



ICT RDI Roadmap

June 2013



Towards Digital Advantage:
Roadmapping South Africa's ICT Future

Objectives of this Presentation

- ▶ Provide an introduction to the ICT Research, Development and Innovation (RDI) Roadmap as the Implementation Plan for National ICT RDI Strategy

Presentation Outline

- ▶ Context
- ▶ Vision and Strategy
- ▶ Building South Africa's Ambition
- ▶ The 10-year Investment Portfolio
- ▶ Structured Engagement and the Synergy Opportunity

CONTEXT: **BENEFITING FROM DIGITAL CONVERGENCE**

The Economic and Social value of ICT

ICT is a driver of **economic growth**

In South Africa
*"the Internet
economy is worth
R59 billion (2011)
and contributes
some 2% to GDP"*

Sources:
ICT for Economic Growth: A Dynamic Ecosystem Driving The Global Recovery - World Economic Forum, 2011
Kenya Economic Update, December 2010
Worldwide Worx Report

Economic Growth

- ▶ When Internet penetration rises by 10% in emerging economies, GDP increases by 1 to 2 %
- ▶ The GDP growth rate of a developing country can be boosted by 0,59 % per annum for every 10 mobile telephones added per 100 inhabitants
- ▶ For the U.S. economy, every \$ invested in broadband provides a tenfold return. Faster broadband deployment in Europe could create 1 million jobs and growth of €850 billion through 2015.
- ▶ "ICT has been the main driver of Kenya's economic growth over the last decade. ... Since 2000, Kenya's economy grew at an average of 3.7 percent. Without ICT, growth would have been a lacklustre 2.8%"

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Key points of this slide:

1. ICT has brought about tremendous changes over the last twenty years, but this is only the beginning.

- We are in the middle of a major disruption that is termed "digital convergence"
- Technology is changing our business models and consumer experience faster than ever
- ICT is now part of the fabric of developed economies
- ICT has become an intrinsic part of everyday life to the extent that, like electricity, modern society could not function without it

2. ICT enables significant economic growth as highlighted by the points on the right. In particular, Kenya's economy has grown substantially more due to ICT.

3. For SA to benefit from ICT

- We require a high degree of national ICT capability
- With the right investments in our national ICT capability, we can address our national priorities and become more than a distribution market by positioning ourselves to capture more of the value of the new digital value chain

ICT contributes directly to key dimensions of national economic growth

WEF Global Competitiveness Report 2012-13

South Africa ranks 52 of 144 countries

12

- ▶ Systematically strengthen ecosystem capacity and collaboration
- ▶ Make ICT RDI pipeline more investable via earlier and targeted industry engagement

11 and 7

Create new industrial and Tradeable Services capability in Analytics and Data Science

9, 5, 4, and 2

- ▶ Research, develop innovative means to provide internet access (in support of Broadband Access)
- ▶ Support initiatives to increase connectivity in schools

Stage of development

1

Factor driven

Transition 1-2

2

Efficiency driven

Transition 2-3

3

Innovation driven

—○— South Africa
—●— Efficiency-driven economies



4

Leverage proliferation of mobile technologies to improve primary healthcare delivery and primary education

5 and 12

- Execute explicit ecosystem skills building strategy
 - ▶ Increase alignment of HEIs with forward market demand for skills
 - ▶ Increase attractiveness of higher degrees and careers in ICT RDI

6 and 12

- ▶ Build local technologies to reduce imports, engage MNCCs as Smarter Buyers
- ▶ Stimulate increased Government procurement of advanced technology products

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The World Economic Forum (WEF) Global Competitiveness Report ranks countries based on the 12 key dimensions shown on the slide. In the 2012-13 Report, South Africa was ranked at nr 52 out of 144 countries. It is important to note that these dimensions are dependent of each other as the Report notes "...they tend to reinforce each other, and a weakness in one area often has a negative impact in others. For example, a strong innovation capacity (pillar 12) will be very difficult to achieve without a healthy, well-educated and trained workforce (pillars 4 and 5) that is adept at absorbing new technologies (pillar 9), and without sufficient financing (pillar 8) for R&D or an efficient goods market that makes it possible to take new innovations to market (pillar 6)."

The Report classifies countries based on 3 stages of economic development:

- **Stage 1 - Factor driven economy:** "The country compete based on their factor endowments—primarily low-skilled labour and natural resources. Companies compete on the basis of price and sell basic products or commodities, with their low productivity reflected in low wages. Maintaining competitiveness at this stage of development hinges primarily on well-functioning public and private institutions (pillar 1), a well-developed infrastructure (pillar 2), a stable macroeconomic environment (pillar 3), and a healthy workforce that has received at least a basic education (pillar 4)."
- **Stage 2 - Efficiency driven economy:** At this point, countries must develop more efficient production processes and increase product quality because wages have risen and they cannot increase prices. Competitiveness is increasingly driven by higher education and training (pillar 5), efficient goods markets (pillar 6), well-functioning labour markets (pillar 7), developed financial markets (pillar 8), the ability to harness the benefits of existing technologies (pillar 9), and a large domestic or foreign market (pillar 10).
- **Stage 3 - Innovation driven economy:** In this stage, wages will have risen by so much that they are able to sustain those higher wages and the associated standard of living only if their businesses are able to compete with new and/or unique products, services, models, and processes. Companies must compete by producing new and different goods through new technologies (pillar 12) and/or the most sophisticated production processes or business models (pillar 11).

South Africa (blue solid line) classified as an efficiency driven economy is doing well compared to the average of other efficiency driven economies (black solid line) on the dimensions of "Financial Market Development" and "Market size", but is lagging behind on key pillars such as "Health and Primary Education". As stated in the report, for South Africa to improve the current competitiveness the country must invest more substantially in research, development and innovation (RDI) that leads to innovation and impact. The slide shows how ICT RDI can significantly contribute to some of the key pillars and directly improve the competitiveness of South Africa.

Underinvestment in ICT R&D, in international comparison

2009 data, pa	Population (million)	GDP \$Bn	GERD % GDP	ICT R&D as % GERD	ICT R&D as % GDP	ICT R&D Expenditure (\$Bn)	ICT Sector Size (\$Bn)
South Africa	50	286	0,92%	13,1%	0,12%	0,34	29
Brazil	191	1 572	0,9%	19,4%	0,46%	7,3	110
South Korea	49	929	3,0%	44,8%	1,73%	16,1	261
Australia	23	925	1,7%	15,9%	0,43%	4,0	129
Taiwan	23	379	2,3%	19,0%	1,85%	6,4	200

► South Africa spends close to 10% of GDP on ICT goods and services, of which most are imported

► 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

► OECD Review of the South African NSI - Report: South Africa ranked below bottom five on ICT for Innovation

*To harness the socio-economic benefits of ICT and to be a player in ICT, we must **significantly** increase investment in ICT RDI*

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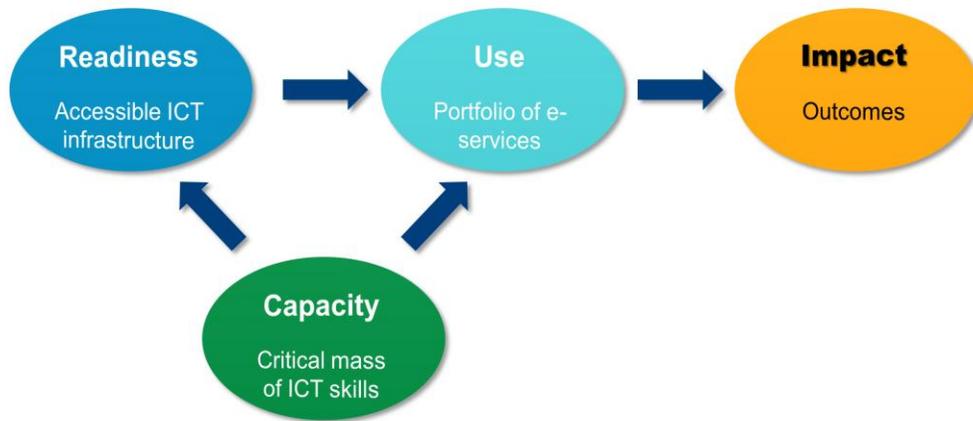
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Key point of slide: Currently South Africa is underinvesting in ICT RDI both in terms of our GERD (Gross Expenditure on Research and Development) and the % of GDP spend on ICT RDI. This is significant when compared to other relevant countries:

- Brazil as another BRICS country
- Australia as another commonwealth country with whom we have strong relationships
- South Korea and Taiwan as countries recognised by the ITU (International Telecommunications Union) that are leading ICT RDI globally.
- Both Brazil and Australia spend 4 times more (as a % of GDP) on ICT RDI than South Africa

Note that data was taken from 2009. For 2010 GERD had dropped to 0,87%, but ICT RDI as a % of GDP has risen slightly to 0.14%.

Three key investment levers for creating Impact via ICT



Source: ITU – Measuring the Information Society

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This slide is based on the Measurements used by the ITU to describe an Information Society. To achieve impact you need investment in three dimensions:

- 1) Readiness, which speaks to ICT infrastructure (eg. Telecommunications lines or Broadband infrastructure) and how accessible they are to the general public
- 2) Capacity: the technical know-how and skills to both manage ICT infrastructure and develop technical innovations on top of the infrastructure
- 3) Use: the ability to use, via services or applications, the available infrastructure

Two-fold strategic intent in developing the ICT RDI Roadmap

1. Enable **increased** public and private **investment in ICT RDI**:

- ▶ Provide a mechanism to **forecast** technology developments in target areas
- ▶ **Identify critical areas** that must be developed to meet SA's socio-economic objectives
- ▶ Surface and demonstrate the research community and sector's understanding and agreement on the **trends, market potential, priorities** and investment requirement
- ▶ Identify ways to leverage R&D investments through **coordinating** research activities nationally and regionally

2. Provide a **framework to plan and coordinate technology development** internationally, nationally and regionally – to enable efficient and **sophisticated investment decision-making**

DST initiated the development of a 10-year ICT Research, Development and Innovation (RDI) Vision and Implementation Roadmap, intended to:

- Take the national ICT RDI Strategy to the next level, in a way that strengthens the local ICT ecosystem
- Enable DST to develop and implement a set of specific interventions required to guide and direct ICT RDI activity in South Africa
- Position South Africa more competitively in the global market, taking cognisance of and addressing the challenges facing a developing economy

DST and CSIR Meraka Institute partnered to develop this Roadmap for South Africa with a two-fold strategic intent described in the slide.

VISION

Vision: Create Digital Advantage for South Africa – from individual to society

Our vision is for a South Africa that has overcome the Digital Divide; by leveraging advances in ICT to address socio-economic challenges it has created **Digital Advantage**

This will be done through **sound investment** and **effective coordination** of ICT R&D and innovation activities

- ▶ Principal focus: satisfaction of National Needs (deliver Impact against 12 Outcomes)
- ▶ Focused export activity as technologies arrive on-market (ie AFIS)
- ▶ Test technologies with local customers before broader export

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The vision of the ICT RDI Roadmap is to create Digital Advantage for South Africa through ICT RDI investment.

The conditions for Digital Advantage is:

- Advanced human capital. Strong and institutional capacity
- Tight engagement with research communities; fast uptake and promotion of research results, indigenous innovation
- A healthy innovation ecosystem focused on achieving impact in society
- Advanced ICT infrastructure connecting South Africa
- Local content and applications that address local needs and also create export opportunities

The bulleted points on the right speaks to the ICT RDI Roadmap's initial focus:

- To create ICT RDI that enables the delivery on the 12 national outcomes and impacts national needs.
- Targeted and focused activities to create technologies that has export potential (eg. Advance Fire Information System – AFIS that already has been exported to Southern California and Eastern Africa)
- These technologies will be tested with local customers (as AFIS was first tested with Eskom) before broader export.

ICT RDI for Digital Advantage 2023: Strategy

Context

Short to medium term

- ▶ Export potential limited due to global economic situation
- ▶ Consumer spend limited
- ▶ Likely economic trajectory – fixed investment

3-5 years from now

- ▶ Global economic recovery
- ▶ Emerging Market growth

Potential

- ▶ Government spending shifts to infrastructure investment and unspent infrastructure budget
- ▶ Transnet R300 billion investment as energy point
- ▶ MTSF priorities present opportunities to service domestic demand
- ▶ Private sector reserves

Strategy

Build ICT RDI capabilities focused on local needs, with export potential in longer term

Catalyse government and industry investment:

- ▶ Provide direction through prioritised market opportunities that are driven by local needs
- ▶ Catalytic MTEF funding to build ICT RDI capability
- ▶ Systematic harmonisation with line departments ie DoC, DoH and adjacent programmes ie Space
- ▶ Strategically involve MNCs
- ▶ Prepare for export opportunity when global economy recovers in 3 to 5 years
- ▶ Monitoring and Evaluation of investment through a portfolio management approach (Office of the Digital Advantage 2023)

The basic strategy for the ICT RDI Roadmap is to build ICT RDI capabilities focussed on local needs, but with export potential in the long term. To do this, the Roadmap needs to catalyse both government and industry investment as explained in the slide. This must be done within the context of the current global economic market ensuring that South Africa is “market-ready” when opportunities emerge during the global economic recovery. Potential leverage points are government infrastructure spending, investments by industry players such as Transnet, South African government’s medium term strategic framework (MTSF) priorities and private sector reserves that can be earmarked for Research and Development (R&D).



This slide presents the full ICT RDI Roadmap. The Roadmap consists of six clusters of 27 market opportunities. The clusters are:

Broadband Infrastructure and Services, ICT for Development, Sustainability and the Environment, Grand Science, Industry Applications and The Service Economy

The descriptions at the bottom gives a definition of each cluster.

From the 27 Market Opportunities, 6 priority areas were selected for the initial MTEF cycle (2013-2016) to kick-start the investment strategy: As illustrated in the figure above, these are:

M-Health: The initial focus in the Service Economy Cluster will be on innovation in mobile technologies, particularly in their use for Health applications. These will leverage developments in related Market Opportunities in this Cluster: E-services, Payment Solutions, Mobile Enablement and Trust and Security

Astronomy: As a Market Opportunity in the Grand Science Cluster, this area will focus on leveraging the ICT components of large projects like Meerkat and SKA to create new industrial and service capability, that will become Outsourced SA Capability in the longer term

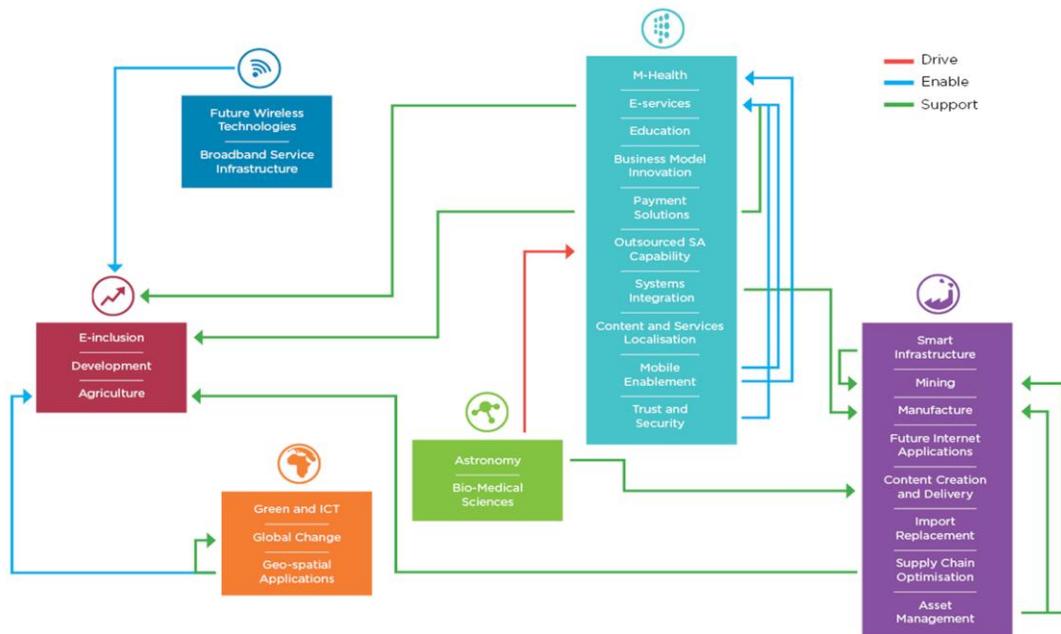
Smart and Green Infrastructure: Two Market Opportunities, “Smart Infrastructure” (Industry Applications cluster) and “Green And ICT” (Sustainability and the Environment Cluster) are focused on developing and further enabling physical and digital Infrastructure so that it is optimised for efficiency, whilst reducing its impact on the environment, whether natural or built

Geo-Spatial Applications and Global Change: Both Market Opportunities are also part of the Sustainability and the Environment cluster which seeks to use ICT to optimise the management of assets, resources and environments, including more effective management and preparedness for the eventualities of climate change

Broadband Infrastructure and Services cluster, with a focus on the 2 Market Opportunities: Future Wireless Technologies and Broadband Service Infrastructure with both the required building blocks for providing innovative means of future access

ICT for Development has three Market Opportunities: E-Inclusion; Development and Agriculture. These are focused on enabling individuals to empower themselves economically, socially and democratically

Affinities exist between Market Opportunities and between Clusters



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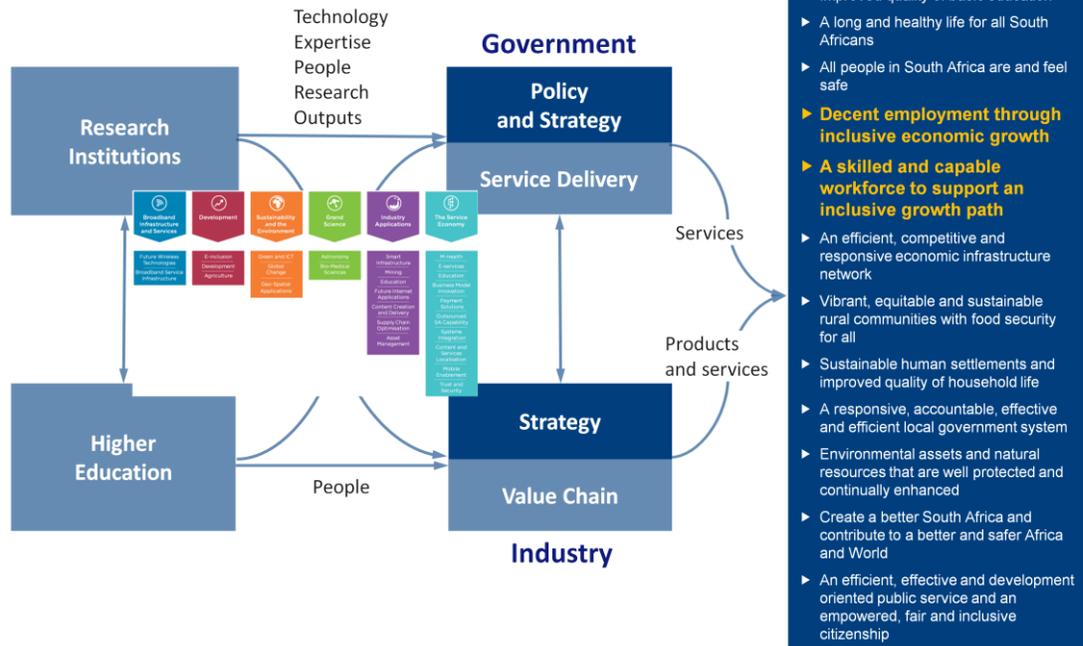
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There are many affinities that exist between market opportunities (MO's) and clusters. In the case of ICT RDI, it can:

- *Drive new industries.* For example building capability in data science and applications (For Astronomy(SKA)) could create strategic national capacity, in combination with the South African National Research Network (SANReN) and the Centre for High Performance Computing (CHPC), in the form of an industry sector that offers outsourced data management services to local and international customers.
- *Enable existing market opportunities.* Work in Mobile enablement and Trust and security will enable RDI in M-Health.
- *Support existing industries.* MO's such as Asset management can support ICT RDI in industries like Manufacturing and Mining.

The Roadmap frames and guides ICT RDI activity – focus is on Impact Outcomes



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Our approach in developing the roadmap has been to address national priorities as articulated in the 12 Government outcomes.

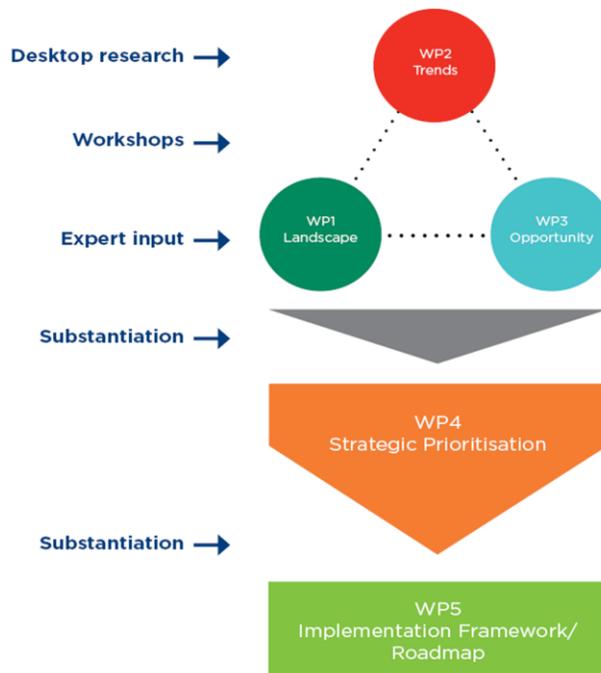
The Roadmap is therefore a plan and direction that coordinates the actions of Government, Industry, academic institutions and the research community to build the necessary capabilities and develop technology and applications that address national challenges.

Research impact pathways are used as a model to show how research flows from research and higher education institutions, through its outputs such as people, technology and expertise to make impact in society and the economy. Impact is achieved either by better strategy and policy or by directly impacting on service delivery or by improving services to citizens.

The ICT RDI Roadmap coordinates interaction with various role players in order to achieve impact on the identified outcomes.

SOUTH AFRICA'S AMBITION: BUILT FROM THE BOTTOM UP

Developing the ICT RDI Roadmap – Ecosystem Triangulation Methodology



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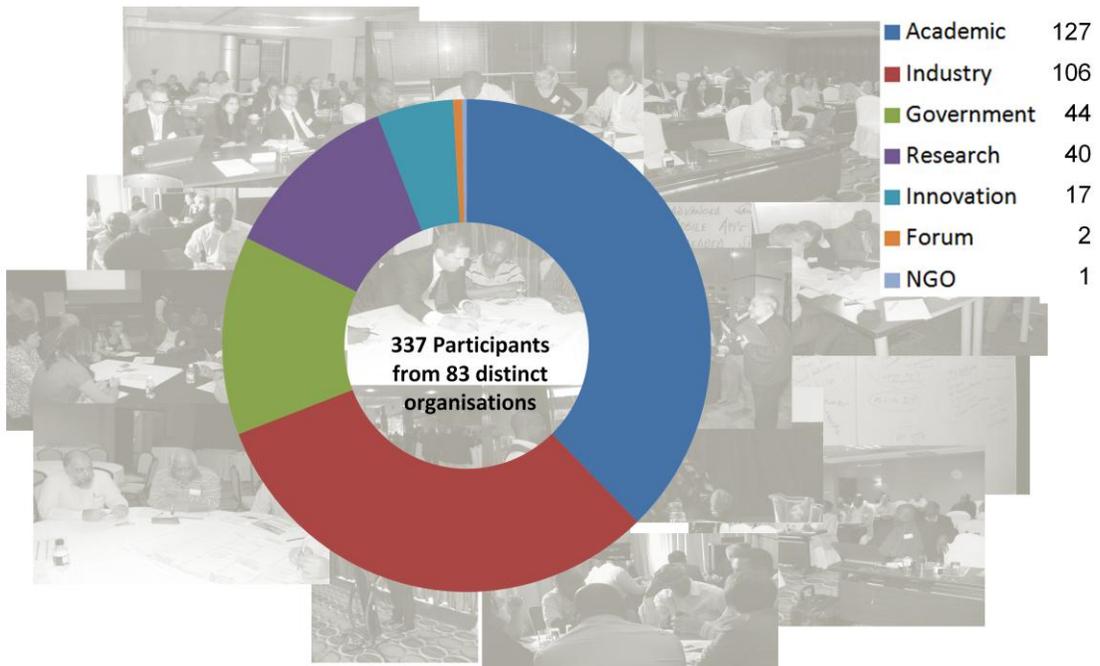
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The ICT RDI Roadmap was developed through extensive interaction with all relevant role players in which an Ecosystem Triangulation Methodology was used. Thus we looked at:

- **The Landscape** (work package 1) to investigate the local capability and capacity to deliver and that which require development
- **Trends** (work package 2) to ensure we are globally and locally relevant
- **Market Opportunities** (work package 3) to ensure sustainability and attractiveness for funding. In other words what are the market pull for ICT RDI.

Information was gathered through desktop research, 5 workshops (3 Regional Landscape workshops in Western Cape, Inland and KwaZulu-Natal; 1 Trends workshop and 1 Market Opportunity workshop) and expert inputs. A strategic prioritisation exercise was conducted with relevant stakeholders which lead to the development of the final Roadmap. Throughout, everything was substantiated with expert inputs and relevant stakeholders.

Broad Participation from all stakeholders



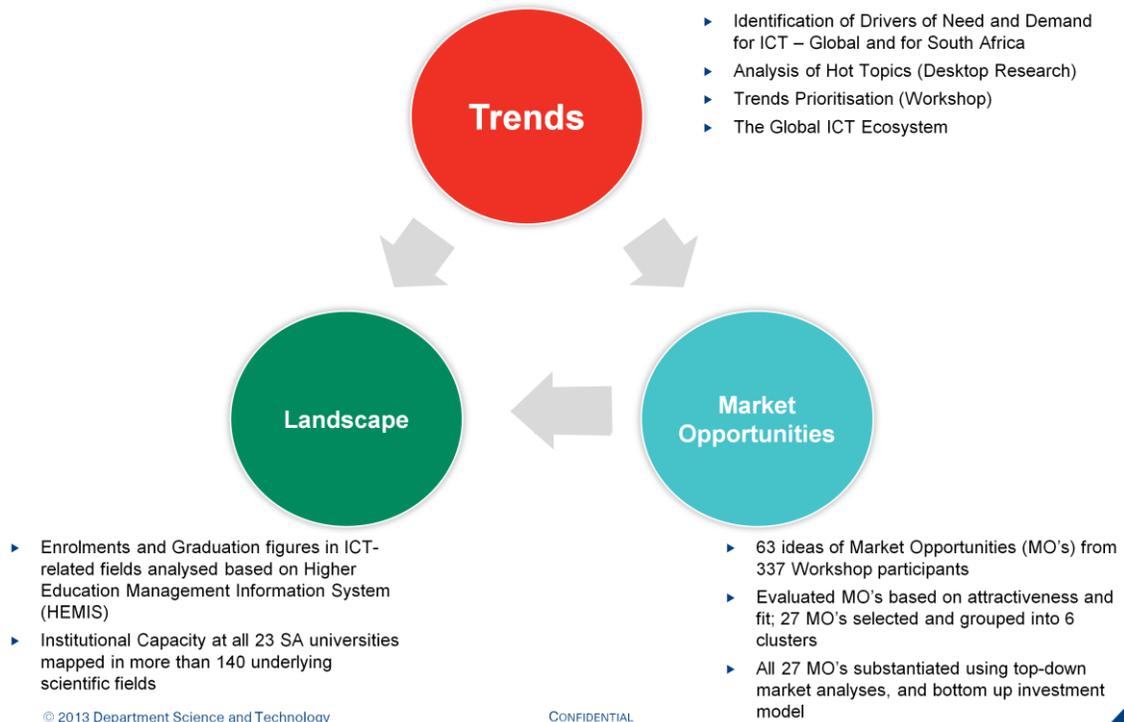
The key point of this slide is to highlight that 337 individuals representing 83 organisations took part in the development of the Roadmap.

Broad Participation from all stakeholders

Workshop	Participating Institutions and Organisations
Landscape KZN	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
Landscape Inland	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
Landscape Cape	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
Trends	CSIR Meraka Institute, CText, North-West University Potchefstroom, DST, DTI, FSATI, InnovationLab, Nelson Mandela Metropolitan University, University of Pretoria, Venture solutions, VTT Finland, WITS
Market Opportunities	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 & 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, Swisttech 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

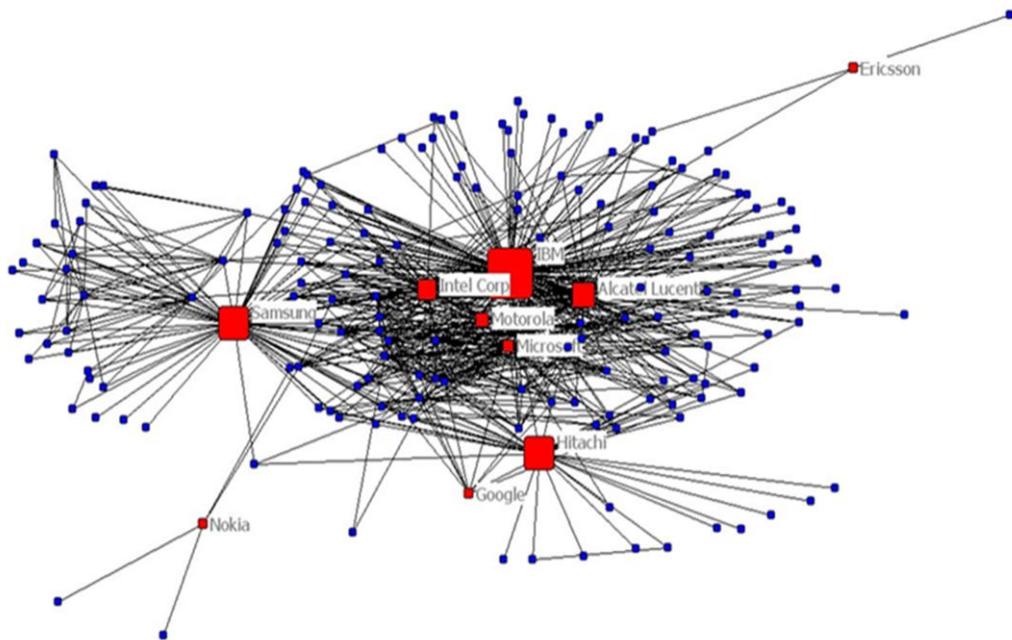
A list of participants - in terms of institutes represented - for each workshop is shown in the slide. Of note is the number of industry participants during the market opportunities workshop, showing both the interest in and relevance of ICT RDI. This also ensured that the elements of the ICT RDI Roadmap are of interest to industry.

Key insights gained from 5 workshops across South Africa



For each of the work-packages, key insights were gained as shown in the slide.

Global ICT ecosystem



Data source: Thomson Reuters Web of Science, Articles , Proceedings and Meeting Abstracts.
N: about 60 000
Note: Data not cleaned – work in progress
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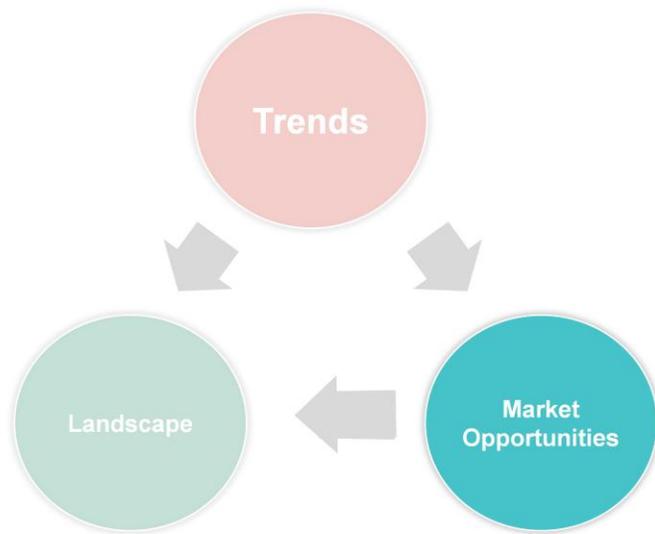
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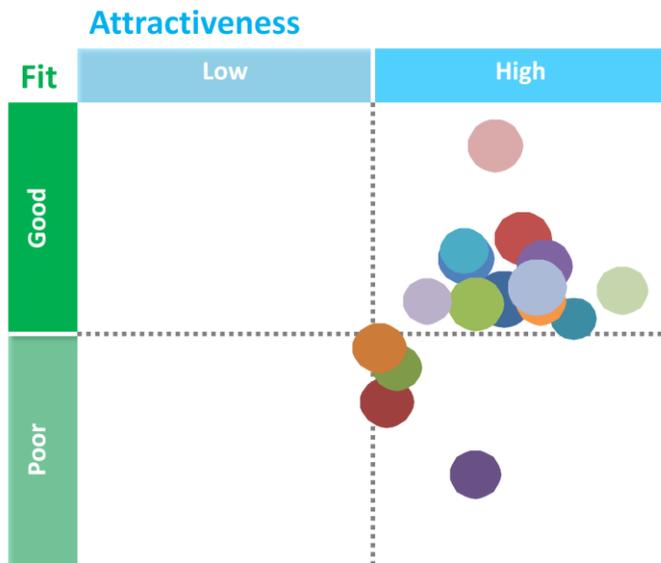
One of the key findings highlighted during the Trends workshop by Dr Hannes Toivaren from VTT in Finland, is that no major ICT RDI company / institute is currently operating in isolation. Most companies have formed an ecosystem of partners with whom they conduct ICT RDI. For ICT RDI to be successful you require the platform / content / application developers; the network providers; the consumers (on a global trade level) and the standardisation partners all to work together. In this manner “Innovation Hotspots” are formed, which combine a strong R&D base with business acumen and user-driven innovation.

This is illustrated with the figure in the slide, which shows the top 10 global ICT companies, and their links or cooperation with another. Here each link signifies more than 10 co-authored publications between the two interlined organisations. The figure shows that companies such as Microsoft, Intel Corporation, Motorola and IBM have formed a strong ecosystem around themselves. Similarly, through Samsung, companies on the Asian Continent are linked to this US ecosystem, ensuring strong cooperation between US and Asian technology partners. The figure also shows the current isolation of European companies, such as Nokia and Ericsson, and explains the recent partnership between Nokia and Microsoft.

South African and African ICT research organisations thus need to stand out and develop distinct, region-specific winning ecosystems. This is particular important as European and North American models do not pay serious attention to poverty or societal challenges in their ICT agendas, in contrast to African countries where these challenges require prioritisation. A national strategy must therefore be able to show how to integrate, capture an add value to the global ICT ecosystem.



Identified, substantiated and evaluated 27 Market Opportunities



Attractiveness

► Need

Job, customer, outcome, outcome value, alternative solutions

► Market Opportunity

Commercial potential, competitive situation, window of opportunity

► Inhibitors

Market, policy, regulation, RDI infrastructure, investment

Fit

► SA Strategic Fit

SA relevance, fit with National priorities, alignment with ICT Strategy

► Synergies

with current technology, production, marketing and investment capacities

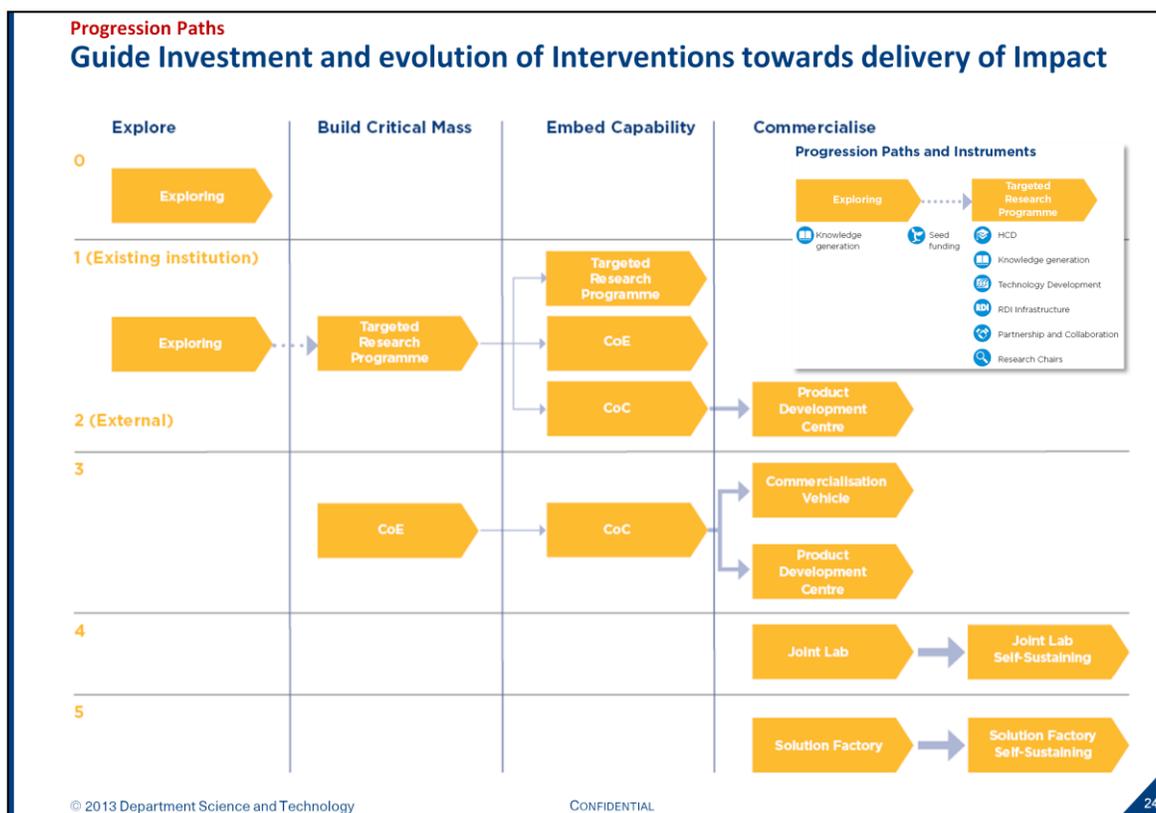
► Realisation

Technology status, fit with current and future capability, partnerships

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Each market opportunity were analysed and prioritised based on a comprehensive and consistent set of criteria in two dimensions:

- The Attractiveness value is derived by scoring the need and market opportunity, and recognising the influence of inhibitors.
- Fit is scored based on alignment to South African strategic objectives, synergies with current capabilities and the likelihood of successful realisation and addressability in terms of current and planned South African ICT RDI capability.



Progression Paths describe the evolution of the Intervention associated with a Market Opportunity, from exploration to commercialisation. 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. Investment instruments could be RDI infrastructure investments, Research chairs, Human capital development (Scholarships, courses, studentships, interns, supervision, research leadership), investment into research groups, seed funding, venture capital, etc.

Different MO's might be at different stages of this evolution and thus require different types of instruments and associated investment during this stage:

Progression path 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.

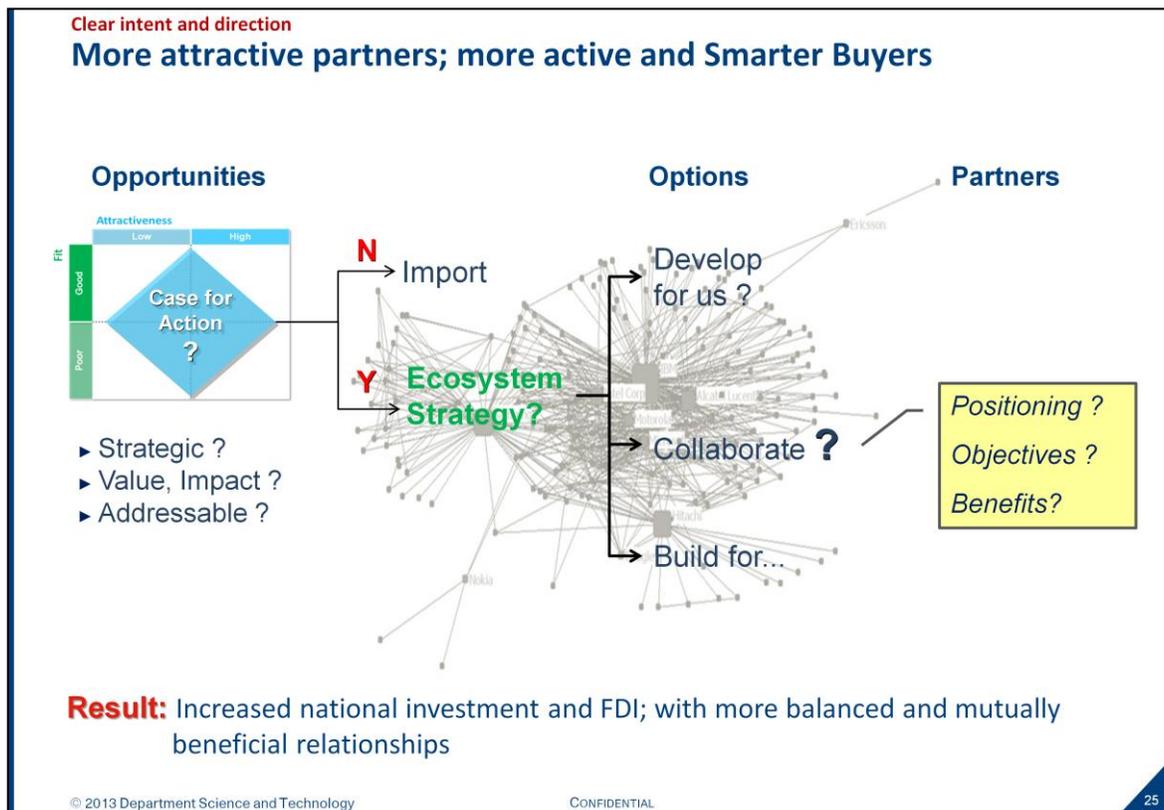
Progression paths 1, 2: This path is indicated where current research activity and capability is fragmented and requires an initial step to concentrate and focus on a clear direction. Depending on what is more appropriate, the research centre may be located at an existing institution (1) or operate more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

Progression path 3: Market Opportunities that are clearer, but require focus, direction and coordination will follow this path from a centre of excellence to a commercialisation vehicle.

Progression path 4: Where the RDI agenda is broader-ranging but closer to market, a Joint Lab with a limited set of partners might serve the Opportunity best, for example.

Progression path 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 might be the most appropriate vehicle.

Using progression paths, market opportunities can be planned and the cost associated estimated.



To ensure the South African ICT RDI community can act as Smart Buyers, a case for action was established for each Market opportunity (MO). Based on a structured evaluation of Attractiveness and Fit for each Market Opportunity, determine whether SA should or can participate, or if there are “others” more suited to deliver (import).

If there is a case for SA to participate, an ecosystem strategy was utilised to understand:

- Whether we should develop the technologies ourselves for local needs (eg. Certain aspects of Trust and security MO related to national security)
- Collaborate with others (foreign institutions) either for local needs or exports
- Build specifically for export potential

With a sharper intent and direction, the scope and scale of ICT RDI activity now planned is more transparent and investable, ensuring balance and mutually beneficial relationships across the ecosystem.

Market Opportunity - Example

Geo-Spatial Applications and Global Change: Intervention and Impact

Intervention		Impact	
RDI Activity		Wealth	
Build Capacity	Competence very spread out, so needs better coordination. Set up Centre of Competence to prime and focus relationship between industry, science councils and users. Develop Top 3 prioritised list of applications, then establish a community around each of these –status, R&D efforts, investment opportunities	Contribution to economy	2.6Bn
Underlying Science	Advanced remote sensing, sensor web enablement and OGC web services, geomatics, spatial databases, EO data structures & algorithms, image processing, machine learning and time-series analysis, scientific workflows, HPC for EO	New businesses	7 medium, 35 small
RDI Infrastructure		Job Creation	700 high-tech, 2800 other
Install, Expand	Leverage Earth Observation Data Centre, CHPC. Expand storage, broadband connectivity to share data. Own space assets, in-situ sensing networks, ground, field, water, meteorological data and systems	Society	
Knowledge		Quality of Life	Access to localised geo-spatial services
Competence	HCD, HRD Via Centre of Excellence	Service Delivery	Improvements enabled through availability of local geo-spatial applications for public sector institutions
IP	Techniques for development of massively scalable algorithms	Strategic Advantage	
Ecosystem		Foreign Policy Objectives	GEOSS and participation in global forums and meeting global targets and initiatives. Participation and support in Africa Self sufficiency
Industry Participation	Set up Centre of Excellence – Stellenbosch, Pretoria, UCT Marine	Science Objectives	Localised solutions
R&D Institutions, Science Councils	GIS and Geo-spatial companies. Industry customers – users of geo-spatial information to provide services	Government Action	
Partnerships	RCMRD, US geo-spatial institutes, ESA and Frame Work Programme participants	Policy	
Innovation	Via market-focused Centre of Competence and network of industry customers	Regulation	
Commercialisation	Focus on services, software packages, knowledge application (consulting and advisory services)		

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The market opportunity “Geo-Spatial Applications and Global Change” is used to illustrate how investment and impact was determined. The methodology is described below:

Investment Estimation

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
- Knowledge Generation, 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. This 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.

Impact Estimation

Contribution to the Economy

For each Market Opportunity – to the degree possible – experts developed a quantified estimate of the benefit, expressed in terms of relevant economic, financial socio-economic metrics (GDP, annual costs or quality of life measures), that would accrue as a result of successful delivery. This references the value chain understanding described in the previous slide

New businesses created

For each Market Opportunity, experts gave an indication / estimated the number of businesses and the size of these businesses we would expect to see at every step of the value chain

Large business (= ~1000 employees)

Medium business (= ~250 employees)

Small business (= ~50 employees)

Job Creation

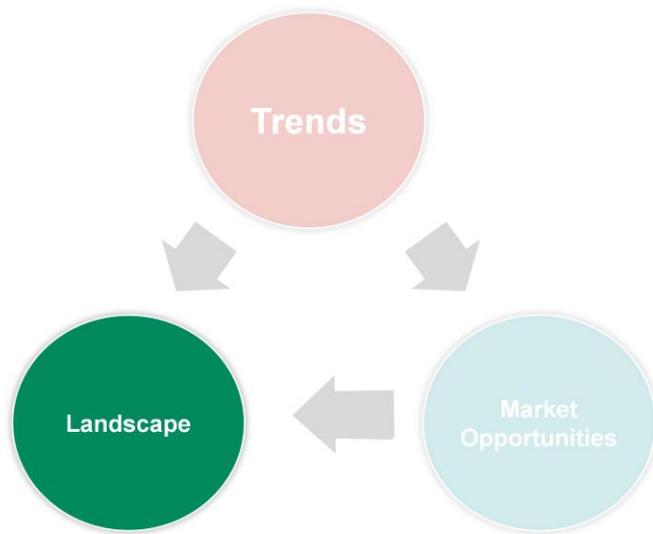
For each market opportunity, we anticipated for the total value chain what proportion of the total number of jobs created would be high-tech and what percentage would be “other” Typically the proportions assumed are High-tech = 20%, Other = 80%.

Social Impact

Where possible an indicative estimate of the social impact was made on the dimensions of “quality of life” and “service delivery”.

Strategic Advantage

Potential contribution to strategic advantage was identified with respect to “Foreign Policy: and “overall Science objectives.”

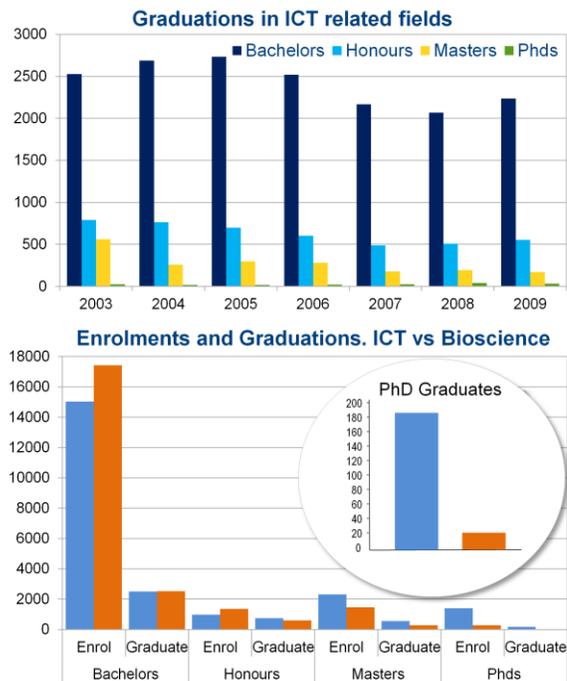


Requirement:

Focus, strengthen and grow the 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 after bachelor's degrees**. This causes a subsequent domino-effect in the pipeline for advanced degrees
- ▶ Despite similar enrolments at Bachelor level, **Biosciences PhD graduations are 9.3 times those of ICT**

*Strengthening and growing the pipeline requires **critical mass**. Supply-side interventions are required*



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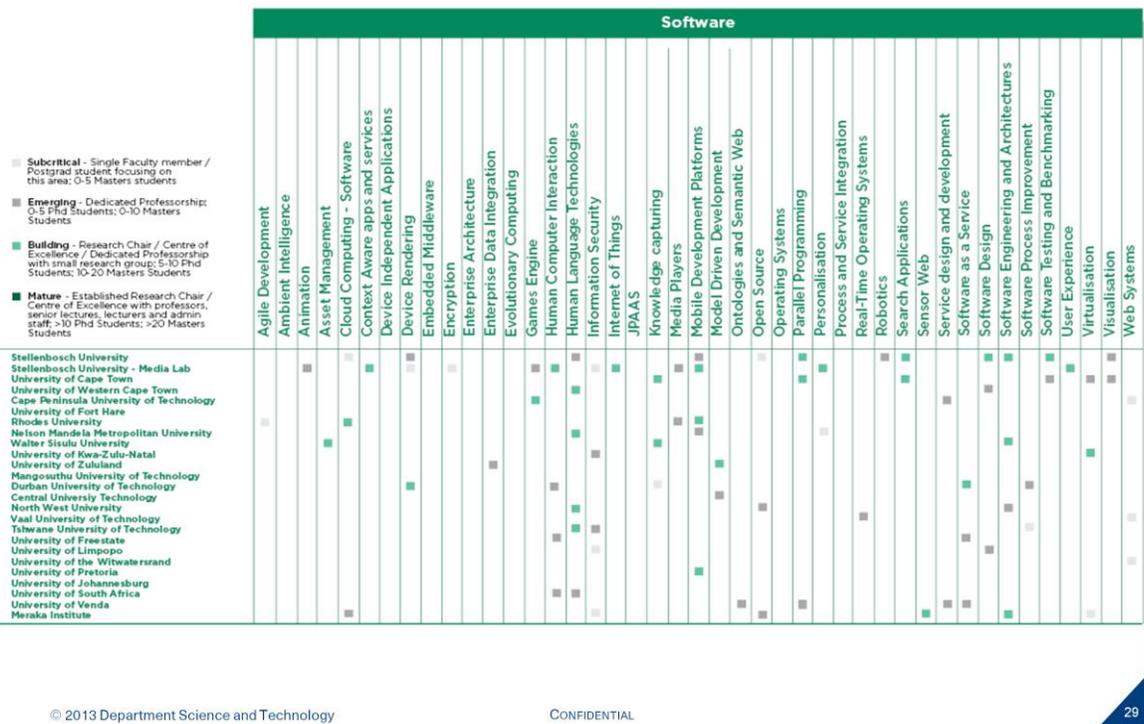
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To understand the development of human capital with advanced knowledge and skills in the ICT field, the Higher Education Management Information Systems (HEMIS) data (2009) from the department of Higher Education and Training (DHET) were analysed. The insights gained from this are shown in the slide.

When compared to Biosciences, which started with a similar number of enrolments, only 20 doctoral graduates were produced in an ICT related field in 2006, while Biosciences produced 186. The lure of a high-paying job in the ICT sector as well as the lack of funding for studies can be given as reasons for fewer students pursuing higher degrees in ICT. However, given the increasing reliance on ICT in society and the need for specialised skills in this domain, special interventions are required throughout the human capital development pipeline. This is to ensure that South Africa has the required people and skills to produce increasing levels of innovation.

Build and Strengthen ICT RDI ecosystem

Strength and Maturity identified in more than 140 capability areas

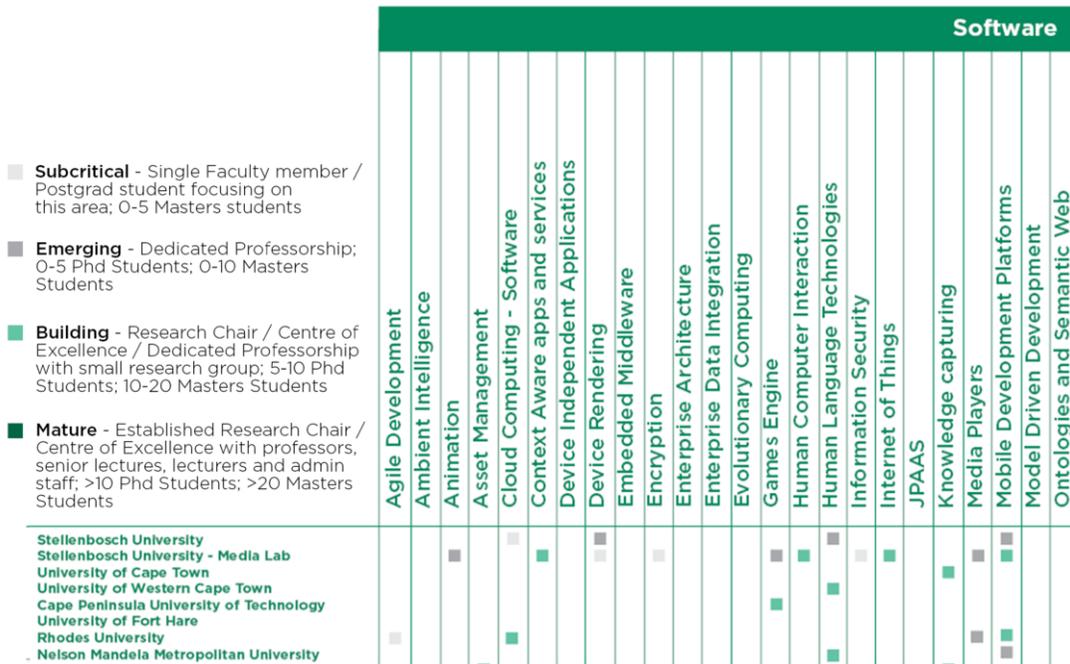


To understand the South African ICT RDI landscape, it is important to ascertain the local institutions and key role players involved in ICT RDI and to analyse their capabilities and strength at a national level. Three regional landscape workshops (KZN, Cape and In-Land) were held to develop a clear and comprehensive perspective of the South African ICT RDI capability, including regional strengths or specialisations.

The project developed further insight into the coverage and strength of RDI capability using this approach:

- An ICT taxonomy was developed where ICT research areas were divided into Hardware, Software, Connectivity, Processing and Content. Questionnaire respondents during the workshops were able to add research areas as further terms to the taxonomy, and identify whether their institution had capabilities within these areas.
- The information gathered during the workshops was used to populate an online database. Substantiation was completed via an online questionnaire linked to the database, allowing all deans of faculty and heads of departments for Electronic and Electrical Engineering, Informatics and Computer Science to review, amend and add to information regarding their respective department. This questionnaire was sent to all 23 universities in South Africa, and other relevant research organisations. Participants had the opportunity to add to the taxonomy and to identify their research areas in ICT and rate the strength of these areas (out of 10) according to the defined scale illustrated in the slide (see next slide for eligibility)
- Using the taxonomy, a capability map was developed showing the strength of a particular institute per research focus area. The institutions are shown down the left as rows and the taxonomy across as columns (140+ terms). In the slide only part of the Software section are shown. The next slide provides a zoomed-in figure for eligibility.
- This capability map is currently being verified even further, with individual visits to universities, in particular previously disadvantaged institutes.

Strength and Maturity identified in more than 140 capability areas



A zoomed-in version of the capability map, showing the different categorisations of strength from subcritical (single faculty member focusing on this area) to Mature (established research chair / group with multiple professors and postgraduate students.)

THE 10-YEAR INVESTMENT PORTFOLIO

10 Year ICT RDI Roadmap: Investment Ambition and Impact

Investment	Investment		Impact		
	Total to Exit ZAR M	Next Stage ZAR M	Contribution to economy pa ZAR Bn	New Businesses created	Job creation
Broadband Infrastructure and Services	800	419	12Bn+	5 medium 1200 micro-businesses/ operators	825 high-tech 2625+ other
Development	596	311	21 Bn	3 medium 1000 micro-franchisees	1750 other
Sustainability and the Environment	1,479	503	27.6 Bn	10 medium 55 small	1200 high-tech 6100 other
Grand Science	1,016	588	6.7 Bn+	1 large 4 medium 5 small	450 high-tech 1800 other
Industry Applications	3,394	1,432	52.2 Bn	15 medium 130 small	1750 high-tech 7200 other
The Service Economy	2,101	1,411	Significant, but indirect	Significant, but indirect	Significant, but indirect
TOTAL	9,385	4,664	120Bn+	1 large 37 medium 190 small 2200 micro	4,225 high-tech 19,475 other

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The approach taken in the roadmap is of an investment framework. Here we highlight the investment required and the expected return.

The investment, intervention and impact numbers were developed iteratively through the strategic prioritisation and substantiation phases of the project. The approach was as follows:

1. For each market opportunity - where possible - its value chain was unpacked:

Understand the various steps and associated "value system" / eco-system in terms of the chain of organisations or elements involved in the market opportunity, each adding some value

Identify actual and potential customers for each step in the value chain – in particular whether there would be potential to leverage intended SA capability in export markets

In some cases, complete more detailed analysis of the application area

2. Participate or not?

Based on a structured evaluation of Attractiveness and Fit for each Market Opportunity, determine whether SA should or can participate, or if there are "others" more suited to deliver a step.

3. Impact Assessment

The potential Impact - in terms of Wealth (contribution to the economy, new business creation and Job creation), Society and Strategic Advantage - associated with each Market Opportunity was determined. This slide concentrates on the wealth aspects only, rolled up to the Cluster level . The methodology used was described in more detail in the preceding slides.

Investment focused on achieving system-level Outputs

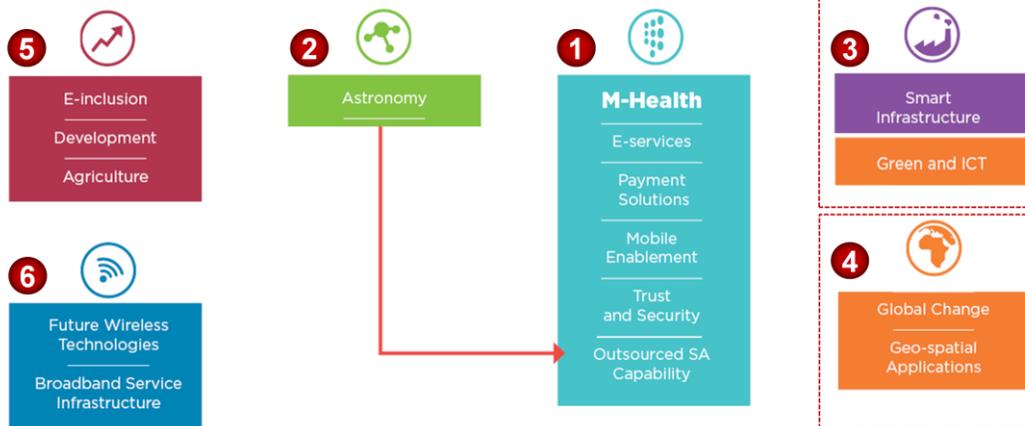
Outcomes-based Objectives	Key Performance Indicator	Outputs
High-Road Scenario		
Wealth Creation	Contribution to Economy p.a.	R 120 Bn +
	New Businesses created	1 large; 37 medium; 190 small; 2200 micro
	Job creation	4 225 high-tech 19 475 other
Technology Development	Products and services to market	40
	Technology packages	124
	Prototypes	470
Knowledge Generation	Registered Patents	42
	Patent Applications	120
	Publications	1700
Human Capital Development	Post Docs	225
	PhDs	450
	Masters	675

In addition to estimating the wealth aspects of impact using the top-down market analyses and the bottom up progression paths as explained in the previous slides, the outputs in terms of technology development, knowledge generation and human capital development was also estimated. Two approaches were used:

- Based on technology developments and human capital currently in the pipeline, a **projection** was done to calculate how much would be produced given the current and potential additional investment over the time period.
- Using benchmarks from South Africa and other countries in terms of the investment costs of publications, postgraduate degrees and technology developments, an **estimation** was done based on the investment instruments of the progression paths in the ICT RDI Roadmap. Looking at the investments to be made in the three dimensions of technology development, knowledge generation and human capital development, the cost per publication / technology development / postgraduate degree was used to estimate the potential number of outputs.

The two approaches were then consolidated to provide the numbers shown in the slide.

Initial focus is on Six Strategic Priority Areas (MTEF)



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From the 27 Market Opportunities, 6 priority areas were selected for the initial MTEF cycle to kick-start the investment strategy: As illustrated in the figure above, these are (the numbers are just to illustrate the six priorities and does not determine order):

M-Health: The initial focus in the Service Economy Cluster will be on innovation in mobile technologies, particularly in their use for Health applications. These will leverage developments in related Market Opportunities in this Cluster: E-services, Payment Solutions, Mobile Enablement and Trust and Security

Astronomy: As a Market Opportunity in the Grand Science Cluster, this area will focus on leveraging the ICT components of large projects like Meerkat and SKA to create new industrial and service capability, that will become Outsourced SA Capability in the longer term

Smart and Green Infrastructure: Two Market Opportunities, “Smart Infrastructure” (Industry Applications cluster) and “Green And ICT” (Sustainability and the Environment Cluster) are focused on developing and further enabling physical and digital Infrastructure so that it is optimised for efficiency, whilst reducing its impact on the environment, whether natural or built

Geo-Spatial Applications and Global Change: Both Market Opportunities are also part of the Sustainability and the Environment cluster which seeks to use ICT to optimise the management of assets, resources and environments, including more effective management and preparedness for the eventualities of climate change

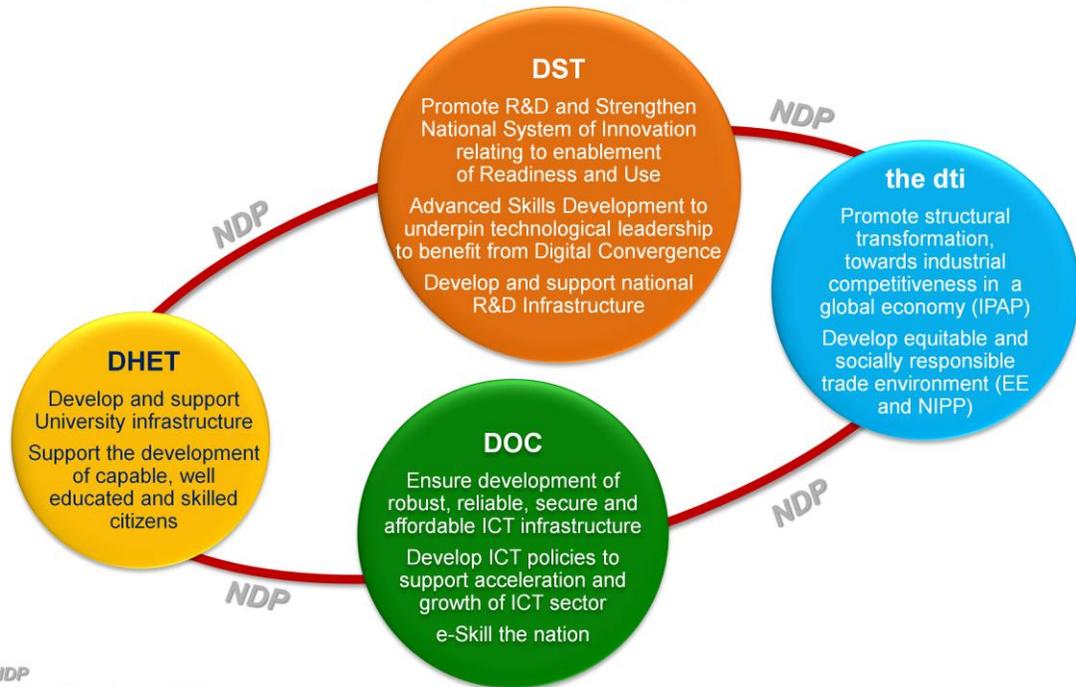
Broadband Infrastructure and Services cluster, with a focus on the 2 Market Opportunities: Future Wireless Technologies and Broadband Service Infrastructure with both the required building blocks for providing innovative means of future access

ICT for Development has three Market Opportunities: E-Inclusion; Development and Agriculture. These are focused on enabling individuals to empower themselves economically, socially and democratically

STRUCTURED ENGAGEMENT AND THE SYNERGY OPPORTUNITY

The subsequent slides show how the elements of the ICT RDI ecosystem – government, academia and industry – need to work together to ensure the success of the ICT RDI Roadmap. Thus, one of the key objectives of the execution of ICT RDI Roadmap is to enable harmonisation and synergy of stakeholders and role players across government, academia and industry and national programmes.

Effective coordination of key Government Departments ensures Impact



NDP

National Development Plan

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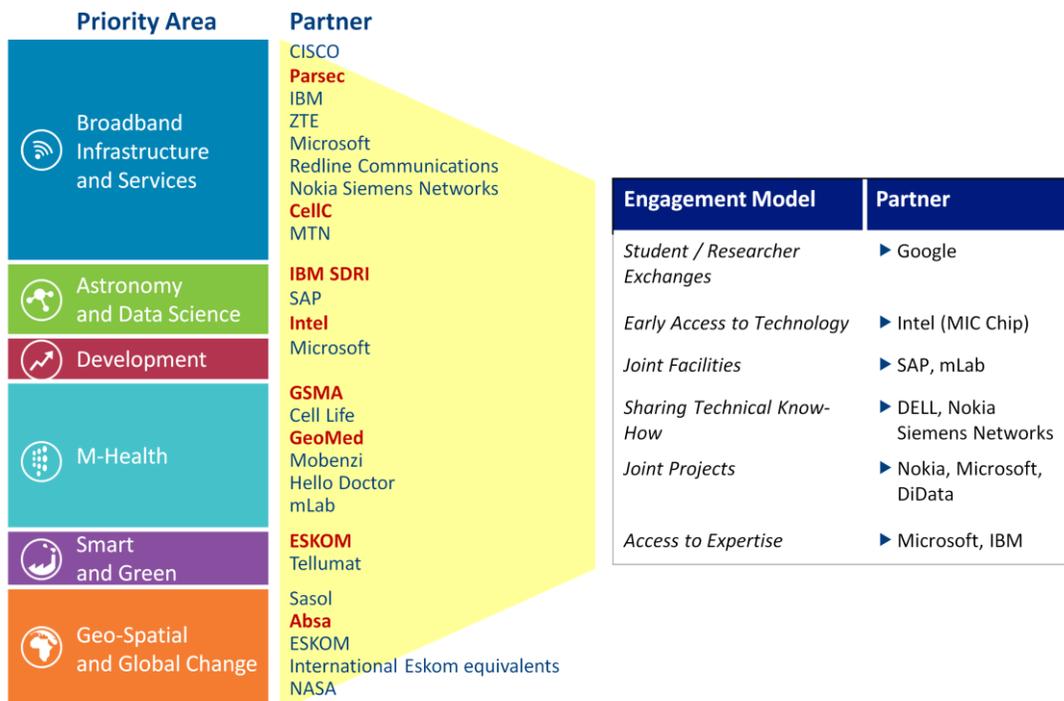
To fully realise all the plans within the ICT RDI Roadmap, requires effective coordination of key government departments as described in the national development plan. Four of the main government departments are shown in the slide with their particular roles and mandates within ICT RDI.

Addressing National Priorities through structured engagement with Government

Priority Area	Government Entity
 Broadband Infrastructure and Services	DOC: Broadband Policy; Knowledge Economy IDC: Commercialisation of new broadband technologies and business models PICC: SIP 15
 Astronomy and Data Science	SKA: Data Science and Analytics NSP: Big Data
 Development	DRDLR: Poverty Alleviation
 M-Health	DoH: NHI; E-Health Strategy
 Smart and Green	DEA: Green Fund (DBSA); Green Economy DoE: Energy Efficiency DMR: Sector strategy on Minerals and Processing IDC: Investment in Green Technologies Provinces, Municipalities (COJ): Smart Cities
 Geo-Spatial and Global Change	NSP: Disaster Prevention Management; Land Cover Change Detection DEA: Global Change

ICT RDI enables the delivery on government outcomes and addresses national priorities. In terms of the six priority areas (shown on the left), we illustrate some relevant government departments and the associated area (eg. DRDLR – Poverty Alleviation as piloted via the Cofimvaba project).

Structured Engagement with International and Local Industry Partners



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Similar to the previous slide that showed engagement with government entities, this slide shows the engagement with and interest from international and local industry partners. Those who we are currently targeting are shown in red (eg. We are currently Speaking to ESKOM in terms of their interest in Smart Infrastructure / Smart Grid Technologies under the Smart and Green Priority Area).

On the right we show the various engagement models that we use with specific examples that are already committed.

Background information:

- Student and Researcher exchanges with Google in the area of Human Language Technologies
- Intel has provided us early access to their new MIC (Many Integrated Core) chip for our developers to test
- Joint facilities with SAP to do Human Capital Development in the area of ERP Systems for SMME's
- mLab is a mobile solutions laboratory and startup accelerator that provides entrepreneurs and mobile developers with the support they need to develop innovative mobile applications and services. Done in conjunction with the World Bank and Nokia
- Models for Rural Connectivity was developed based on experts from both CSIR Meraka and Nokia Siemens Networks coming together to share their technical knowledge
- We are currently in talks with IBM to assist them in the development of a Software Development Research Institute (IBM SDRI) aligned with areas of the Roadmap, as part of their equity equivalence obligations to the dti.
- The specific relationships with Microsoft, IBM, and Nokia is highlighted in the following slide

Multinational ICT Companies Collaboration Programme

Current



In Dialogue



Outcomes Investment

DST R1m pa
Microsoft R1m pa

ED: Rural ICT (3)
HCD: BSc studies support
HPC: Climate Change model

DST R6m pa
SAP R12m pa

Innovation: Mobile ERP for < SMME's
HCD: 20 x PhD + MSc students

DST R3m
Nokia R3m

Open Innovation training



Equity Equivalent (Part of \$100m)

ICT RDI Roadmap areas:
- Analytics
- Smart and Green ICT
- Mobile

RDI Investment

ICT RDI Roadmap areas:
Broadband / Fibre networks and technology

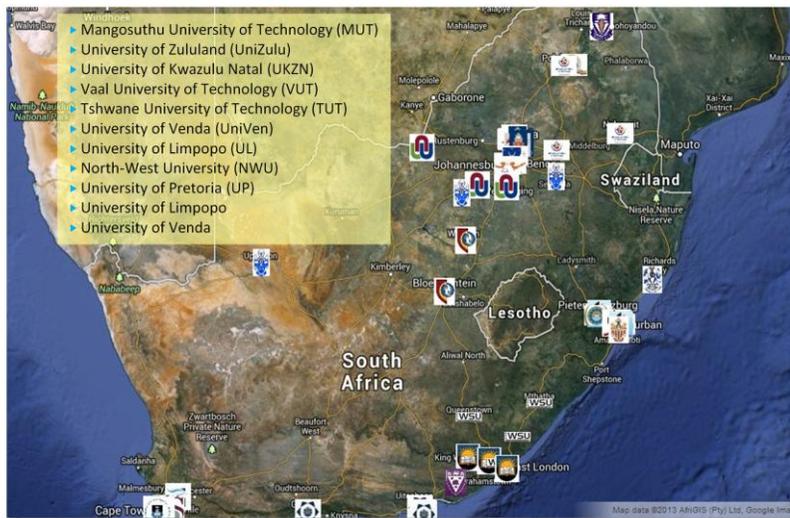
Promising...



The key points highlighted in this slide is our collaborations programme with multinational ICT companies, both in terms of current collaborations and those in dialogue. The investment from DST and the Multi-National Company is shown along with the outcomes achieved. The clarity of direction, focus and strength of the Roadmap, have so far encouraged significant levels of engagement with international industry.

Build and Strengthen ICT RDI ecosystem

University Connect and Engage Programme



Summary Reactions

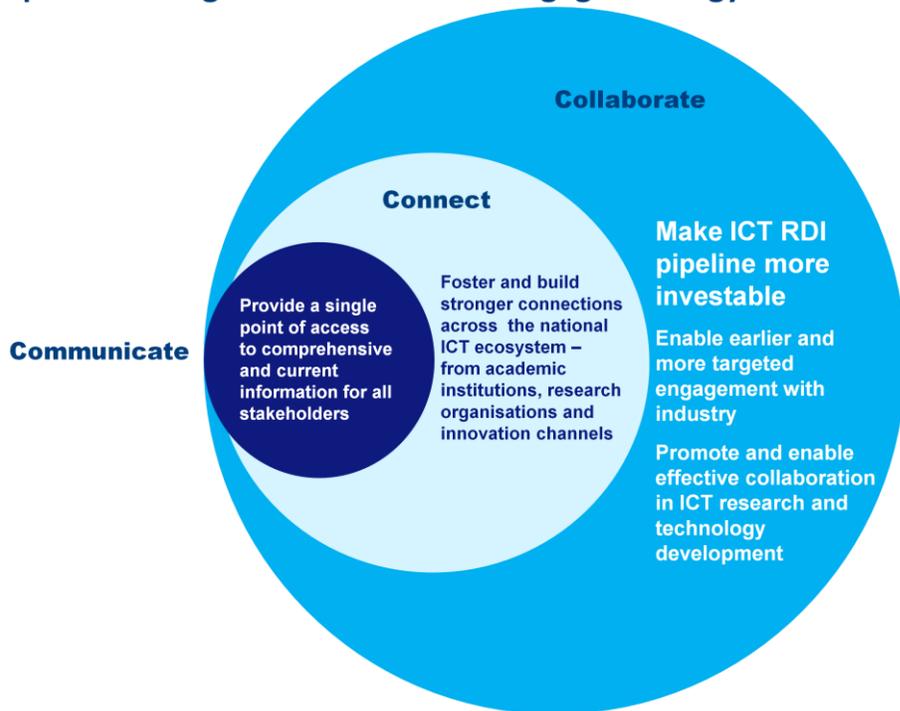
- ▶ *We are excited by these plans!*
- ▶ *And we look forward to opportunities to participate*
- ▶ *Now we can formulate our plans to develop capability and strengthen our expertise in certain areas, aligned to the Roadmap*
- ▶ *In order to be able to make a significant contribution, we need focused support*

Academia is one of the key places where ICT RDI capacity and capability is developed and nurtured. A connect and engage programme is currently underway to visit the faculty / departments of Electronic and Electrical Engineering, Informatics and Computer Science at universities, in particular the previously disadvantaged institutes to:

- Update them on the ICT RDI Roadmap to garner the continuing support and participating in the implementation phase of the ICT RDI Roadmap
- Verify the capacity and maturity of current ICT RDI Capability in targeted HEIs
- Understand, in particular, research projects and activities in these institutions
- Identify the opportunity to participate in ICT Roadmap initiatives, both those currently in progress and in development
- More broadly, discuss institution plans to build and strengthen Roadmap-aligned Capability and Capacity

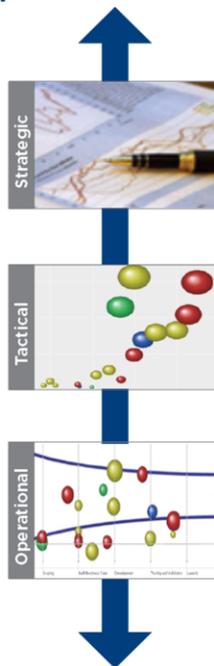
On the left, the universities already visited are shown, with some of their reactions in the block on the right.

Implement long-term Connect and Engage Strategy and Plan



The connect and engage strategies with government, academia and industry is part of a long-term strategy to ensure collaboration across the ecosystem and make the ICT RDI pipeline more investable. This might initially start with comprehensive communication across the landscape to ensure stronger connections across government, academia and industry ultimately resulting in targeted engagement and effective collaboration.

Execution managed via Portfolio Management approach – Office of Digital Advantage



- ▶ 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 – with investment priorities
- ▶ Source, evaluate, approve and **Project** proposals
- ▶ Initiate project investments
- ▶ Monitor and review project progress; evaluate benefits delivery

Manage Investment

To ensure efficient and transparent coordination, monitoring and active management – across strategic, tactical and operational levels - of the portfolio of RDI investments made by South Africa in ICT

Grow Ecosystem

- ▶ Improved coordination of research activity
- ▶ Inherent incentives to cooperate
- ▶ More targeted engagement with industry
- ▶ Focused international collaboration
- ▶ Stronger connection with innovation channels
- ▶ More comprehensive and transparent monitoring (of investment and impact)
- ▶ A better basis of tracking HCD outputs

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The execution of the ICT RDI Roadmap requires a large investment across the ICT RDI ecosystem involving the harmonisation and synergy of a number of role players, stakeholders, programmes, interventions and instruments. A portfolio management approach called the Office of Digital Advantage will be utilised to ensure efficient and transparent coordination, monitoring and active management – across strategic, tactical and operational levels - of the portfolio of RDI investments made by South Africa in ICT, as explained in the slide.

We recognise that ICT is a cross-cutting **Enabler** ...

Roadmap objective

Create Digital Advantage

- ▶ Prioritise market opportunities that deliver Impact through satisfaction of National Needs
- ▶ Build integrated and well-coordinated ICT RDI Capability and Capacity over a 10 year timeframe
- ▶ Foster and enable more effective collaboration across the national ICT RDI ecosystem
- ▶ Make the ICT RDI pipeline more investable via earlier and more targeted engagement with industry and the involvement of strategic MNC partners

The Synergy Opportunity

- ▶ R&D results can enable successful delivery of Government Department objectives (eg Future Wireless Technologies support Rural Broadband Connectivity)
- ▶ Via systematic harmonisation, increase investment efficiency, align resource deployment, focus capability development (eg NSP)
- ▶ Biennial Roadmap refresh provides inclusive opportunity for key stakeholders to co-refine emphasis of direction and investment

As the slide show, ICT is a cross-cutting enabler for delivery of government and industry objectives. The ICT RDI Roadmap provides an investment framework, strategy and plan to ensure collaboration and synergy across the ICT RDI ecosystem to build capability that can innovatively address national needs, and create technologies for export. Thus creating Digital Advantage for South Africa.

THANK YOU