determine the Investment required over time
- **Process:** Iterative consultation with Champions and experts
- **Output:** An overall implementation plan for the ICT RDI Roadmap, at the level of cluster and individual Market Opportunity, based on sound investment proposals, enabling more coordinated and better-directed investment in ICT RDI across the country
The Baseline Study

**Aim**

The primary aims of the baseline study were to:

- Scan the South African ICT RDI landscape
- Determine the state of and expenditure on ICT RDI
- Understand the Human Capital Development (HCD) profile in ICT RDI
- Identify institutions and the key role players and their areas of expertise
- Understand South Africa’s ICT RDI focus areas

**Scope**

The study focused on these key questions:

- Where is the spending on ICT RDI in South Africa?
- What do our people / does our institutional profile look like?
- What are we focusing on as a country?
- On what and where are we innovating?

More detail on the baseline study is available in the **Capabilities** document.

**Purpose**

Developing a thorough understanding of the ICT RDI capabilities across the landscape, had a three-fold purpose:

- to establish a baseline and identify concentration and synergies more clearly
- as a basis to assess Fit by determining how well the South African ICT RDI sector can address identified current and future market opportunities
- as a platform to engender closer connection and cooperation between institutions and underpin the earlier, more active and targeted involvement of industry in the RDI value chain.

We envisage that, through the introduction of mechanisms to make visible the nature and trajectory of forward demand for ICT skills, future students will shape and complete their education with greater success.

**The ICT RDI Landscape**

The South African ICT RDI Landscape consists of:

- A number of universities with active research groups in ICT, mostly housed by the departments of Computer Science, Electric / Electronic Engineering and Informatics
- A small number of multi-nationals with a significant and expanding research presence in the ICT industry (e.g. Nokia, IBM, Microsoft, Google, SAP)
- A growing list of incubators and entrepreneurial development programmes contributing to small scale innovation
- A strong promotion of ICT RDI by Government through various large-scale initiatives and institutions e.g. CSIR Meraka Institute, MICT SETA.

However, there are areas of concern regarding South Africa’s current pipeline of human capital and talent in ICT RDI, the scarcity of focused funding efforts, as well the lack of coordination and cooperation amongst the institutions involved in ICT RDI.

**Key Insights: R&D Expenditure**

- South Africa as a country spends close to 10% of GDP on ICT goods and services, of which most are imported
- The R&D intensity of South Africa has stabilised at around 0.92% of GDP over the past few years, but is still well below the global norm of 2%
- Government, universities and science councils have a keen interest in ICT RDI, but funding and current spending on ICT R&D is limited, compared to other fields

**Key Insights: Human Capital Pipeline**

- Graduations in ICT-related fields have decreased, in comparison to other fields
- There is a scarcity of instruction and supervision staff in ICT fields
- There is a high dropout rate for bachelor’s degrees and a subsequent domino-effect in the pipeline for advanced degrees, resulting in very few graduates with Master’s and doctoral degrees in ICT
Key Insights: Drivers

Trends and drivers, both global and national, inform customer needs at the individual, societal or economic level. Opportunities arise where the application of ICT can help respond to these needs.

- Baseline research identified a set of global drivers that are currently influencing technology needs.
- Beyond these, it is also important to understand the particular drivers of the technology needs of people in South Africa.

More detail on the baseline study and insights on trends and drivers is available in the Drivers document.

Global Drivers

- **Increased Individualism**
  People are requiring Personalised and Directed Content chosen by them and suited to their preferences and styles.

- **Increased Green consciousness**
  Issues such as Climate Change and Energy Conversation are increasingly at the forefront of public consciousness.

- **Increased spend on Entertainment**
  Increased consumer spend on Gaming, 3D Animation, Web-entertainment and other forms of digital entertainment.

- **Interaction on the move**
  Nowadays, people are expecting always on, everywhere broadband connectivity.

- **Urbanisation**
  Increased focus on development such as Smart Cities, Wireless Area Networks, Smart Grids.

- **Wealth Creation**
  In developed countries there is a focus on wealth creation. This means that high-end markets are attracting most business focus.

- **Ageing Population**
  In developed countries drives different needs in regards to medical requirements, labour divisions, entertainment, etc., that must be supported by latest technology development.

National Drivers

- **Penetration of Mobile**
  Mobile penetration has reached 100% in South Africa. More people are relying on mobile phones for their livelihood, to access information and to connect with family and friends.

- **Increased Spend on Entertainment**
  As globally, South Africa there is also an increase in spending on entertainment. However, the difference is that consumers are interested in Mobile Gaming, Ringtones, Images, and other products and services that can be utilised and accessed via a mobile device.

- **Companies targeting Bottom of the Pyramid (BOP) Market**
  Currently BOP markets provide the most reliable source of growth in the ICT market. Companies are increasingly looking towards South Africa as a doorway to access the African market.

- **Importance of Social Issues**
  Issues such as Poverty Reduction, Service Delivery Efficiency, Job Creation are much more important than wealth creation.

- **Affordability and Localisation**
  Technologies must be affordable and localised, as most consumers can not afford to follow the latest trend in technology.

- **Younger Population**
  South Africa has a much younger population. This influences technology needs and requirements.
The 10-year ICT RDI Roadmap

The 10-year ICT RDI Roadmap provides a strategic national direction, a set of action-plans and an implementation framework to guide, plan, coordinate and manage South Africa’s portfolio investment for the next ten years in the associated programmes of research, technology development and innovation activity.

At the highest level, the roadmap comprises four elements shown on the opposite page: Drivers, Opportunity Areas, Capabilities and Enablers.

This represents the Market Context of demand and supply in which Opportunities for ICT RDI in South Africa were identified and evaluated.

**Drivers**, both global and local, inform customer Needs at the individual, societal or economic level.

**Opportunities** were identified where the application of ICT can help respond to these Needs.

The six clusters are: Broadband Infrastructure and Services, Development, Sustainability and the Environment, Grand Science, Industry Applications and The Service Economy.

The intention is that these Clusters will remain constant over the ten-year timeframe and refreshed periodically. Opportunities may receive more or less emphasis, new ones may be added.

The ability to address this portfolio of Opportunities successfully depends on the current and planned strength of the supply-side, South Africa’s ICT RDI Capability.

This capability exists in research organisations, academic institutions and industry - we baselined the existing capability in the underlying science at the former two.

Drawing on this analysis, we see that South Africa’s ICT ecosystem will be able to address and deliver upon opportunities in the six Clusters.

The following sections of this document describe these clusters further, in terms of the scope and nature of the Intervention required to address each Opportunity, as well as the anticipated Impact.

**Enablers**, namely Monitoring and Management, Feasibility and Planning, Industry Collaboration, Education and Training and Government Action outline the involvement required of different stakeholders in the ICT ecosystem to enhance the chances of successful delivery of the strategy.

By carrying out enabling actions in a well-coordinated and -managed way, stakeholders will work together more effectively to develop new technologies and offerings, as well as the base capabilities that will allow this to happen.

More detailed information on **Drivers**, **Opportunities** and **Capabilities** is available in the accompanying documents.

- **Broadband Infrastructure and Services**  
  Research and innovation into future means of providing access.

- **Development**  
  Enabling individuals to empower themselves: democratically, socially and economically.

- **Sustainability and the Environment**  
  Using ICT to optimise management of resources, assets and environments.

- **Grand Science**  
  Leveraging the ICT component of Grand Science projects to create new industrial and service capability.

- **Industry Applications**  
  Facilitating growth and performance in existing and emerging sectors.

- **The Service Economy**  
  Enabling improved, lower cost and more convenient access and consumption of physical and digital services.
Fig 3: Summary of Roadmap Opportunity Areas
## Market Opportunities Identified

**Broadband Services and Infrastructure**
- **Future Wireless Technology**
  - Design and development of technologies that respond to changes in demand for wireless broadband services and particularly related to enabling higher availability and quality of connectivity in rural areas (digital inclusion)
- **Broadband Service Infrastructure**
  - Utilisation of public broadcast and wireless spectrums, freed-up through digital migration and new approaches to spectrum regulation

**Development**
- **E-inclusion Development**
  - Making possible and offering access to ICT, so that individuals are able to empower themselves: democratically, socially and economically
  - The application of ICT for socio-economic development
- **Agriculture**
  - ICT to support enhanced agricultural production, principally for the purpose of rendering support to emerging farmers to contribute towards increasing food security, export and in order to mitigate environmental impact

**Sustainability and the Environment**
- **Green and ICT**
  - All means of using ICT to create a greener environment through: improvements in the efficiency and cost of consumption and reduction of the damaging effects associated with consumption
- **Global Change**
  - Sensing, observing and modelling to understand global changes in terms of climate change, human migration, environmental factors.
- **Geo-Spatial Applications**
  - Leverage of technologies related to observation from space and in situ of large areas and detection of related changes. Includes application for remote sensing, earth observation applications, positioning and location-based services, environmental and disaster management.

**Grand Science**
- **Astronomy**
  - Leveraging major science initiatives in South Africa such as SKA
- **Bio-Medical Sciences**
  - The application of computer science and information technology to the field of biology and medicine.

**Industry Applications**
- **Smart Infrastructure**
  - Optimisation of networked infrastructure such as electricity grid, water, roads, rail, pipes, etc
- **Mining**
  - ICT for mine safety and asset location, disaster response, modelling and simulation
- **Manufacturing**
  - ICT systems, systems integration, management information systems, computer aided design, collaborative engineering and robotic management systems for enhanced and modernised manufacturing capacity in South Africa
- **Future Internet Applications**
  - Utilising future Internet and pervasive ICT as platform/environment for the development of new applications
- **Content Creation & Delivery**
  - Participation in and provision of support along the value chain for digital content – creation, production, distribution
- **Supply Chain Optimisation**
  - Supply chain optimisation and logistics management
- **Asset Management**
  - Management, condition monitoring and tracking of physical assets for optimal utilisation (including preventative maintenance) and disposition; protection, including against theft; and maintenance of asset registries

**The Service Economy**
- **m-health**
  - Health management offerings and business models delivered via mobile and online services, including ability to cater for implications of NHI
- **e-services**
  - Electronic delivery of government services including applications in Smart Cities (municipalities being enabled with e-government services)
  - To improve the learning experience, skills and competencies; learning outcomes through integrating ICTs into the education system; the administration and management of the education system
- **Business Model Innovation**
  - Development of business models and scalability cases for ICT (especially mobile) products and services to the developing world markets
- **Payment Solutions**
  - Secure (mobile) payment solutions for developing economies, in respect of both for digital and physical goods and services, including P2P, addressing cash-less applications, unbanked needs, and addressing security and regulatory considerations
- **Outsourced SA Capability**
  - Leveraging South African capacity and capability to deliver transaction- and customer- related services including BPO, infrastructure management as a service and, access to storage and processing utility
- **Systems Integration**
  - Software platforms for management of services industries, involves back-office integration, management information systems, business intelligence and localisation
- **Content and Services Localisation**
  - Development of content and services for the local contexts taking into account local language, data and needs.
- **Mobile Enablement**
  - Making services accessible via mobile platforms
- **Trust and Security**
  - Trust and security offerings intended to create safe environments for online and offline interactions, transactions and networks, with focus on enabling the service economy
Market Opportunities Evaluated

The first phase defined future market opportunities and matched these against existing capabilities to identify whether and how these opportunities can be realised.

- We developed an understanding of the global and local context for ICT RDI, in terms of trends and drivers of technology demand, as well as the global ICT ecosystem.
- In the context of these drivers, we identified 27 areas of Market Opportunity.
- These were substantiated with inputs from experts, then evaluated in two dimensions: Attractiveness, which covers need, as well as the value and potential of the opportunity; and Fit, which covers alignment with national and ICT objectives, as well as the likelihood of realisation.
- We mapped the ICT RDI landscape to understand the foundation of research capability. Strengths in more than 140 capability areas was the basis of our assessment of Fit.

The second phase of the project grouped Market Opportunities into six Clusters.

- For each Opportunity, we further substantiated Attractiveness and Fit, together with experts.
- We articulated a proposed Intervention, together with the anticipated Impact, Progression Path, Instruments and Investment.

- A key element of the Intervention is the ecosystem strategy: which collaborators and partners should be included and how? With clear focus and intent we are becoming smarter buyers in our engagement with international partners.
High-Level 10-Year ICT RDI Roadmap

Fig 4: High-Level ICT RDI Roadmap
## Monitoring and Management

Implementation of a Portfolio Management Office (PMO) enables coordination and management of all strategic, tactical, and operational activity in a transparent and integrated manner.

## Feasibility and Planning

Structured and time-boxed evaluation of developing and new opportunities leads to rapid and sound investment decisions and prioritisation.

## Industry Collaboration

Earlier, more active and targeted engagement of industry in the RDI value chain strengthens the national ecosystem.

## Education and Training

Through the introduction of mechanisms to make visible the nature and trajectory of forward demand for ICT skills, future students shape and complete their education with greater success.

## Government Action

The structured evaluation of Market Opportunities highlights areas where Policy and Regulation inhibitors can be lightened or removed.

<table>
<thead>
<tr>
<th>Capabilities</th>
<th>Enablers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research Organisations</strong></td>
<td>Academic Institutions</td>
</tr>
<tr>
<td>Through the definition of an impact-driven Roadmap to guide RDI activity, research organisations are able to adjust their own strategies to align more closely with this intent and direction.</td>
<td>The Capability Map provided insights into ICT RDI coverage and strength across the landscape. This creates the basis for more coherent cooperation between institutions, in the interests of increased investment efficiency. It also provides strategic input as to where investment is needed.</td>
</tr>
<tr>
<td><strong>Academic Institutions</strong></td>
<td>Industry</td>
</tr>
<tr>
<td>With the Roadmap as a unifying plan, opportunities for the participation of industry and of ICT sector players in RDI activity are clear, well-directed and -managed. In particular, industry input with respect to drivers of demand and needs - both for technology and for skills - is essential to ensure that ICT RDI activity and education remain always attuned to delivering benefit and impact.</td>
<td></td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2012 - 2020</strong></td>
<td><strong>2012 - 2018</strong></td>
</tr>
<tr>
<td><strong>Smart Infrastructure</strong></td>
<td><strong>The Service Economy</strong></td>
</tr>
<tr>
<td><strong>Future Internet Application</strong></td>
<td><strong>M-Health</strong></td>
</tr>
<tr>
<td><strong>Mining</strong></td>
<td><strong>E-Services</strong></td>
</tr>
<tr>
<td><strong>Content Creation and Delivery</strong></td>
<td><strong>Payment Solutions</strong></td>
</tr>
<tr>
<td><strong>Asset Management</strong></td>
<td><strong>Systems Integration</strong></td>
</tr>
<tr>
<td><strong>Outsourced SA Capability</strong></td>
<td><strong>Content &amp; Services Localisation</strong></td>
</tr>
<tr>
<td><strong>Business Model Innovation</strong></td>
<td><strong>Mobile Enablement</strong></td>
</tr>
<tr>
<td><strong>Trust &amp; Security</strong></td>
<td><strong>Enablers</strong></td>
</tr>
<tr>
<td><strong>Content &amp; Services Localisation</strong></td>
<td><strong>Future Internet Application</strong></td>
</tr>
<tr>
<td><strong>Systems Integration</strong></td>
<td><strong>Manufacturing</strong></td>
</tr>
<tr>
<td><strong>Payment Solutions</strong></td>
<td><strong>Supply Chain Optimisation</strong></td>
</tr>
<tr>
<td><strong>M-Health</strong></td>
<td><strong>Education</strong></td>
</tr>
<tr>
<td><strong>E-Services</strong></td>
<td><strong>Business Model Innovation</strong></td>
</tr>
<tr>
<td><strong>Future Internet Application</strong></td>
<td><strong>Outsourced SA Capability</strong></td>
</tr>
<tr>
<td><strong>Mining</strong></td>
<td><strong>内容创作与交付</strong></td>
</tr>
<tr>
<td><strong>Content Creation and Delivery</strong></td>
<td><strong>资产管理系统</strong></td>
</tr>
<tr>
<td><strong>Asset Management</strong></td>
<td><strong>内容与服务本地化</strong></td>
</tr>
<tr>
<td><strong>Outsourced SA Capability</strong></td>
<td><strong>Trust &amp; Security</strong></td>
</tr>
</tbody>
</table>
Investment and Impact

The objective of investment is to achieve a return. In respect of South Africa’s investment in RDI for ICT, the nature of the return sought lies in the Impact that this will deliver, to the economy, for society and to create national advantage.

<table>
<thead>
<tr>
<th>Investment Category</th>
<th>Total to Exit ZAR M</th>
<th>Next Stage ZAR M</th>
<th>Contribution to economy pa ZAR Bn</th>
<th>New Businesses created</th>
<th>Job creation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadband Infrastructure and Services</td>
<td>800</td>
<td>419</td>
<td>12Bn+</td>
<td>5 medium 1200 micro-businesses/ operators</td>
<td>825 high-tech 2625+ other</td>
</tr>
<tr>
<td>Development</td>
<td>596</td>
<td>311</td>
<td>21 Bn</td>
<td>3 medium 1000 micro-franchisees</td>
<td>1750 other</td>
</tr>
<tr>
<td>Sustainability and the Environment</td>
<td>1,479</td>
<td>503</td>
<td>27.6 Bn</td>
<td>10 medium 55 small</td>
<td>1200 high-tech 6100 other</td>
</tr>
<tr>
<td>Grand Science</td>
<td>1,016</td>
<td>588</td>
<td>6.7 Bn+</td>
<td>1 large 4 medium 5 small</td>
<td>450 high-tech 1800 other</td>
</tr>
<tr>
<td>Industry Applications</td>
<td>3,394</td>
<td>1,432</td>
<td>52.2 Bn</td>
<td>15 medium 130 small</td>
<td>1750 high-tech 7200 other</td>
</tr>
<tr>
<td>The Service Economy</td>
<td>2,101</td>
<td>1,411</td>
<td>Significant, but indirect</td>
<td>Significant, but indirect</td>
<td>Significant, but indirect</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9,385</td>
<td>4,664</td>
<td>120Bn+</td>
<td>1 large 37 medium 190 small 2200 micro</td>
<td>4,225 high-tech 19,475 other</td>
</tr>
</tbody>
</table>
Assessment of each Opportunity also included the development of a set of actions required (‘The Intervention’).

These actions are in four categories:

- RDI Activity, in the form of capacity building and strengthening of the underlying science
- the installation or expansion of enabling RDI infrastructure
- the development of knowledge, both in the form of human capital and of intellectual property
- measures to strengthen the ecosystem through participation and partnership

Progression Paths and Instruments were used as the means to identify and quantify the investment needed to enable these actions was defined, both in terms of the total required and to fund the next stage of development, where “next stage” describes one stage of evolution along the Progression Path.

To the degree possible, the anticipated Impact that would be achieved through Investment in each recommended Intervention was quantified, in terms of Wealth, Society and Strategic Advantage.
Progression Paths and Instruments

Progression Paths describe the evolution of the Intervention associated with a Market Opportunity. At each stage of this evolution, particular Instruments are appropriate. The Investment requirements in respect of each Intervention are therefore driven by the application of these Instruments. A range of sources of such investment is anticipated.

### Progression Paths

**0** Exploring is indicated when an Opportunity is identified, but further analysis with stakeholders is required to identify the nature and attractiveness of the Opportunity. The duration and investment required to reach a sound decision in this regard are fixed.

**1, 2** This path is indicated where current research activity and capability is fragmented and requires an initial step to focus on a clear direction. Depending on what is more appropriate, the research centre may be located at an existing institution (1) or operate more independently (2).

**3** Market Opportunities that are clearer, but require focus, direction and coordination will follow this path.

**4** Where the RDI agenda is broader-ranging but closer to market, a Joint Lab with a limited set of partners serves the Opportunity best.

**5** Where the principal emphasis is on developing, integrating and testing end-market technologies and offerings, typically in close partnership with multiple industry players and stakeholders, a Solution Factory is the most appropriate vehicle.

### Instruments

- HCD: Scholarships, courses, studentships, interns, supervision, research leadership
- Knowledge generation
- Technology Development
- RDI Infrastructure
- Partnership (PPP) and Collaboration
- Research Chairs (NRF)
- Centre of Competence
- Seed funding, including innovation stimuli
- Venture Capital

The relationship between Progression Paths, Instruments and Investment is illustrated above.

In this example, a finite amount of investment and time in exploring and evaluating a Market Opportunity results in the decision to establish a Research Centre-of-Gravity which is resourced via a defined set of Instruments, each of which relates to bounded levels of Investment.

The mobilisation phase towards the Research Centre is facilitated by Seed Funding, again in standardised investment volumes.
<table>
<thead>
<tr>
<th>Explore</th>
<th>Build Critical Mass</th>
<th>Embed Capability</th>
<th>Commercialise</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Exploiting</td>
<td>Targeted Research Programme</td>
<td>CoE</td>
</tr>
<tr>
<td>1 (Existing institution)</td>
<td>Exploiting</td>
<td>Targeted Research Programme</td>
<td>CoE</td>
</tr>
<tr>
<td>2 (External)</td>
<td>CoE</td>
<td>CoC</td>
<td>Commercialisation Vehicle</td>
</tr>
<tr>
<td>3</td>
<td>CoE</td>
<td>CoC</td>
<td>Product Development Centre</td>
</tr>
<tr>
<td>4</td>
<td>Joint Lab Self-Sustaining</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Solution Factory Self-Sustaining</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig 6: Progression Paths guide evolution of interventions towards delivery of impact.
Future Wireless Technologies

Future Wireless technologies centres on the design and development of technologies that respond to changes in demand for wireless broadband services and particularly related to enabling higher availability and quality of connectivity in rural areas (digital inclusion)

Via an accelerated emerging and Research Centre phase, applications are prioritised, then a community established around each of these. Drive towards a Centre of Competence in the second phase

Broadband Service Infrastructure

Broadband Service Infrastructure focuses on utilisation of public broadcast and wireless spectrums, freed-up through digital migration and new approaches to spectrum regulation

The intention is to increase access via more available and less costly broadband in underserviced areas. This provides direct support of the drive to improve the delivery of government services

Intervention is to establish a Centre of Excellence in rural broadband and access technologies
## Broadband Services and Infrastructure

<table>
<thead>
<tr>
<th>Investment</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contribution to economy pa</td>
</tr>
<tr>
<td><strong>Future Wireless Technologies</strong></td>
<td></td>
</tr>
<tr>
<td>Total to Exit</td>
<td>Next Stage</td>
</tr>
<tr>
<td>614</td>
<td>316</td>
</tr>
<tr>
<td><strong>Broadband Service Infrastructure</strong></td>
<td></td>
</tr>
<tr>
<td>186</td>
<td>103</td>
</tr>
<tr>
<td>800</td>
<td>419</td>
</tr>
</tbody>
</table>

### Notes:
- Manufacture of local technology with export focus.
- 5 medium businesses.
- 1,200 micro-businesses/operators.
- 200 high-tech businesses.
- 2,625 other businesses.
E-Inclusion

E-inclusion focuses on the removal of barriers to use of ICT for individuals and communities. Such as people with language, economic status, disabilities. Bringing marginalised people into society through the removal of barriers such as language, disability or literacy delivers increased economic participation and more involvement of citizens.

Base capacity needs to be built across the value chain in this area in research, technology development and commercialisation. This needs to be guided by a clear focus and direction in the form of a sound roadmap.

Development

Development is concerned with the application of ICT for socio-economic development.

Effective intervention in this area brings the currently marginalised community into the broader SA context and has the potential to lift GDP by up to 10% in the longer term.

Recommended Intervention is to put in place two research chairs to lead thinking in the area. This research thrust develops into a Centre of excellence in second phase.

As for e-inclusion, the focus and direction should be on the basis of a sound roadmap.

Agriculture

Agriculture encompasses the use of ICT to support enhanced agricultural production, principally for the purpose of rendering support to emerging farmers to contribute towards increasing food security, export and in order to mitigate environmental impact.

Extending extension to the base of the pyramid in a manner that creates new enterprise and job opportunities will serve to increase Agricultural GVA per worker, reverse the loss of investment in resettlement and create agri-business mobility.

The recommended intervention is to establish a Centre of Excellence from the start, which becomes a Centre of Competence focused on Product Development in the second phase.

Progression Path: 2

Progression Path: 2

Progression Path: 3
## Development

<table>
<thead>
<tr>
<th>Investment</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total to Exit</td>
<td>Next Stage</td>
</tr>
<tr>
<td>E-inclusion</td>
<td>114</td>
</tr>
<tr>
<td>Development</td>
<td>275</td>
</tr>
<tr>
<td>Agriculture</td>
<td>208</td>
</tr>
<tr>
<td></td>
<td>596</td>
</tr>
</tbody>
</table>

Addresses poverty and inequality. Extending extension to the base of pyramid creates new enterprise and job opportunities
Sustainability and Environment

► Green and ICT

Green and ICT describes all means of using ICT to create a greener environment – achieve improvements in the efficiency and cost of consumption and reduction of the damaging effects associated with consumption.

The opportunity lies in creating a new industry that comprises new SMEs, as well as new ways of working for established companies.

The recommended intervention is to establish a Centre of Excellence from the start, which becomes a Centre of Competence focused on Product Development in the second phase.

► Global Change

Global Change includes the sensing, observing and modelling to understand global changes in terms of climate, human migration, environmental factors. Enables planning and mitigation.

Given its natural advantages and the strength of the current and developing capacity, South Africa could attract a greater share of the available funding by providing technology, know-how and services to sub-Saharan Africa.

Via an accelerated emerging and Research Centre phase, applications are prioritised, then a community established around each of these. Drive towards a Centre of Competence in the second phase.

► Geo-Spatial Applications

Geo-Spatial Applications leverage technologies related to observation from space and in situ of large areas and detection of related changes. Includes applications for remote sensing, earth observation applications, positioning, and location-based services, environmental and disaster management.

Competence in this area is currently spread thin and requires a market-focused Centre of Competence to provide focus, direction and coordination.

Emphasis is on commercially focused development of services, software packages and knowledge application in the form of consulting and advisory services.
## Sustainability and the Environment

<table>
<thead>
<tr>
<th>Investment</th>
<th>Impact</th>
<th>Investment</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total to Exit</strong></td>
<td><strong>Next Stage</strong></td>
<td><strong>Contribution to economy per annum</strong></td>
<td><strong>New Business</strong></td>
</tr>
<tr>
<td><strong>Green and ICT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>378</td>
<td>144</td>
<td>10Bn+</td>
<td>New industry established. New SMEs as well as new ways of working for established companies.</td>
</tr>
<tr>
<td><strong>Global Change</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>695</td>
<td>264</td>
<td>0.5 - 1% GDP =&gt; 15 - 30Bn</td>
<td>3 medium 20 small</td>
</tr>
<tr>
<td><strong>Geo-Spatial Applications</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>411</td>
<td>95</td>
<td>2.6Bn</td>
<td>1 new industrial value chain: 7 medium 35 small</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>10 medium 55 Small</strong></td>
</tr>
</tbody>
</table>


Grand Science

Astronomy

“Astronomy” is shorthand to describe leveraging the ICT component associated with major science initiatives in South Africa, such as SKA, to deliver impact in other areas.

The performance requirements of the SKA project will drive and challenge advances in all of the ICT building blocks: Hardware, Software, Content, Processing and Connectivity. In effect, the project is an R&D Lab for ICT.

Building out pockets of excellence, especially in visualisation, data filtering, storage and data mining techniques through the creation of a Market-driven Centre of Competence in Data Science and Applications, will enable the development of a strategic national capability in data management, resulting in exportable services.

Bio-Medical Science

Bio-Medical Science is the application of computer science and information technology to the field of biology and medicine.

Further analysis with stakeholders and experts is required to identify the nature and attractiveness of the Opportunity.
## Grand Science

<table>
<thead>
<tr>
<th>Investment</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total to Exit</strong></td>
<td><strong>Next Stage</strong></td>
</tr>
<tr>
<td>Astronomy</td>
<td>1,016</td>
</tr>
<tr>
<td>Bio-Medical Science</td>
<td></td>
</tr>
</tbody>
</table>

| 1,016 | 588 | 6.7Bn+ | 1 large | 4 medium | 5 small | 450 high-tech | 1800 other |
Smart Infrastructure is associated with the management and optimisation of networked infrastructure such as electricity grid, water, roads, rail, pipes...

Improved service delivery with fewer outages, energy efficiencies and environmental management contributions deliver significant economic contribution, businesses and jobs. More broadly, this intervention aligns with the imperative to protect critical infrastructure and with the Global Change Grand Challenge.

The intervention begins by establishing a collaboration centre around Advanced Sensor Networks (ASNSA).

Mining focuses on ICT for mine safety, asset location, disaster response, modelling and simulation.

With significant economic contribution and export potential the thrust of this intervention is to increase mine productivity and viability and hence the continuing operation of marginal mines and the associated jobs.

The intervention leverages the collaboration centre around Advanced Sensor Networks (ASNSA) and builds specific capacity in Disaster Immune Communications and Localisation for Underground Mines.

Manufacture includes ICT systems, systems integration, management information systems, computer aided design, collaborative engineering and robotic management systems for enhanced and modernised manufacturing capacity in South Africa.

Further analysis with stakeholders and experts is required to identify the nature and attractiveness of the Opportunity.

Future Internet Applications describes the use of future Internet and pervasive ICT as a platform and an environment for the development of new applications.

Whilst still early-stage, large impact is anticipated in many application domains, leading to better information, automatic control and improved services.

The opportunity lies in creating a new industry that comprises many new SMEs.

The intervention is to establish a Centre of Excellence from the start, which becomes a Centre of Competence focused on Product Development in phase two.

Content Creation and Delivery is concerned with participation in and provision of support along the value chain for digital content – ie in respect of its creation, production and distribution.

Further analysis with stakeholders is required to identify the nature and attractiveness of the Opportunity.
Industry Applications

- **Supply Chain Optimisation**
  
  Supply Chain Optimisation encompasses efficiency and effectiveness of supply chains, including performance improvement in logistics management.

  This intervention focuses on reducing South Africa’s total cost of logistics (currently 13.4% of GDP), with the resultant economic impact.

  To this end, the implementation of a National Centre for Supply Chain Improvement will combine synergistic pockets of excellence, in order to spearhead and coordinate the research and technology development agenda.

- **Asset Management**
  
  Asset Management relates to the management, condition monitoring and tracking of physical assets for optimal utilisation (including preventative maintenance) and disposition; protection, including against theft; and maintenance of asset registries.

  Intervention is to create multi-disciplinary competence that will focus on the research and development of particular solutions that are geography or industry-specific (high-value maintenance related to resources mining, electricity, gas, bridges, roads).

Progression Path: 2  Progression Path: 1
## Industry Applications

<table>
<thead>
<tr>
<th>Industry</th>
<th>Investment Total to Exit</th>
<th>Next Stage</th>
<th>Contribution to economy pa</th>
<th>New Business</th>
<th>Job creation</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart infrastructure</td>
<td>875</td>
<td>341</td>
<td>10Bn+</td>
<td>5 medium</td>
<td>200 High-tech, 1,000 other</td>
<td>Improved service delivery, fewer outages Environmental observation and monitoring, environmental disaster management, 10% CO2 reduction.</td>
</tr>
<tr>
<td>Mining</td>
<td>456</td>
<td>192</td>
<td>10Bn</td>
<td>5 Medium 20 small</td>
<td>200 high-tech 800 other</td>
<td>Reduce fatalities, energy use pollution.</td>
</tr>
<tr>
<td>Manufacture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future Internet Applications</td>
<td>455</td>
<td>175</td>
<td>9Bn+</td>
<td>Many new SMEs establishment of new industry</td>
<td></td>
<td>Better informed, automatic control, improved services</td>
</tr>
<tr>
<td>Content Creation and Delivery</td>
<td>185</td>
<td>185</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Chain Optimisation</td>
<td>610</td>
<td>272</td>
<td>16bn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset Management</td>
<td>814</td>
<td>263</td>
<td>7.2bn</td>
<td>Many regional service companies, 3-5 national sensor devcos, ca 10 niche providers</td>
<td>1350 high-tech 5400 other</td>
<td>Infrastructure operating better with fewer outages leads to better quality of life for citizens. Municipality and hospitals can provide a much better service if their assets are in a good condition</td>
</tr>
</tbody>
</table>

| Total Investment                  | 3,394                    | 1,432      | **52.2Bn**                  | 15 medium 130 small | 1750 high-tech 7200 other |                                                        |

The Service Economy

- **m-Health**
  m-health is focused on health management offerings and business models delivered via mobile and online services, including ability to cater for implications of NHI.

  The principal impact, in line with millennium development goals, is to improve quality of life through better and more convenient access to healthcare.

  Activities in this area are managed via a coordinating Research Centre. This becomes a Product Development Centre in second stage, evolving rapidly into a Solutions Factory.

- **e-services**
  e-services are the electronic delivery of government services, including applications in Smart Cities (for example municipalities being enabled with e-government services).

  With the emphasis on enabling more modern government through efficient service delivery, the principal focus is more on development than on research, and particularly related to the resolution of integration issues.

  Activities in this area are managed via a coordinating Research Centre. This becomes a Product Development Centre in second stage, evolving rapidly into a Solutions Factory.

- **Education**
  Education encompasses improvements to: the learning experience, skills and competencies; learning outcomes through integrating ICTs into the education system; administration and management of the education system.

  Better educated learners with 21st Century skills are the basis of sustained economic growth and prosperity.

  An organisation, in the form of a Joint Lab, delivers upon a mandate for integration of ICT into schools, bridging the gap between current and emerging technologies and the education system, which is slow to move towards technology.

- **Business Model Innovation**
  Business Model Development is the development of business models and scalability cases for ICT (especially mobile) products and services intended for the developing world markets.

  Further analysis with stakeholders is required to identify the nature and attractiveness of the Opportunity.

- **Payment Solutions**
  Payment solutions are secure (mobile) payment solutions for developing economies, in respect of both digital and physical goods and services, including P2P, and addressing cash-less applications, unbanked needs, as well as trust, security and regulatory considerations.

  Reducing the cost of cash management in the economy to levels in more developed economies has valuable economic impact, not least through direct reductions in the cost of payments made by government to citizens.

  A commercially-driven Solutions Factory is established to develop and test applications and their usability. This becomes self-sustaining within the short term.
Outsourced SA Capability

Outsourced SA Capability speaks to leveraging South African capacity and capability to deliver: transaction- and customer-related services including BPO, infrastructure management as a service and, access to storage and processing utility.

In anticipation that data management will be at the core of the next wave of outsourcing, the opportunity exists to leverage the ICT component associated with major science initiatives, such as SKA (storage, processing, bandwidth, data mining etc.) to develop an indigenous industry sector that offers outsourced data management services to national, regional and international customers.

Further analysis with stakeholders is required to identify the nature and attractiveness of this Opportunity.

Progression Path: 0

Systems Integration

Systems Integration relates to software platforms for management of services industries. Involves back-office integration, management information systems, business intelligence and localisation.

A National Centre for Integration is anticipated capable of addressing needs and challenges at the Enterprise, Application, System and Technology level.

Further analysis with stakeholders and experts is required to identify the nature and attractiveness of the Opportunity.

Progression Path: 0

Content and Service Localisation

Content and Services Localisation is about the development of content and services for the local contexts, taking into account local language, data and needs. Creating local landing platforms for multinationals wanting access to developing world market.

Further analysis with stakeholders required to identify the nature and attractiveness of the Opportunity.

Progression Path: 0

Mobile Enablement

Mobile enablement is concerned with making services accessible via mobile platforms. Better access to relevant information drives more efficient consumption of services, both public and private. More and stronger interaction between individuals and organisations stimulates economic growth.

Development and delivery of new mobile applications drives the emergence of new mobile-service oriented businesses, including in rural areas.

The means to achieve this is through establishing a Joint Lab which becomes self-sustaining by the medium-term.

Progression Path: 4

Trust and Security

Trust and Security is focused on enabling the service economy. Trust and security offerings, including privacy, are intended to create safe environments for online and offline interactions, transactions and networks.

User identity registration is a building block. It enables more efficient service delivery and consumption, in B2B, B2G or between individuals and business or government: removing the need to be physically present allows people access to services with more convenience, ease and less wasted time and cost:

A National Centre for Trust is the core of an ecosystem for identity management and services.

Progression Path: 2
# Service Economy

<table>
<thead>
<tr>
<th>Investment</th>
<th>Total to Exit</th>
<th>Next Stage</th>
<th>Impact</th>
<th>New Business</th>
<th>Job creation</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>m-health</td>
<td>209</td>
<td>209</td>
<td>Secondary</td>
<td></td>
<td></td>
<td>Improved quality of life through better access to healthcare</td>
</tr>
<tr>
<td>e-services</td>
<td>360</td>
<td>360</td>
<td>Primary focus 100% on service delivery</td>
<td>Entrepreneurs develop products for content, delivery, school management</td>
<td>New positions to support, maintain and extend ICT infrastructure</td>
<td>Modernising government</td>
</tr>
<tr>
<td>Education</td>
<td>320</td>
<td>199</td>
<td>Better educated learners delivers prosperity in medium term</td>
<td>Entrepreneurs develop products for content, delivery, school management</td>
<td>New positions to support, maintain and extend ICT infrastructure</td>
<td>Better education improves job opportunities, which raises quality of life. Learners with 21C skills more easily, effectively and efficiently reached via e-services</td>
</tr>
<tr>
<td>Business Model Innovation</td>
<td>5</td>
<td>5</td>
<td>Further analysis with stakeholders required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Payment Solutions</td>
<td>177</td>
<td>177</td>
<td>10 - 13bn</td>
<td>Allows many more smaller businesses to trade sustainably</td>
<td></td>
<td>Increases access, safety and the ability to manage finances, savings and investment at an individual and family level. Easier for people to receive payments – less time wasted, less cost. More transparency, less corruption, increased faith in overall financial system</td>
</tr>
<tr>
<td>Outsourced SA Capability</td>
<td>5</td>
<td>5</td>
<td>Further analysis with stakeholders required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems Integration</td>
<td>387</td>
<td>104</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content and Services Localisation</td>
<td>5</td>
<td>5</td>
<td>Further analysis with stakeholders required</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Enablement</td>
<td>197</td>
<td>167</td>
<td>Large impact from new mobile applications</td>
<td></td>
<td></td>
<td>Better access to relevant information drives services consumption and interaction with individuals and organisations. Stimulates economic growth</td>
</tr>
<tr>
<td>Trust and Security</td>
<td>437</td>
<td>181</td>
<td>User identity registration enables more efficient service delivery</td>
<td></td>
<td></td>
<td>People can access services with more convenience, ease and less wasted time and cost. Enables faster roll-out of government and industry services</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,101</strong></td>
<td><strong>1,411</strong></td>
<td>Significant, but indirect</td>
<td>Significant, but indirect</td>
<td>Significant, but indirect</td>
<td></td>
</tr>
</tbody>
</table>
Roadmap Execution: Portfolio Management

Governance, coordination, management and monitoring of the overall portfolio follows an investment management approach.

The DST will move beyond project-based management of the past to assume a more strategic and proactive role.

This requires the adoption of a portfolio investment approach that manages strategic, tactical and operational activity in an integrated manner.

This will enable more active, efficient, transparent and sophisticated planning, monitoring and management of RDI investments in ICT, at the level of portfolio, programme and project.

With such joined-up innovation governance, the desired impact required by the system-level objectives and outcomes will be achieved with more certainty.

Key objectives of this approach are to enable DST to:

- guide and coordinate ICT RDI activities at strategy and policy level more effectively
- enable earlier and more targeted engagement with industry
- focus and strengthen international collaboration
- play a stronger role in the development of the ICT innovation ecosystem
- track progress and monitor impact more comprehensively and efficiently
- manage risks and performance more actively and effectively

Fig 7: Portfolio Management Approach Integrates ICT RDI activity at three levels

- Define Objectives, Key Initiatives, Strategic and Operating Plans
- Set RDI Portfolio Investment Plans to achieve business strategy
- Continuously monitor Portfolio for progress and impact
- Prioritise, review and refine Programme investments to meet strategic goals
- Re-balance resource allocation - capacity and investment via instruments - to match investment priorities
- Source, evaluate, prioritise and approve Project proposals
- Initiate investments and projects
- Monitor and review project progress; evaluate benefits delivery
To achieve this a Portfolio Management Office (PMO) will be established with this mandate:

“**To ensure the efficient and transparent coordination, monitoring and active management of the portfolio of RDI investments made by South Africa in ICT**”

The functional architecture required to coordinate and manage ICT RDI Roadmap Implementation activity across all three levels is illustrated in figure 8.

The operational mode of DST in the PMO is strategic and will encapsulate:

- the instantiation of proper governance
- providing policy and strategy inputs as direction and guidance for investment decisions
- ensuring adequate and appropriate resourcing of the ICT RDI portfolio
- stakeholder engagement and management, including partnerships with private sector, other government departments, research and innovation institutions, and strategic international partners
- effective continuous environmental scanning to influence and direct both strategy and policy, as well as the direction and evolution of the portfolio
- (at the Programme level) Investment Management; Monitoring, evaluation and impact reporting.

As the DST’s qualified Implementation Partner, the CSIR Meraka Institute will provide services to the PMO in respect of other tactical and operational functions, as well as advisory support and capacity for strategic functions, such as the periodic review and refresh of strategic roadmaps and of the portfolio overall, as DST requires.

A joint workshop confirmed the mandate, objectives, scope and functions of the PMO and explored options for its instantiation.

We anticipate that beyond the improved ability to manage a broad and long-term investment portfolio more effectively and with greater transparency, the creation and operation of a PMO represents an important path-finding contribution to the development of portfolio management as a strategic capability for the DST.
Figure 8: PMO Functional architecture

- Governance
- Decisions
- Funding
- Stakeholders

**Strategic Plans**
- Active Environment Scanning
- Strategic Roadmaps
  • Review
  • Refresh
- Portfolio
  • Review
  • Renew

**Tactical**
- RDI Pipeline Management
- Programme Monitoring
- Evaluation and Impact Reporting
- Programme Investment Management

**Operational Plans**
- Broadband Infrastructure and Services
- Development
- Sustainability and the Environment
- Grand Science
- Industrial Applications
- The Service Economy

**Operational**
- Project Management
  - Lead Research Institution
  - Participating Research Institution
  - Academic Research Institution
  - Industry Partners
  - Other Partners
Stakeholder Participation

The process of developing the Roadmap benefited from the participation of stakeholders from across South Africa’s ICT ecosystem.

With the desktop research study as a baseline, the project consulted with experts in the field through a series of workshops with relevant stakeholders from across the South African ICT RDI ecosystem.

As the graph opposite illustrates, this included participation from academic and research institutes, from industry and from other government departments.

Champions and experts assisted with further substantiation of individual Market Opportunities.

The distribution of a Consolidated Report to outline interim progress provided an opportunity for all to give valuable comment and feedback.

<table>
<thead>
<tr>
<th>Type</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>127</td>
</tr>
<tr>
<td>Industry</td>
<td>106</td>
</tr>
<tr>
<td>Government</td>
<td>44</td>
</tr>
<tr>
<td>Research</td>
<td>40</td>
</tr>
<tr>
<td>Innovation</td>
<td>17</td>
</tr>
<tr>
<td>Forum</td>
<td>2</td>
</tr>
<tr>
<td>NGO</td>
<td>1</td>
</tr>
</tbody>
</table>
## Workshop Participants

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Participating Institutions and Organisations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Landscape KZN</strong></td>
<td>Black IT Forum (BITF), Business Connexion, CSIR Meraka Institute, Department of Economic and Development (KZN), DST, DUT ((ADCOMM), Identisoft Access Systems, Immedia, KPMG Services (Proprietary) Limited, Mangosuthu University of Technology, Microvision, MUT, Neotel, Ocule IT, SITA, Smartxchange, UKZN, UKZN Robotics, Umsizi Consulting, Xpedite</td>
</tr>
<tr>
<td><strong>Landscape Inland</strong></td>
<td>Central University of Technology, CSIR Meraka Institute, CSIR DPSS, Dcisio, DOC, DST, DTI, FSATI, InnovationLab, SAP, SAP Meraka, SITA, Softstart, South African Communications Forum, University of Pretoria, University of Venda, WITS</td>
</tr>
<tr>
<td><strong>Landscape Cape</strong></td>
<td>Cape IT Initiative, Cape Peninsula University of Technology, CSIR CHPC, CSIR Meraka Institute, DST, Eastern Cape Information Technology Initiative (ECITI), Infobahn RDT, Nelson Mandela Metropolitan University, Rhodes University, S1 Corporation, SAP Research, SMC Enterprise, University of Cape Town, University of Stellenbosch, University of Western Cape, Village Telco</td>
</tr>
<tr>
<td><strong>Trends</strong></td>
<td>CSIR Meraka Institute, CTexT, North-West University Potchefstroom, DST, DTI, FSATI, InnovationLab, Nelson Mandela Metropolitan University, University of Pretoria, Venture solutions, VTT Finland, WITS</td>
</tr>
<tr>
<td><strong>Market Opportunities</strong></td>
<td>Black IT Forum (BITF), Cape Peninsula University of Technology, Cell C, CISCO, Convergence Partners, CPSI, CSIR Meraka Institute, DBE, DeLoitte and ISGAfrica, DiData, DOC, DST, DTI, FutureForesight, GITOC &amp; Department of Social Development, GIZ, IDC, InfoDev, The World Bank, Innovation Hub, Internet Solutions /ISLabs, Invenfin / SiliconCape, ISETT SETA, IT4All, Mathomo Consulting and Training, Microsoft South Africa, Nokia, Ontelligent Software Services (Pty) Ltd, Oracle, SABC, SAFIPA Programme, SAP, Siera Wireless, SITA, South African Communications Forum, Swisstech Solutions, Telecomms, Telkom Centre of Excellence in Distributed Multimedia Rhodes University, Tellumat, TIA, Tshohle, UNIDO, University of Pretoria, University of Stellenbosch / MIH Media Lab, Vaal University of Technology, Venture Solutions, Vodacom, Western Cape Provincial Government: ICT Sector Development, WITS, Z-Coms</td>
</tr>
</tbody>
</table>
In the course of developing the ICT RDI Implementation Roadmap, we have been privileged to have had the opportunity to discuss, deliberate, debate and most importantly co-develop the Roadmap with so many stakeholders, key players and experts within the ICT RDI ecosystem.

Their collaborations have significantly enhanced the rigour of the Roadmap and assisted in identifying the means of unlocking the potential inherent in the Market Opportunities, while ensuring we stay globally and nationally relevant and invest in building the competitiveness of our national ICT RDI capabilities.

In this regard, we hereby gratefully acknowledge their invaluable contributions, which will continue to ensure the success and renewal of the execution of the Roadmap, driving South Africa towards Digital Advantage.