



DEPARTMENT OF SCIENCE AND TECHNOLOGY

Strategic Plan for the Fiscal Years 2015 - 2020



science
& technology

Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

Official sign off



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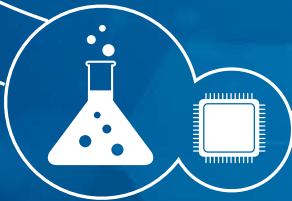


Table of Contents

Foreword by Minister	2
PART A: STRATEGIC OVERVIEW	4
Legislative mandates.....	5
Relevant court rulings.....	6
Vision.....	6
Mission	6
Values.....	6
Policy context	6
Policy mandate.....	10
Situational analysis.....	10
The strategic planning process.....	17
Strategic outcome-oriented goals.....	18
Planned policy initiatives	19
Knowledge generation.....	21
Human capital development.....	21
Using knowledge and innovation for economic development	22
STI support for the development of SMEs	24
Using knowledge and innovation for inclusive development.....	24
Enablers	25
International cooperation and resources	28
PART B: STRATEGIC OBJECTIVES.....	30
Programme 1: Administration	31
Programme 2: Technology Innovation	36
Programme 3: International Cooperation and Resources	42
Programme 4: Research Development and Support.....	46
Programme 5: Socio-economic Innovation Partnerships	52
PART C: LINKS TO OTHER PLANS.....	57
Links to the long-term infrastructure and other capital plans.....	58
Public entities	58
APPENDIX A.....	60
List of case studies on biotechnology and hydrogen and fuel cells technology initiatives	60
Abbreviations.....	62



Foreword by the Minister

Ms Naledi Pandor, MP

Minister of Science and Technology

Science and technology (S&T) underpin the socio-economic development and global competitiveness of any modern state. Innovation is seen as a key driver to lift economies out of the global economic crisis which began in 2008.

The growing global economic importance of Africa has been matched with an increasing readiness to develop solutions to our own unique challenges. In order to make the optimum use of the opportunities arising from Africa's growing role in the global economy, it is important that we foster a culture of innovation and entrepreneurship, particularly among our youth. With the unprecedented growth in many sectors – in particular mobile and information and communication technology – there has never been a better time in history for Africans, particularly the youth, to develop solutions that can address a range of challenges.

The South African Science and Technology sector grows stronger each year. The Department has made many important contributions to South Africa's development and continues to do so, living up to its mandate to use science and technology to improve the country's economy, create employment and improve the quality of life of all citizens.

The Department's 2011-2016 Strategic Plan identified human capital development, global and Africa collaboration, knowledge generation (research and development), knowledge exploitation (innovation), and infrastructure development as priority focus areas. The Department's 2015-2020 Strategic Plan continues these five focus areas but with new emphases on innovation and capacity building in Africa. The five priorities are now the following: boosting our human capital development

for science, technology and innovation, with a special focus on transformation; promoting government-business-university investment in R&D; translating more effectively the outcomes of our investments in research into the development of new products and services for the South African economy; ensuring consistent progress of the SKA project with construction starting on schedule in 2018; and, contributing decisively to science, technology and innovation capacity-building elsewhere in Africa.

Our first priority in the 2015-2020 Strategic Plan is human capital development with a special emphasis on addressing gender and racial imbalances in the make-up of our science and technology workforce. However, we do not have the capacity to train all the researchers we need, especially at doctoral level, in South Africa. We need to train over 5 000 PhDs per annum. Our current challenges in training PhDs include a lack of research capacity and a narrow supply pipeline. We therefore plan to support emerging researchers through partnerships with the private sector, increasing the number of research chairs, and sending some of our students overseas to expand our capacity.

Our second priority is boosting government-business-university investment in R&D. We plan to boost business and government collaboration to increase South Africa's gross expenditure on research and development from the current 0,8% of GDP to 1,5% by 2020. We also plan a dedicated foreign investment strategy focused on cooperation with partners such as international foundations and philanthropic organisations, which are already investing significantly in South African science, especially in health research. Currently 15% of R&D investment in South Africa comes from foreign partners. It is our aim to encourage international companies to

relocate some of their R&D programmes to South Africa, using smart investments and incentives to make South Africa a preferred destination for global R&D. Our policy is to develop a few world-class centres and programmes in the science and higher education sectors over the next five years. We can count the Square Kilometre Array as an example of how we are positioning ourselves as a strategic partner and an attractive destination for global science and technology infrastructure, projects and investment. International companies such as IBM, Cisco and Intel are already involved in various SKA spin-offs.

Our third priority is the development of entrepreneurial skills in order to translate the outcomes of our investments in research into the development of new products and services for the South African economy. There is a need to strengthen the links in the chain in the very complex interactions and collaboration between diverse public and private actors in innovation systems. To achieve that, government has to provide the necessary support and play a co-coordinating role. Effective innovation systems depend on a smooth flow of knowledge and technology between enterprises, universities, and research institutions. The mechanisms that enable this smooth flow of knowledge include joint industry research, public-private partnerships, technology diffusion, and movement of personnel.

We have already ensured that the intellectual property resulting from publicly funded R&D will be better managed and exploited through the establishment of the National Intellectual Property Management Office. But we plan to do more. Ensuring the necessary institutions and instruments are in place for South Africa to bridge the so-called “innovation chasm” or “valley of death” between research and market is a priority. This will involve the continued revitalisation of our Technology Innovation Agency (TIA) to exploit the research funding of our National Research Foundation.

Our fourth priority is the SKA – arguably the most exciting global science project in the twenty-first century – which will be proudly co-hosted by Africa. We are currently in

the pre-construction phase, preparing for construction proper to start in 2018. The current global investment is approximately R2 billion in this design phase – an impressive figure but dwarfed by the ultimate anticipated investment of more than R30 billion for the full SKA construction. The operational costs and aggregate impact on the South African economy will be several billion Rand more per annum during the lifetime of the telescope, which will extend over several decades.

Our investment in projects like the SKA will ensure South African scientists are part of the charge to discover the origins of the universe. On the other hand, they will also be in pole position to exploit the innovation in computing and network technology the SKA is driving. Thanks to the SKA we should be in a good position to benefit from new developments in big data.

Our fifth priority is promoting science, technology and innovation in Africa. We are part of an African research and innovation system. We look for international cooperation to support science and technology capacity-building in Africa. For this priority we seek to leverage our portfolio of international relations and are keen to partner with Asian, American or European nations in reinforcing African capacities.

The Department’s 2015-2020 Strategic Plan is part of the vision of our National Development Plan to tackle the interlinked challenges of poverty, inequality and unemployment. I commend our Strategic Plan to South African citizens and hope that our proposals are easy to read and understand.



Ms Naledi Pandor, MP

Minister of Science and Technology



Part A:

STRATEGIC OVERVIEW

Strategic overview

Legislative mandates

Academy of Science of South Africa Act (2001)

This act establishes the Academy of Science of South Africa to promote common ground in scientific thinking across all disciplines, including the physical, mathematical and life sciences, as well as human, social and economic sciences; to encourage and promote innovative and independent scientific thinking; to promote the optimum intellectual development of all people; to advise and facilitate appropriate action in relation to the country's needs, opportunities and challenges; and to link South Africa with high-level scientific communities within the Southern African Development Community, the rest of Africa and internationally.

Astronomy Geographic Advantage Act (2007)

This act provides for the preservation and protection of areas in South Africa uniquely suited to optical and radio astronomy, and for intergovernmental cooperation and public consultation on matters concerning such areas.

Human Sciences Research Council Act (2008)

This act provides for the continued existence of the Human Sciences Research Council, which carries out research that generates critical and independent knowledge relative to all aspects of human and social development.

Income Tax Act (1962)

Section 11D of the Income Tax Act gives the Minister of Science and Technology authority to approve scientific and/or technological research and development (R&D) undertaken or funded in South Africa by the private sector for a 150% tax deduction on qualifying R&D expenditure.

Intellectual Property Rights from Publicly Financed Research and Development Act (2008)

The act provides for the more effective use of intellectual property (IP) emanating from publicly financed R&D through the establishment of the National Intellectual Property Management Office (NIPMO), the Intellectual

Property Fund, and offices of technology transfer at higher education institutions and science councils.

National Advisory Council on Innovation Act (1997)

This act establishes the National Advisory Council on Innovation to advise the Minister of Science and Technology and, through the Minister, the Cabinet on the role and contribution of science, mathematics, innovation and technology in promoting and achieving national objectives.

National Research Foundation Act (1998)

This act establishes the National Research Foundation (NRF) to promote basic and applied research, as well as the extension and transfer of knowledge in the various fields of science and technology (S&T).

Natural Scientific Professions Act (2003)

This act establishes the South African Council for Natural Scientific Professions and legislates the registration of professional natural scientists, scientists-in-training, technologists and technologists-in-training.

Scientific Research Council Act (1988)

This act refers to the activities of the Council for Scientific and Industrial Research (CSIR), which undertakes R&D for socio-economic growth.

South African National Space Agency Act (2008)

This act establishes the South African National Space Agency (SANSA) to promote space science research, cooperation in space-related activities, and the creation of an environment conducive to industry's development of space technologies.

Technology Innovation Act (2008)

This act established the Technology Innovation Agency (TIA) to promote the development and exploitation of discoveries, inventions, innovations and improvements in the public interest.

Relevant court rulings

None.

Vision

Increased well-being and prosperity through science, technology and innovation.

Mission

To provide leadership, an enabling environment, and resources for science, technology and innovation in support of South Africa's development.

Values

Professionalism

The Department of Science and Technology (DST) is professional and delivers high-quality performance to both internal and external stakeholders.

Innovation

The Department is innovative in solving problems and enhancing effectiveness and efficiency.

Ethical behaviour

The Department and its employees are consistent in their actions, and accountable and transparent in dealing with public funds and other resources.

Knowledge sharing

The Department and its employees share and use knowledge constructively to ensure it contributes to the building of a robust and productive knowledge economy.

Policy context

The National Development Plan and science, technology and innovation

South Africa's National Development Plan (Vision 2030) highlights the centrality of science, technology and innovation (STI) to national development. The National Development Plan (NDP), published in 2012, notes that developments in STI fundamentally alter the way

people live, communicate and transact, with profound effects on economic growth and development. STI is key to equitable economic growth, underpinning economic advances and improvements in health systems, education and infrastructure. The NDP argues that countries that are able to tackle poverty effectively by growing their economies are characterised by strong STI.

The NDP acknowledges that economic development takes time and that innovation should grow in importance in years to come. In the first phase (2012–2017), the focus should be on “intensifying research and development spending, emphasising opportunities linked to existing industries”. In the second phase (2018–2023), the “country should lay the foundations for more intensive improvements in productivity”, and “innovation across state, business and social sectors should start to become pervasive”. As 2030 approaches, “the emphasis should be on consolidating the gains of the second phase, with greater emphasis on innovation, improved productivity, more intensive pursuit of a knowledge economy, and better utilisation of comparative and competitive advantages in an integrated continent”.

In implementing the NDP's three phases of innovation, the DST's strategic plan proposes the following:

- **Phase one (2014–2019): Use knowledge to increase economic efficiency.** Building on progress achieved, the national system of innovation (NSI) will expand research capacity by developing human capital and building institutions. It will build on what it has learnt about commercialising research ideas and continue to support existing economic sectors such as agriculture, forestry, agroprocessing, aquaculture, manufacturing and mining. Through technological innovation, the NSI will also support emerging sectors such as mineral beneficiation, greener energy and active pharmaceutical ingredient manufacturing.
- **Phase two (2020–2025): Use knowledge to enhance industrialisation.** The NSI will continue to accelerate the demographic transformation of the STI sector and use knowledge to enhance efficiency

in the economy. The government will increase R&D investment and commercialisation, and optimise the use of imported technology.

- **Phase three (2025–2030): Knowledge-based economy.** The number of knowledge workers and high-technology industries will have increased, boosting exports and increasing South Africa's capacity to commercialise indigenous technologies. The DST will aim to sustain and build on this progress.

If South Africa's economy is to advance along the trajectory set out in the NDP and reduce poverty, it will require a strong, coherent and effective NSI, working in a coordinated manner to achieve national priorities. In particular, the NSI should help improve global competitiveness by leading the creation and application of new knowledge.

The NDP acknowledges the role that STI can play in addressing poverty, unemployment and inequality. Internationally, STI and related discoveries are recognised as future sources of economic growth with the potential to create new types of jobs, and new solutions to challenges like poverty, poor health and water shortages.

The Department has begun to identify ways in which its work and the NSI could contribute to the reduction of inequality, poverty and unemployment. Some of the DST's initiatives are outlined below.

NSI support for private-sector companies, both STI and financial, should lead to increased turnover and greater employment. The DST will assess how the TIA's Technology Stations Programme and Technology Localisation Programme ensure that the turnover of small and medium enterprises (SMEs) is increased, and that SMEs secure better contracts with large private-sector companies.

The NSI's initiatives to develop new R&D-led industries could improve South Africa's technology balance of payments and help reduce the current account deficit.

Support for master's and doctoral students contributes to the employability of graduates and a total of 1 140 interns are currently employed in the DST-NRF internship programme.

Initial analysis indicates that a total of 90 new innovations are being investigated for commercialisation potential, which could contribute significantly to economic growth and employment.

The DST is also involved in initiatives to enhance the standard of living in previously marginalised communities. It works with the Department of Basic Education, using innovative technologies to improve access to basic education for children who are visually and hearing impaired. The DST also has a partnership with the Eastern Cape Department of Education, the Department of Water and Sanitation and the Bill & Melinda Gates Foundation to provide innovative and appropriate off-grid sanitation technologies for rural and peri-urban areas.

The DST champions innovation-enabled local economic development and runs pilot projects to see how STI can help achieve sustainable livelihoods. Pilot projects include community-based processing of traditional medicines, cosmeceuticals and nutraceuticals, which should be completed by 2016.

These initiatives demonstrate the potential of the NSI to help address poverty, unemployment and inequality. Further detail on STI's direct and indirect contribution to addressing these challenges is set out in Table 1.



Table 1: Contribution of STI to the reduction of poverty, inequality and unemployment

STI contribution	Poverty	Inequality	Unemployment
Direct	<p>Innovation-enabled local economic development:</p> <ul style="list-style-type: none"> • Pilot three community-based agroprocessing plants (traditional medicines, cosmeceuticals and nutraceuticals) by 2016 • Ensure that STI poverty alleviation initiatives are demand driven and informed by local economic development priorities in at least three provinces <p>Mainstream applied indigenous knowledge-based R&D (traditional medicines, cosmeceuticals and nutraceuticals), including innovation and local manufacturing to support commercialisation models for sustainable livelihoods</p>	<p>Transformation of scientific workforces in terms of race and gender</p> <p>Innovations to enhance standards of living:</p> <ul style="list-style-type: none"> • In partnership with the Department of Basic Education, leverage innovative technologies to improve access to basic education for children with special needs, prioritising the visually and hearing impaired • In partnership with the Eastern Cape Department of Education, the Department of Water and Sanitation, and the Bill & Melinda Gates Foundation, provide innovative and appropriate off-grid sanitation technologies for rural and peri-urban areas 	<p>Internships</p> <p>Researchers</p> <p>Postdoctoral support</p> <p>Economic growth:</p> <ul style="list-style-type: none"> • Help grow companies' turnover • Reduce technology balance of payments contribution to current account deficit • Support SMEs through technology localisation and station programmes • Grow local industries through the Emerging Industries Action Plan <p>Initiatives to improve the technology-based competitiveness of the established primary economic sectors</p> <p>New industry development initiatives such as Hydrogen South Africa, the Fluorochemicals Expansion Initiative, the Titanium Beneficiation Initiative and the Advanced Manufacturing Technology Strategy</p>
Indirect	<p>Postgraduate bursaries, South African Research Chairs Initiative, centres of excellence</p> <p>Providing and packaging information to enhance policy decision-making</p>	<p>Targeted postgraduate bursaries (for black people and women) and funding to support young and emerging researchers</p> <p>Use technology to improve service delivery and demonstrate better living standards, such as through the use of wireless mesh networks to bridge the digital divide</p>	<p>Postgraduate bursaries, South African Research Chairs Initiative, centres of excellence</p> <p>R&D infrastructure:</p> <ul style="list-style-type: none"> • manufacture, assembly, integration and testing, and launch Earth observation satellite (EOSat1), in addition to ZACUBE2 satellite • manufacture and launch South Africa's first indigenous cube satellite constellation to provide automatic identification system services to Operation Phakisa (ocean economy) and Africa • MeerKAT/Square Kilometre Array (SKA) radio astronomy telescope

The NDP and the Medium Term Strategic Framework

Government will implement the NDP in three five-year phases. The 2014–2019 medium-term strategic framework (MTSF) will be implemented in the first phase. The MTSF is based on an “outcomes approach”, focusing on 14 key outcomes, with measurable outputs and key activities.

These outcomes are: (1) improved quality of basic education; (2) a long and healthy life for all South Africans; (3) all people in South Africa are safe and feel safe; (4) decent employment through inclusive economic growth; (5) a skilled and capable workforce to support an inclusive growth path; (6) an efficient, competitive and responsive

economic infrastructure network; (7) vibrant, equitable and sustainable rural communities with food security for all; (8) sustainable human settlements and improved quality of household life; (9) a responsive, accountable, effective and efficient local government system; (10) environmental assets and natural resources that are well protected and continually enhanced; (11) create a better South Africa and contribute to a better and safer Africa and World; (12) an efficient, effective and development-oriented public service and an empowered, fair and inclusive citizenship; (13) an inclusive and responsive social protection system; (14) transforming society and uniting the country.

The DST contributes to many of these outcomes, as well as sub-outcomes defined under the overall MTSF umbrella (see Table 2).

Table 2: Actions and commitments led by the DST in the 2014-2019 MTSF

Outcome	Sub-outcome	Action/commitment
Outcome 3: All South Africans are safe and feel safe	Sub-outcome 4: Secure cyberspace	1. Develop R&D capacity
Outcome 4: Decent employment through inclusive economic growth	Sub-outcome 10: Research, development and innovation (RDI) investment supports inclusive growth	1. Strengthen RDI partnerships between government and the private sector 2. Align strategies for emerging/new industries with the Industrial Policy Action Plan and monitor regularly for long-term growth and competitiveness, job creation and export potential 3. Review existing market-based and state incentives for effectiveness in increasing investment in innovation
Outcome 5: A skilled and capable workforce to support an inclusive growth path	Sub-outcome 3: Increase access to high-level occupational directed programmes in needed areas	1. Expand access to communication technologies 2. Bursary support for postgraduate students 3. Research infrastructure grants to higher education institutions, science councils and national facilities 4. Increase outputs by NRF-funded researchers 5. Increase the number of research grants
Outcome 10: Protect and enhance South Africa's environmental assets and natural resources	Sub-outcome 2: An effective climate-change mitigation and adaptation response	Undertake research in climate sciences
	Sub-outcome 3: An environmentally sustainable, low-carbon economy resulting from a well-managed, just transition	Increase investment in RDI to support the transition to a green economy

The DST's 2015–2020 Strategic Plan will be implemented through five successive annual performance plans, incorporating lessons learnt from previous strategic plans.

The NSI has a productive researcher community that lacks the critical mass required for socio-economic transformation. The DST's Strategic Plan analyses this situation in detail, setting goals to expand and transform research capacity. The plan's discussion of human capital development (HCD) provides strategies for transforming research enterprise in the next five years.

Policy initiatives such as the Intellectual Property Rights from Publicly Funded Research and Development Act,

the TIA and NIPMO were introduced to accelerate the commercialisation of ideas from research. These initiatives will need to be strengthened over the medium term.

A number of large-scale pilots or demonstrators that can support local economic development and R&D-led industrial development will need to be converted into full-scale commercial companies. Partnerships initiated with the private sector in the previous five years will need to be strengthened to ensure that the NSI responds to industry needs. In addition, enhanced communication of NSI activities is critical to ensure that the public and stakeholders are engaged.

The DST's Strategic Plan aims to:

- Use knowledge and innovation for:
 - New industrial development and economic diversification
 - Commercialisation of ideas
 - Improved SME competitiveness
 - Inclusive social development.
- Expand and transform research capacity through HCD and the provision of R&D infrastructure (including the roll-out of MeerKAT dishes and completion of phase one of the SKA).
- Deepen bilateral engagement with the rest of the African continent.
- Build youth support (including internships, Youth into Science strategy initiatives and the TIA Youth Fund).
- Engage with the public continuously.

Policy mandate

The DST derives its mandate from the 1996 White Paper on Science and Technology, which introduced the concept of the NSI – a set of interacting organisations and policies through which a country creates, acquires, diffuses and puts into practice new knowledge to help achieve individual and collective goals. A coordinated and efficient NSI would help achieve the country's national development priorities by promoting change through innovation, enabling all South Africans to enjoy the economic, socio-political and intellectual benefits of STI.

The DST supports the NSI in a number of ways. It:

- Coordinates the development of country-level strategies, such as the National Research and Development Strategy (NRDS) and the Ten-Year Innovation Plan (TYIP), which identify specific priority areas that require supporting strategies.
- Works with all actors in the NSI to coordinate, facilitate and implement strategies, roadmaps and action plans to optimise cooperation and alignment.
- Provides the NSI network with measures, indicators and analysis, creating an evidence base for improving the NSI's performance.

- Optimises publicly funded STI institutions to support government's priority outcomes.
- Funds HCD at postgraduate level.
- Creates systems and structures to coordinate government departments and agencies on STI.
- Unlocks STI resources and partnerships with international, continental and multilateral agencies.

Situational analysis

STI underpins the socio-economic development and global competitiveness of any modern state.

The Organisation for Economic Cooperation and Development sees innovation as central to lifting economies out of the global economic crisis. It is a source of new and sustainable growth and competitiveness, as well as a powerful engine for addressing social challenges. It holds the key, in both advanced and emerging economies, to creating jobs and improving productivity.

In response to the 2008 global economic downturn, several developed and developing countries prioritised innovation. They put together stimulus packages for investment in infrastructure and extended support for RDI, HCD, green technology and the fostering of entrepreneurship.

The NDP's vision for 2030 takes a similar approach. South Africa is competitive in many areas but continues to face challenges. The following section provides an overview of the main challenges that the DST aims to address.

Using knowledge and innovation for economic development

The country's account deficit is currently about 6% of GDP. Of this, 10–15% is attributable to the technology balance of payments. The DST aims to accelerate programmes to reduce this, including tax incentives to promote private-sector R&D, action plans for emerging industries, technology assistance packages and sector innovation funds.

The Department will develop a framework to assess STI's contribution to reducing inequality, poverty and unemployment, using bioeconomy and fuel cell case studies. An initial list of case studies from biotechnology and hydrogen and fuel cells technology initiatives is provided in Appendix A.

Using knowledge and innovation for new industry development and economic diversification

A broad agenda for R&D-led industrial development, for 2030 and beyond, is now in place. The DST has made significant investments in industrial R&D, focusing on a range of priority areas identified in the NRDS and the TYIP.

Globally, there is an established body of knowledge on how to convert promising technological breakthroughs into full-scale industrialisation and minimise failure. Maturing promising initiatives to higher technology and market readiness can take anything from a few years to more than a decade. The DST and its entities, in particular the CSIR and the TIA, have developed a portfolio of technology initiatives (minerals beneficiation, advanced manufacturing, the bioeconomy, nanotechnology, information and communication technology [ICT], waste and energy), which have reached different levels of maturity.

New industry development will require strategic partnerships with other countries, multinationals and the private sector. Over time, the DST has grown its successful international research partnerships into innovation partnerships. South Africa participates in the EUREKA programme (a European Commission network that coordinates RDI funding), and has developed partnerships with ICT firms such as IBM, Cisco, SAP and Microsoft.

Using knowledge and innovation for economic competitiveness

Although the primary economic sectors have an established technological base, there is room to grow by addressing specific challenges (for example, responding to demands for green supply chains and energy and water constraints in mining). Opportunities to improve competitiveness are often linked to ICT, automation and the ability to mine,

manufacture or beneficiate products on a smaller scale, while still being economically viable. The DST will identify niche improvement areas and, together with industry, implement new technology building blocks to increase competitiveness. A start has been made through the establishment of partnership programmes, especially the sector innovation fund initiative. Based on an initial pilot on post-harvest innovation with the Fresh Produce Exporters' Forum in 2009, and a similar partnership in mining and beneficiation in 2012, the DST secured funding through the Economic Competitiveness Support Programme to extend the model to other priority sectors.

An open, competitive process secured successful proposals from nine industrial sectors, including forestry, sugar, aquaculture and boat-building, for an initial four-year programme. The successful proposals are well aligned with the Industrial Policy Action Plan.

Using knowledge and innovation to support SMEs

The DST supports SMEs by providing access to technological services via the Technology Stations Programme, which is hosted by the TIA. The 15 technology stations and three institutes of advanced tooling under the Technology Stations Programme focus on different sectors. SMEs can access specialised equipment, knowledge and innovation support through the technology stations. In the past five years, more than R70 million has been invested in modernising and capacitating the technology stations, which have provided technology support to about 2 000 SMEs annually.

Government has put in place local content requirements for public procurement. SMEs in engineering and manufacturing will be key beneficiaries, but many of these companies need to modernise technologies and processes to meet the requirements. The DST, through the Technology Localisation Implementation Unit, has benchmarked the technological capabilities of 147 companies, more than 60% of which were SMEs. Using this data, the unit will provide targeted technology assistance packages to 151 companies (half of which are SMEs) by the end of March 2015.

Commercialising research results

The TYIP introduced the Intellectual Property Rights from Publicly Funded Research and Development Act, the TIA and NIPMO as a policy package to accelerate the conversion of research ideas into marketable products and services. The TIA's achievements over the past few years include:

- R1.2 billion disbursed (R424 million for accelerating new technologies, services and products).
- R564 million leveraged through third-party funds.
- A total of 98 products, processes and services developed and 18 investments commercialised.
- More than 500 interns trained in the innovation space.
- Kapa Biosystems offers next generation polymerase chain reaction reagents. The firm now employs more than 50 staff members.
- XSIT, sterile insect technology developed in conjunction with the South African Nuclear Energy Corporation, addresses citrus industry needs. To date, about 8 500 hectares have been protected from the False Codling Moth.
- Altis Biologics developed bone-regeneration products and is seeking investments to obtain accreditation for global markets.

NIPMO has provided more than R27 million to support the offices of technology transfer at 13 higher education institutions and three science councils. It has also awarded more than R42 million to 24 institutions seeking to protect their IP derived from publicly funded R&D.

Early data from NIPMO indicates that invention disclosures have increased. About 682 disclosures were received by NIPMO for IP generated after 2 August 2010, of which 643 are still active, and 76% are for inventions for which patent protection is being obtained. Furthermore, of the total number of disclosures received, 5% have an enforceable right, and a further 5% have been licensed (pre-revenue) or commercialised.

Figure 1: IP types for disclosures received by NIPMO

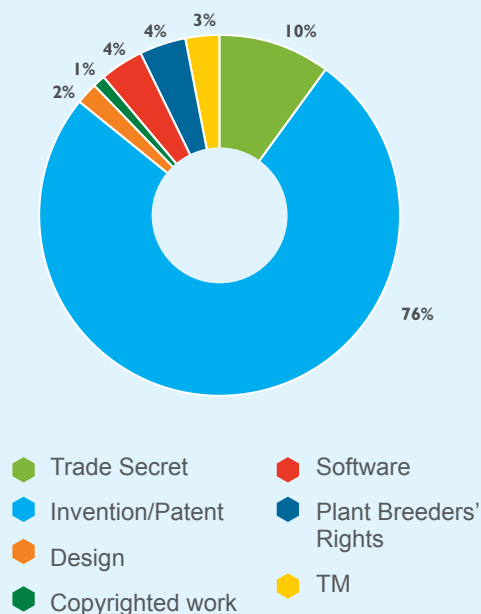
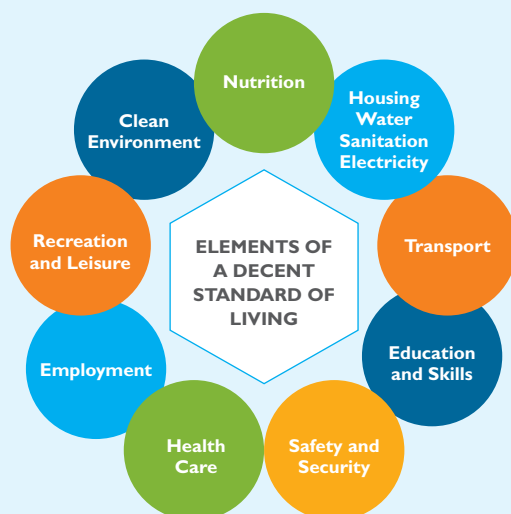


Figure 2: Proposed framework for a decent standard of living





Using knowledge and innovation for inclusive development

The NDP proposes a “multidimensional framework to bring about a virtuous cycle of development, with progress in one area supporting advances in others”.

It makes a “firm commitment to achieving a minimum standard of living ... progressively realised through a multipronged strategy”. The proposed framework for a decent standard of living is set out in Figure 2.

The DST works closely with national and local government, providing funds and technical support to demonstrate, customise and assess innovative service-delivery technologies. Demonstration and testing enables the Department to produce evidence-based knowledge products that support decision-making and the systemic roll-out of public services. These knowledge products include policy briefs to enhance decision-making and technical briefs to advise on integrating STI with service delivery. The DST has also provided technology solutions for water, energy and housing.

The DST's interventions in service-delivery improvement include Earth observation for improved spatial planning, equipping decision-makers to understand the risks associated with global change and improving disaster management. The DST is also piloting a decision-support tool that will assess the innovation potential of people living in marginalised communities. This will, in the long term, help the DST design appropriate interventions to enable innovators in these communities and incorporate them into the knowledge economy.

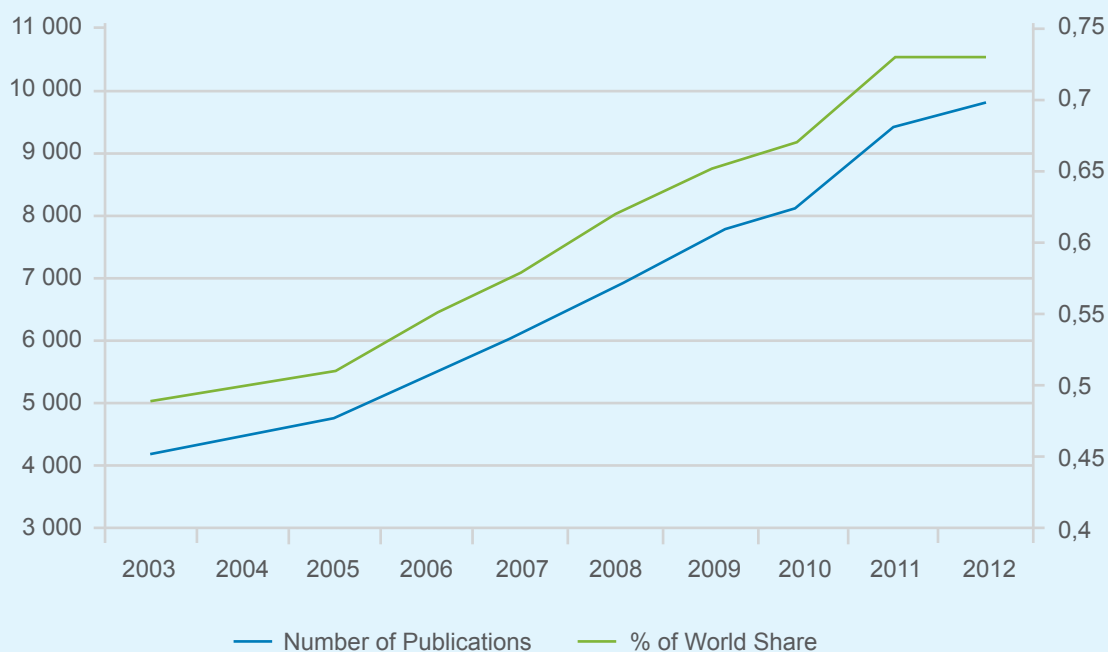
The DST continues to cooperate with partners like the European Union in applying STI to unlock wealth and create jobs. The interventions enable and advance socio-economic participation and inclusion, particularly in marginalised areas. Interventions have strengthened cooperation between the formal and informal economies, and developed products for the health, food and cosmetics

sectors. This enhances the innovation and job-creation role of indigenous knowledge holders, and improves the NSI's responsiveness to grassroots innovations. South Africa is one of the few countries that has promulgated legislation that promotes, develops and protects indigenous knowledge.

Globally transdisciplinary approaches that involve policy-makers and communities in the research process are gaining in importance. The DST will play a major role in facilitating the establishment of national transdisciplinary programmes on poverty and inequality. The DST will also support South Africa's participation in global programmes such as Future Earth as well as emerging international data partnerships for sustainable development.

Expanding and transforming research capacity

Research capacity is the fuel that drives the NSI. The NRDS and the TYIP led to the introduction of the South African Research Chairs Initiative, as well as the centres of excellence and centres of competence programmes, to accelerate knowledge generation and HCD. South Africa's scientific output, measured by publications in internationally accredited journals, increased at an average rate of 10% per year from 2003–2012, representing an average growth of about 624 publications per year. This is much higher than the world average, with a steady increase in the country's share of the world's journal publications (from 0.49% in 2003 to 0.73% in 2012, as illustrated in Figure 3).

Figure 3: South African publications in science journals, and world share

Source: National Advisory Council on Innovation, 2014

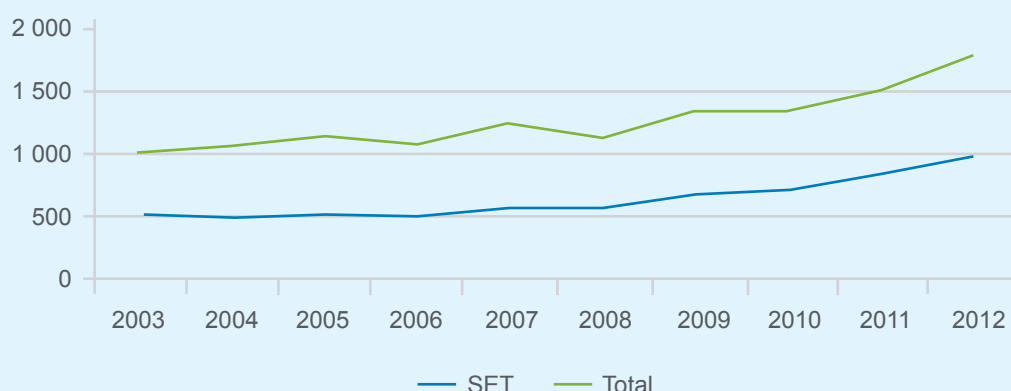
The DST's funding programmes supported the studies of 9 771 postgraduates (honours/BTech, master's and doctoral students, and postdoctoral fellows) in 2013/14. The increase in the number of students receiving bursaries between 2010/11 and 2013/14 is shown in Table 3.

Table 3: Postgraduate students supported between 2010 and 2014

Postgraduate students supported	2010/11	2011/12	2012/13	2013/14
Number of honours students	3 181	1 692	2 846	3 149
Number of master's students	2 542	3 478	3 087	3 704
Number of PhD students	1 259	1 913	1 779	2 265

Figure 4 shows a steady increase in the graduation of doctoral students in the past decade, with especially strong growth between 2010 and 2012. However the number of doctoral graduates in science, engineering and technology and the rate of increase are still significantly below benchmarks set in the TYIP and the NDP. The rise in scientific output highlighted earlier is linked to the significant increase in the doctoral graduate pool, because these graduates would have been active postgraduate researchers during the four to six years preceding publication, and would almost certainly have contributed to that work.

Figure 4: Doctoral degrees awarded by South African higher education institutions



Between 2002 and 2012, the proportion of black students who graduated with honours degrees grew from 62% to 65%, those with a master's from 43% to 57%, and those with a doctorate from 35% to 56%. Growth over the 11-year period has been impressive – 14 percentage points at master's level and 21 percentage points at doctoral level.

In 2012, the proportion of women enrolled at honours level was 63%, at master's level 49%, and at doctoral level 44%. Women made up 45% of total science, engineering and technology enrolment and 51% of total graduations. However, in engineering, only 26% of the 2012 graduates were women. Women have caught up in many areas, but more needs to be done at doctoral level, particularly in engineering and agriculture.

The DST supports emerging and established researchers. Its backing for emerging researchers has had good results – the proportion of women researchers supported by the NRF increased from 34% in 2012/13 to 41% in 2013/14, and of black researchers from 26% to 31%. However, Figure 5 shows that black women remain the least represented, both at doctoral level and as researchers.

Figure 5: Demographic profile of emerging researchers

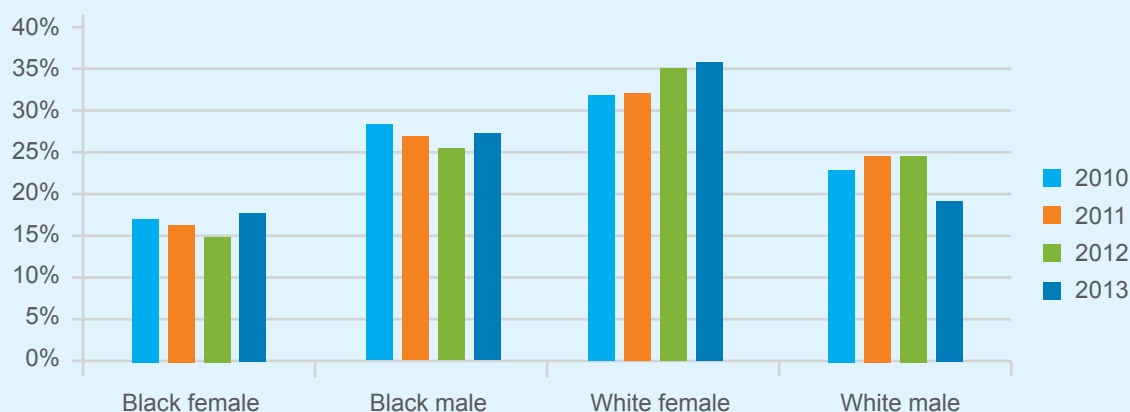


Table 4 compares the productivity of South African researchers with selected countries. While the data shows that the country's science system is productive considering its size, its research output is still comparatively low because the system is small.

Table 4: Summarised publication efficiency for South Africa and selected countries (2012)

	South Africa	Brazil	China	India	Russia	Japan	United Kingdom	USA
Number of Institute for Scientific Information (ISI)-accredited journal publications	9 793	37 346	186 577	48 151	28 050	77 125	103 528	369 258
Number of citations	6 442	14 315	88 164	19 045	11 863	43 166	86 794	282 590
Publications per million capita	192	192	138	38	196	604	1 638	1 176
% share of world output	0.73	2.78	13.90	3.59	2.09	5.75	7.71	27.51
Publications per 100 full-time equivalent researchers	52	28	14	32	6	12	40	26
Citations per 100 full-time equivalent researchers	34	11	7	13	3	7	34	20
Publications per \$100 million in public-private partnership R&D expenditure	244	147	105	198	84	55	262	90
Citations per \$100 million in public-private partnership R&D expenditure	161	56	49	78	35	31	220	69

Sources: Citations data from Thomson Reuters InCites; 2012 population data from Population Reference Bureau; 2010/11 R&D expenditures and full-time equivalent researchers from the Organisation for Economic Cooperation and Development's Main Science and Technology Indicators; South Africa's R&D expenditure and full-time equivalent researchers from the DST's 2010/11 National Survey of Research and Experimental Development; R&D expenditure and full-time equivalent researchers data for Brazil and India from UNESCO's 2010 Science Report.

The DST works with the Department of Higher Education and Training to better align research-related investments in the higher education sector with those made by the DST through the NRF. Its key focus is on short-term interventions to grow South Africa's scientific output.

Summary of key challenges

The DST has made substantial progress in enhancing knowledge production, growing and transforming the pool of knowledge workers, and exploiting knowledge for development. Over the next five years, it aims to:

- Create a responsive, coordinated and efficient NSI with robust planning and monitoring and evaluation (M&E) capacity.
- Develop and strengthen regional and provincial innovation systems and capabilities to meet community and industry demands.
- Develop and transform STI human capital.
- Ensure adequate human capital in a small number of long-term, large-scale, high-impact priority areas.
- Strengthen efforts that enhance South Africa's ability to exploit and use knowledge effectively for economic and social good.
- Build the knowledge-generation and knowledge-utilisation capabilities of historically disadvantaged higher education institutions.
- Provide and maintain a state-of-the-art STI infrastructure.



- Build an institutional (and interdepartmental) instrument to help ensure that promising R&D matures into new industries.
- Improve uptake and local procurement of STI outputs in the public and private sectors.
- Secure key investor support for an action plan to increase gross R&D expenditure from 0.76% of GDP to 1.5%.
- Strengthen government-industry-higher education partnerships.

The strategic planning process

The DST started its strategic planning process in June 2013. The Department's executive committee managed the process, which began with discussing and approving a strategy development plan, including steps to be taken and time frames. The executive committee analysed national and international trends – macro-political, economic and social. The NDP and the MTSF were analysed to identify STI priorities that would contribute to national goals. The DST also reviewed the previous Strategic Plan to identify and learn from key successes and failures. The Department's programmes were given an opportunity to develop their objectives, indicators and targets. A draft plan was developed and debated at various executive committee and extended executive committee meetings before being presented to the Minister of Science and Technology. The draft was revised several times before the Minister approved it for submission to the National Treasury and the Presidency.

The Minister and the Director-General presented selected high-level priorities at a meeting with the heads of DST public entities. These entities needed to understand the Department's five-year priorities when they developed their strategic plans. Three agencies (the NRF, the TIA and SANSA), two science councils (the CSIR and the Human Sciences Research Council), the National Advisory Council on Innovation, the Academy of Science of South Africa, and the South African Council for Natural Scientific Professions are accountable to the Ministry of Science and Technology.

In addition to these bodies, several science councils fall under other line departments, such as the Agricultural Research Council, the Medical Research Council and the Water Research Commission. The DST's coordination of these entities is outlined in the 2004 Strategic Management Model for South Africa's S&T system, with several operational links established. This model was intended to clarify the respective functions of the Department and other line departments and to create a framework for coordinating the NSI.

The DST also consulted other government departments such as the National Treasury (for budget alignment) and the Department of Planning, Monitoring and Evaluation in the Presidency (for alignment with the 2014–2019 MTSF). Further consultations with business also took place.

Strategic outcome-oriented goals

In order to position STI within the framework of the NDP, the DST's priorities, plans and deployment of funding will be directed towards the following five strategic outcome-oriented goals:

Strategic outcome-oriented goal	Responsive, coordinated and efficient NSI
Goal statement	Over the next five years, build on previous gains to create a responsive, coordinated and efficient NSI
Proxy indicators	<p>Proxy indicator 1: Cabinet approval secured for the first comprehensive decadal plan for STI aligned with the NDP by 2019</p> <p>Proxy indicator 2: Budget coordination and legislative instrument for coordination finalised by 2019</p> <p>Proxy indicator 3: Improved systems in place by 2019 for a more rational and strategic deployment of public funding for STI activities</p> <p>Proxy indicator 4: By 2019, a 300% increase in the rand value of government and private-sector investment in R&D partnerships when compared with 2013 (MTSF outcome 4, sub-outcome 10)</p>

Strategic outcome-oriented goal	Increased knowledge generation
Goal statement	Over the next five years, maintain and increase the relative contribution of South African researchers to global scientific output
Proxy indicators	<p>Proxy indicator 1: 22 032 researchers supported by 2019</p> <p>Proxy indicator 2: Publication of at least 33 700 ISI-accredited research articles supported by 2019</p> <p>Proxy indicator 3: Number of articles co-published with researchers on the African continent doubled</p>

Strategic outcome-oriented goal	Human capital development
Goal statement	Over the next five years, increase the number of high-level graduates and improve their representivity
Proxy indicators	<p>Proxy indicator 1: 70 960 postgraduate students supported by 2019</p> <p>Proxy indicator 2: 4 200 graduates and students placed in science, engineering, technology and innovation institutions by March 2019</p> <p>Proxy indicator 3: 5 521 160 people reached through science engagement activities by 2019</p> <p>Proxy indicator 4: Three times the number of master's and PhDs in priority areas identified in the NRDS and TYIP by 2019 (measured on a 2012 baseline)</p>

Strategic outcome-oriented goal	Using knowledge for economic development
Goal statement	Over the next five years, derive a greater share of economic growth from R&D-based opportunities and partnerships
Proxy indicators	<p>Proxy indicator 1: By 2019, new commercial and industrial financing of R2 billion secured for a portfolio of R&D-led industrial development initiatives funded by the DST</p> <p>Proxy indicator 2: By 2019, additional revenue of R500 million generated from firms and companies supported from DST-funded instruments since 2010</p> <p>Proxy indicator 3: By 2019, performance of 10 000 SMEs improved through technology interventions</p>

Strategic outcome-oriented goal	Knowledge utilisation for inclusive development
Goal statement	Over the next five years, accelerate inclusive development through scientific knowledge, evidence and appropriate technology
Proxy indicators	<p>Proxy indicator 1: By 2019, decision support provided that improves the delivery of at least 10 government services or functions</p> <p>Proxy indicator 2: Between 2014 and 2019, contribution of technology-based opportunities for local economic development introduced or strengthened in at least five distressed municipalities</p> <p>Proxy indicator 3: By 2019, opportunities for improving the living standard of at least 500 000 people in South Africa and/or 12 communities unlocked through S&T interventions funded by the DST</p>

Planned policy initiatives

System governance

Priorities for the next five years to strengthen the STI policy and strategy environment include:

- Finalising detailed strategies to fill gaps in policy and strategy. This includes an innovation for inclusive development strategy, an Africa RDI cooperation strategy, national roadmaps for research infrastructure and appropriate cyberinfrastructure, and an action plan for increased cooperation with the private sector by March 2016.
- Developing the first decadal plan for STI aligned with the NDP by 2016, led by the National Advisory Council on Innovation.
- Investigating the desirability of an S&T Act for South Africa.
- Coordinating the budget process for STI institutions.

Financing

It is generally recognised that the NSI is inadequately financed. Public funding constituted 45.3% (R10 832 million) of total funding for R&D in 2012/13. The Department is analysing how public funding is structured and deployed – in particular how it is used to leverage private-sector and international funding. This will enable government to increase its own share of investment to achieve the country-level target of 1.5% of GDP and will assist in the design of initiatives that help secure additional private and international funding.

The Department intends to create an efficient system for the budget coordination of public investment by 2019.

Planning, monitoring and evaluation

The 2012 report of the Ministerial Review Committee (MRC) on the Science, Technology and Innovation Landscape in South Africa noted that NSI operations were still hampered by the inadequate availability, collation, maintenance and analysis of STI indicators needed for M&E, planning and management. Notwithstanding, there are data collection and analysis organisations and initiatives in the NSI, including the Centre for Science, Technology and Innovation Indicators, the Centre of Excellence in Scientometrics and STI Policy, the annual Scientific and Technological Activities report, the Higher Education Management Information System, the Research and Information Management System and the Council on Higher Education.

The MRC argued that, although there is an excess of data, there is a dearth of information. No entity in the NSI currently has the required capacity in system mapping, analysis, system building and steerage, evaluation, learning or foresight.

The DST, through the National Advisory Council on Innovation, will address this by:

- Developing and hosting a portal for all STI data, and rapidly integrating major developments in data science to model, analyse and visualise data to help with planning, M&E and learning.
- Formulating a framework with the Committee of Heads of Research and Technology to be used for the regular, systematic M&E of the entire NSI.

Policy support instruments and incentives to stimulate R&D

The DST seeks to stimulate R&D investment and promote the technological development and market readiness of R&D outputs (especially publicly funded outputs). This complements measures taken by the Department of Trade and Industry and other government agencies.

Organisation for Economic Cooperation and Development research in 2007 showed that policy intervention is needed to address a market failure where business

under-invests in cutting-edge RDI that would support long-term competitiveness. To address this, governments have introduced R&D tax incentive programmes.

The DST introduced an R&D tax incentive to increase private-sector investment in this area. Over the next two years, it aims to improve efficiency in the administration of this incentive. Over the next five years, the Department will improve its analysis of uptake and how the tax incentive supports policy priorities.

STI support for regional innovation

Local and provincial governments are key players in economic development. They create an enabling environment and facilitate access to critical inputs such as land, transport, skills and infrastructure. The DST has assisted in this regard through the sector and regional innovation programme. It has:

- Set up eight regional innovation forums (Nelson Mandela Bay, the Western Cape, Limpopo, the Free State, the Northern Cape, South Gauteng, East London and the Stellenbosch Innovation District). Four continue to function.
- Completed four innovation-based studies and strategies – the Limpopo Integrated Innovation Strategy, the Eastern Cape Innovation Strategy, the Eastern Cape Agro Value Chain Study and the Stellenbosch Innovation District Study.
- Partnered in the development of two S&T parks: the South Gauteng Science and Technology Park and the East London Industrial Development Zone Science and Technology Park. It also supported feasibility studies for other S&T parks.

More DST support is needed to facilitate the development of provincial and regional innovation strategies, so that scientific and technological activities are given priority in planning and budgeting, and SMEs, government, higher education and research bodies can work together.

Over the next five years, the DST will continue to fund, support and facilitate innovation-enabling ecosystems that support regional economic development and growth

strategies. It will include innovation stakeholders outside formal NSI structures, as well as those in marginalised or informal sectors of communities. A set of performance indicators will be developed to track the outcomes and impact of the DST's support for these regional structures.

Knowledge generation

The publication of scientific papers is a key source of innovation and an important international benchmark for national research prowess.

The DST has numerous programmes to support knowledge generation across all areas of science, including the geographic advantage areas and the TYIP "grand challenges". These include centres of excellence, the South African Research Chairs Initiative and the Thuthuka programme, administered mainly by the NRF. The Department will continue to support these extremely effective programmes.

As they mature and stabilise as individual research programmes, the Department will work with centres of excellence to ensure continued responsiveness to South Africa's socio-economic needs.

Central to the goal of bringing gross expenditure on R&D to 1.5% of GDP will be the financing of research support programmes focused on developing human capital and generating knowledge. The Department will model the impact of greater investment in its flagship HCD projects to determine their capacity to absorb a major increase in funds and assess medium-term impact.

Achieving a significant increase in knowledge output would require at least four inter-linked interventions:

- More funding for researchers and students
- Enhancing economies of scale and strategic alignment
- Better use of existing research and institutional infrastructure
- Improved intergovernmental coordination.

These will all require increased funding. The planned growth in researchers clearly indicates a need to grow the number and type of institutions that support the NSI. The establishment of new research institutions in areas in which South African research is already at scale (such as astronomy, marine research, and earth systems science) will be investigated and planned for. This will require improved resourcing of existing institutions.

The Department will investigate the feasibility of establishing several new research institutes and consult across government to secure better coordination of public research organisations and the more efficient use of research infrastructure.

Human capital development

Increasing national scientific output will require a significant expansion in capacity and more active researchers in South African laboratories. In the short term, it may be necessary to recruit researchers, appoint joint research chairs with international institutions and increase the postdoctoral fellowship programme. However, in the longer term and for the increase to be sustainable, South Africa needs to generate additional capacity among its citizens. This should take into account the need for demographic representivity and equity in the NSI.

Initial modelling suggests that, by 2020, South Africa would need to invest at least R5.9 billion per year more than the current medium-term expenditure framework (MTEF) allocations to produce 6 000 PhDs per year.



These models suggest that, within six years, a strategy of incremental growth, scaling up the R&D enterprise and leveraging foreign opportunities could deliver 6 000 PhDs per year. However, this rate of growth and level of output is insufficient to reach the NDP benchmarks of an additional 100 000 doctoral graduates by 2030 – 100 PhDs per million people.

In conjunction with the NRF and the Department of Higher Education and Training, the DST will use historical data to model the output of master's and doctoral graduates linked to various funding levels in the DST/NRF. This information will support strategic financial planning with the National Treasury to develop rational frameworks for increased HCD funding. It will also be used to estimate the number of PhDs per million people by 2019, 2025 and 2030.

The Department's investment in HCD has increased in recent years and will be maintained. Given this massive investment, comprehensive M&E to determine impact is vital, moving beyond recording the number of students supported and graduated. The DST needs to monitor career choices immediately after graduation to ensure skills are not lost to the system. Tracking students after graduation is difficult, but web-based systems are providing innovative solutions and the Department will design and implement such a system.

The NDP has highlighted the massive social challenge of youth unemployment and underemployment. The Department supports several effective interventions that provide opportunities to unemployed graduates, placing them in internships across a wide range of research-intensive organisations, both public and private. These interns make important contributions to the work of their host organisations, and the Department will seek resources to expand this programme.

Transforming the NSI's human resource base is imperative for the system's sustainable growth, and the Department has formulated guidelines for the NRF's bursary programmes to ensure equity and transformation.

The DST will ensure that at least 80% of postgraduate students receiving support are black, 55% are women and 4% are disabled. The current guidelines for the bursary and research support programmes will be monitored and evaluated annually to ensure the participation of previously disadvantaged institutions and individuals such as African women.

It is crucial that awareness of S&T and related careers is deeply embedded in communities to maximise the likelihood of school leavers choosing to pursue scientific and research careers. The Department's Science Engagement Strategy provides a framework that aligns efforts across all DST entities and partners to maximise the impact of science communication efforts. The Department will empower the South African Agency for Science and Technology Advancement to implement the Science Engagement Strategy and ensure that science communication activities are prioritised and coordinated across all DST entities. The Department will also pursue the establishment of a flagship national institution to support science engagement and promotion.

The DST will continue to support the talent development programme, educational technology pilot projects and science and mathematics olympiads and competitions.

The strategies outlined above are informed by the belief that the main barrier to stronger growth and transformation in postgraduate enrolment and graduation is the current inadequacy of public financial support. Too few students are supported at too low a financial level. Massive increases in public support for postgraduate studies would change this significantly, especially if coupled with more communication on the importance of science to social and personal development.

Using knowledge and innovation for economic development

Chapter 3 of the NDP states that "South Africa must develop a more competitive and diversified economy". Globally it is acknowledged that the successful exploitation

of knowledge is the primary driver of competitiveness and new enterprise development.

The challenge lies in transforming the economy and ensuring that the growth rate exceeds 5% a year on average.

According to the NDP, key drivers for achieving this include increased exports, more efficient and competitive infrastructure, reduced cost of living for low-income families, small business support and public and private procurement that stimulates domestic industry and job creation. Among the imperatives is the need for “a larger, more effective innovation system”.

R&D-led new industrial development

The NDP acknowledges that South Africa’s economic growth still relies on the export of primary products, including minerals, and that “mineral-exporting economies tend to have difficulty in diversifying their industrial base”. Over the next five years, the DST must “strengthen the ability of the NSI to identify, prioritise and adequately invest in new sources of growth and employment including higher levels of government investment in research, development, and innovation” (MTSF outcome 4).

Since commercialisation on the basis of R&D is long term, risk-prone and requires the support of multiple role players, building long-term capacity within the state to drive consolidated industrialisation and infrastructure development programmes is vital. To meet the need for a well-managed R&D-led industrial development programme, the MTSF proposes the Emerging Industries Action Plan, which will be led by the DST.

The DST’s five-year priority is to make promising initiatives ready for higher technology, introduce promising initiatives at lower technology readiness levels and exit initiatives that will not reach minimum market readiness levels. Most importantly, the DST must secure commercial financing for initiatives that have matured and where public funding has reduced innovation risks.

To raise R2 billion in commercial financing for DST-funded initiatives over the next five years, policy priorities are as follows:

- Introduce the Emerging Industries Action Plan to coordinate agencies and partners, and ensure the seamless conversion of R&D-based opportunities into successful commercial initiatives. This includes securing effective financing, removing blockages to commercialisation (including regulatory and skills challenges) and seizing opportunities arising from the localisation drive.
- Enhance the TIA’s capacity over the next two years to rapidly evaluate the commercial viability of R&D-based opportunities and accelerate investment decisions.
- Enhance South African participation in international innovation partnership programmes.
- Strengthen NSI models and skills to manage complex and large-scale innovation projects, including a focus on “learning by doing”.

R&D-led economic competitiveness

The Department will strengthen and grow existing initiatives that will help achieve greater economic competitiveness. It will:

- Commercialise existing programmes (such as the unmanned aircraft system project) by establishing new plants or entering into strategic private-sector partnerships.
- Fully operationalise and grow the sector innovation fund programme, starting with an initial portfolio of nine funds.
- Introduce and grow a rock innovation programme to



assist the mining sector in dealing with competitiveness challenges.

- Develop a strategic health innovation hub and management model, and build the Cape Health Technology Park.
- Support technology optimisation for scale-up manufacturing and validation of a foot-and-mouth disease vaccine, helping South Africa regain its international status in this area.
- Develop a rust-resistant wheat variety by 2019.

STI support for the development of SMEs

The Department will continue to strengthen existing programmes such as the technology stations and technology localisation initiatives. The conversion of high-technology SMEs into successful enterprises will be facilitated through the Emerging Industries Action Plan.

Using knowledge and innovation for inclusive development

Targeted decision support that helps transform government services and functions

To improve the accessibility and quality of public services, the DST will support technology demonstrators that address the national priorities of basic agriculture, education, health and human settlements, and improve delivery. It will partner with the Department or agency responsible for a specific service to provide funding for technology development and application, demonstration projects and the development of decision-support tools and systems as follows:

- In partnership with the Department of Basic Education and provincial departments of education, the DST will provide a model to integrate ICT into the teaching and learning process.
- With the departments of Basic Education and Health, the DST will provide an ICT-enabled model to improve school healthcare in support of the National School Health Policy. The model will include rapid screening

for learning difficulties and disabilities and improved access to health information.

- The DST will expand the use of Spatial Temporal Evidence for Planning in South Africa to more municipalities. It will also secure an appropriate institution to house the Sanitation Technology Assessment Tool, which ensures that sanitation technologies are validated technically before they are used.
- The Department will develop and pilot the Rural Innovation Assessment Tool to understand rural innovation capacity and guide strategies for strengthening innovation in these areas.

Innovation-enabled local economic development

Drawing on global successes and its own experience in supporting the development of sustainable livelihoods, the Department will broaden its current focus on individual initiatives to a system-level focus. The DST will fund a range of catalytic economic initiatives in partnership with local authorities and innovation agents, economic development agencies and financiers. The Innovation for Local Economic Development investment will also help strengthen the local innovation infrastructure.

The priorities for the next five years are to:

- Ensure that the DST's STI poverty alleviation initiatives are demand-driven and informed by local priorities in at least three provinces.
- Develop and pilot a grassroots innovation framework targeting innovations based on both indigenous and non-indigenous knowledge systems.
- Commercialise indigenous and non-indigenous knowledge systems technology innovations.
- By 2019, in partnership with appropriate institutions, graduate at least five DST-funded sustainable livelihood initiatives from projects to viable enterprises.
- By 2019, provide support to at least five grassroots innovators with activities aligned with the national Bio-economy Strategy.
- Support eight indigenous knowledge systems

technology innovations in the health, food and cosmetics sectors.

- Pilot three community-based agroprocessing plants (traditional medicines, cosmeceuticals and nutraceuticals) by 2016.
- Commercialise indigenous knowledge systems technologies (traditional medicines, cosmeceuticals and nutraceuticals) by 2017, resulting in broad-based empowerment and job creation, especially in rural areas.

Innovation towards a decent standard of living

Working with the relevant departments, the DST will provide targeted S&T support to enhance efforts to provide a decent standard of living:

- In partnership with the Department of Basic Education, leverage innovative assistive technologies for children with special needs, especially the visually and hearing impaired.
- In partnership with the Department of Human Settlements and at least one province, facilitate the introduction of a large-scale STI-enabled sustainable human settlement, consistent with the principles of the Department of Human Settlement's "Breaking New Ground" plan.
- Support food security, health and wellness based on indigenous knowledge systems in three marginalised communities.
- In partnership with the Eastern Cape Department of Education, the Department of Water and Sanitation and the Bill & Melinda Gates Foundation, provide innovative appropriate off-grid sanitation technologies for rural and peri-urban areas.
- Support the certification of HIV/AIDS point-of-care diagnostics to determine viral load and drug resistance by 2018.
- In collaboration with an international partner, support the development of AIDS passive immunity and a possible vaccine by 2019.
- Support the development of a malaria drug by 2019.
- Support the development of a microbicide for HIV prevention in women.

- Support the development, validation and certification of tuberculosis point-of-care diagnostics, which can be used in rural settings to provide a diagnosis within an hour, saving lives.
- Continue to use partnerships to discover and develop locally relevant drugs, diagnostics, vaccines, biologics and medical devices. Strengthen the Strategic Health Innovation Partnerships, with a focus on HIV, malaria, tuberculosis and non-communicable diseases like diabetes and cardiovascular conditions.
- Support the development of high-end nutraceutical products by 2018 to contribute to food and nutrition security.
- Support the development of diagnostics for Rift Valley Fever by 2018.

Enablers

Research and development infrastructure

The NDP sees the high domestic cost of broadband internet connectivity as a major hindrance to development. The institutional management of the ICT environment needs to be well structured to close the digital divide. ICT is a key component of economic infrastructure such as transport, energy and water resources and can be used to fight poverty and unemployment, and facilitate education and entrepreneurship.

The defined outputs and targets in the MTSF and the NDP outcomes include the construction and commissioning of 64 MeerKAT antennae under Strategic Infrastructure Project (SIP) 16: the SKA and the MeerKAT project. Also included is contributing to 100% broadband penetration by 2020 under SIP 15: expanding access to communication technology.

Providing research infrastructure across the innovation value chain

The Department will continue to grow access to research infrastructure across the NSI by focusing on the following initiatives.

Research infrastructure grants

The target for the next five years is to award 330 research infrastructure grants to researchers and institutions across the innovation value chain. The grants will include support for innovation infrastructure in the form of pilot plants, technology demonstrators and specialised facilities.

Specialised infrastructure facilities

In space S&T, the DST's five-year focus will be on the development of South Africa's nascent satellite technology platforms and infrastructure. In particular, this will include:

- Manufacturing, integrating, testing and launching EOSat1 and ZACUBE2.
- Manufacturing and launching South Africa's first indigenous cube satellite constellation to provide automatic identification system services to Operation Phakisa and the African continent.
- Strengthening and expanding existing HCD transformation programmes like the satellite engineering programme at the Cape Peninsula University of Technology.
- Establishing a fully operational assembly, integration and testing facility. The Houwteq facility will be fully migrated to SANSA and upgraded gradually to world-class standards.

The satellite technology platforms and infrastructure will play an important role in public and private decision-making and will contribute towards:

- MTSF outcome 7: Vibrant, equitable rural communities contributing towards food security for all.
- MTSF outcome 9: Responsive, accountable and efficient developmental local government.
- MTSF outcome 10: Protecting and enhancing South Africa's environmental assets and natural resources.

MeerKAT/SKA radio astronomy telescope

On 25 May 2012, the SKA Organisation announced that Africa (South Africa and eight African partner countries) and an Australia-New Zealand consortium would share the hosting of the SKA. South Africa has also attracted other radio astronomy initiatives from abroad, namely

the C-Band All Sky Survey and the Precision Array for Probing the Epoch of Reionization.

National preclinical infrastructure facilities

The newly established national preclinical platform at North-West University consists of a world-class facility capable of conducting preclinical work in accordance with good laboratory and manufacturing practices. These two international quality standards are necessary for drug and vaccine production. A key priority will be to get the facility accredited good laboratory and manufacturing practices, which will automatically give the facility international standing. The American multinational pharmaceutical company Pfizer has signed an agreement to perform some of the required rodent research once the facility has been fully accredited.

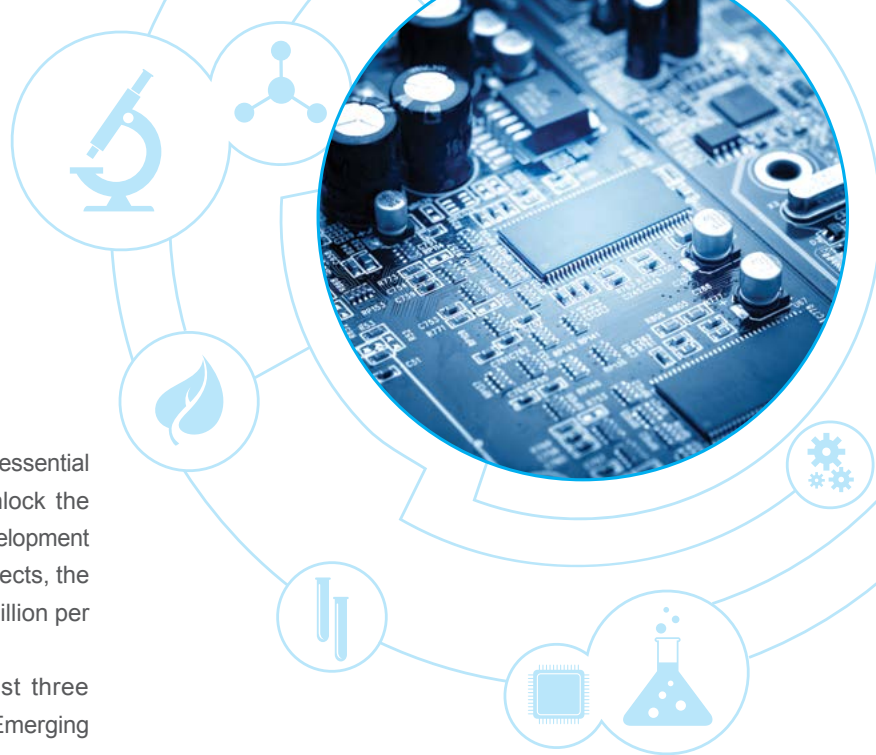
Biotechnology service platforms

Five new technology service platforms will be established in the next five years, including a bioinformatics service platform to service the life science sector, and agro-innovation hubs to provide R&D and connect researchers and rural communities.

High-end infrastructure

The DST will focus on increasing the rate of development and the deployment of low-carbon technologies in the South African market. The work done through existing and new RDI initiatives is expected to result in pilot plants in the fields of lignocellulose, battery cell manufacturing, high-temperature membrane electrode assembly, algae-based biofuels, lithium ion battery precursor materials, metal hydrides, low temperature membrane electrode assembly catalysts and multipurpose centrifuge. This will directly contribute towards MTSF Outcome 6: An efficient, competitive and responsive economic infrastructure network.

The Department will continue to fund projects that can unlock existing/new products and markets. A number of projects have been identified that have economic potential provided R&D or technological development continues.



The high-end infrastructure funding allocation is essential to scaling up and maturing technology to unlock the market potential of leading R&D-led industry development projects. Based on the current portfolio of projects, the DST envisages an investment of about R80 million per year to:

- Enable technology maturation of at least three projects, which qualify for funding from the Emerging Industries Action Plan.
- Expedite the development and maturation of at least five technology demonstrators derived from local IP.
- Expedite and enable joint science, engineering and technology programmes with at least five projects that involve the private sector and three more involving foreign partners.
- Help establish a follow-on pilot plant/technology demonstrator, financed predominantly by private industry.

Cyberinfrastructure

Broadband capacity

The roll-out of a gigabit per second (Gbps) capacity broadband network through the South African National Research Network will continue to enable data transmission to all research and academic institutions. The national backbone and its points of presence will be upgraded to increase the average bandwidth per South African National Research Network site per year from 2 800 megabits per second (Mbps) in 2014/15 to 8 000 Mbps in 2018/19. The achievement of this target will also increase the number of network users, contributing to the goal of expanding access to communication technology (SIP 15) to 100% broadband penetration by 2020.

International capacity will also be increased from 10 Gbps to more than 100 Gbps. This is necessary for the successful implementation of national interest projects such as the MeerKAT/SKA project, the Southern African Large Telescope, the African Very Long Baseline Interferometry Network and the Big Data Project, and will allow researchers to participate in competitive research.

Data storage and management

Two petabytes of data storage, shared between the primary Centre for High Performance Computing site in Cape Town and the disaster recovery site at the CSIR in Pretoria, are available through the Data Intensive Research Infrastructure South Africa (DIRISA) initiative. This capacity is used to host a CERN (European Organisation for Nuclear Research) tier 2 data node, an international astronomy data mirror site and data from the Applied Centre for Climate and Earth Systems Science. To store, curate and manage the growing data from these projects and new ones, especially the radio-astronomy data that will soon be generated at MeerKAT, it has become necessary to expand the DIRISA initiative.

Towards the long-term provision of research infrastructure

The South African Research Infrastructure Roadmap

The DST expects this roadmap to be completed by the end of 2015/16. The roadmap will guide the strategic development, acquisition and deployment of research infrastructure as a necessary enabler for RDI.

It will consist of at least 10 research infrastructures with a focus on six scientific domains: humans and society; health, biological and food security; Earth and the environment; energy; materials and manufacturing; and physical sciences and engineering. Over the next five years a significant portion of infrastructure investment will be used to implement the roadmap. The DST will approach the National Treasury for a dedicated research infrastructure fund to support the implementation.

A national integrated cyberinfrastructure system

In 2013, the DST commissioned a study to develop a framework for a national integrated cyberinfrastructure system, which will help South Africa maximise impact, sustainability and effective management of its cyberinfrastructure. The recommendations will be implemented over the next five years. In addition to the three existing components of the cyberinfrastructure system (the South African National Research Network, the Centre for High Performance Computing and Data Intensive Research Infrastructure South Africa initiative), a fourth pillar for skills and training services will be formally established.

International cooperation and resources

Priorities for the next five years

To achieve its strategic goals, the DST will continue to build a diverse and vibrant portfolio of international STI partnerships, seeking appropriate expansion, greater geographic diversity and deeper partnerships with a greater focus on innovation and market-orientated research. The DST will aim to conduct world-class science diplomacy and seek more active participation by historically disadvantaged institutions in its international STI partnership portfolio.

In keeping with South Africa's foreign policy agenda, supporting the development of STI capacities in Africa will remain a strategic priority. The Department will strive to secure support and investment for African STI initiatives from international partners using Southern African Development Community (SADC) and African Union (AU) frameworks. The overall goal will be to ensure that South Africa plays a leading role in the implementation of the AU's Science, Technology and Innovation Strategy for Africa.

In Southern Africa, the challenge will be to implement STI policies and strategies, leveraging international partnerships for additional resources and support.

Efforts to promote international STI partnerships will always be guided by the broader goal of harnessing STI to fight poverty, inequality and unemployment. These partnerships must contribute directly to key DST strategies such as the TYIP, the Bio-economy Strategy, the ICT RDI Implementation Roadmap and the Human Capital Development Strategy for Research Innovation and Scholarship. The focus will also be on accessing international resources for flagship programmes such as Africa's hosting of the SKA and the DST's thematic priorities, including climate science, health innovation and minerals beneficiation.

For 2014/15, the DST's goal is to secure R354.6 million from international partners. The annual target of secured funds will increase annually to reach a cumulative amount of R2 billion over the next five years.

The Department aims to move beyond traditional research cooperation, with joint publications as the chief output, to focus on promoting innovation partnerships and market-orientated research cooperation. The DST will actively seek partnerships in the commercialisation of R&D results and joint product and service development, especially involving SMEs.

The increased focus on innovation will also be a focus in bilateral partnerships with African countries. Within the context of cooperation with the European Union, the priority will shift towards participation in market-orientated programmes such as EUREKA and opportunities for SMEs.

The complexity of major societal challenges, to which the DST is required to respond in terms of the NDP, invariably necessitates cooperation across borders. It is essential to access the knowledge, capacity and resources of foreign partners to complement South Africa's own STI investments.

The DST's activities to promote international cooperation will align with the NDP's Chapter 7 ("Positioning South



Africa in the world”), and respond directly to MTSF outcome 11: Creating a better South Africa and contributing to a better and safer Africa in a better world.

MTSF outcome/output indicators and targets (2014–2019)

Foreign funding to grow and develop the NSI

The DST aims to make South Africa a preferred investment destination for multinational companies, international foundations, philanthropic organisations and development cooperation agencies. It will promote participation in competitive research and innovation funding programmes, such as the European Union’s Horizon 2020 programme, and prioritise foreign investment in joint ventures targeting commercialisation and product and service development.

International support for HCD in the NSI

International partnerships will be actively sought to achieve the DST’s HCD objectives, specifically PhD training, and to help build South Africa’s innovation management and entrepreneurial skills. Specific attention will be paid to the involvement of historically disadvantaged institutions.

The five-year target is to launch a comprehensive national programme, similar to Brazil’s “Science without Borders”, for international researcher (PhD) training. By 2019, the DST aims to secure 900 new international bursaries or fellowships for South African researchers to gain postgraduate qualifications.

S&T cooperation in Africa

The DST will step up its efforts to play a critical, but constructive leadership role to ensure various African regional and continental STI policies and initiatives are concretely implemented, with international partner support.

The five-year target is to ensure that the DST makes an annual, active contribution to the implementation of at least 45 major African (SADC or AU) STI partnership initiatives, as well as the Science, Technology and Innovation Strategy for Africa framework.

Science diplomacy to support South Africa’s foreign policy

International STI cooperation is a valuable foreign policy tool for South Africa’s foreign policy, often enabling strategic political and economic relations. The DST has a direct contribution to make to the achievement of MTSF outcome 11, including sub-outcome goals (advancing South Africa’s national priorities in bilateral engagements; achieving an economically integrated Southern Africa; fostering a sustainable and economically integrated Africa; building strong and mutually beneficial South-South partnerships; and developing beneficial relations with strategic formations in the North).

The DST’s five-year target is to shape global STI governance strategically by ensuring that South Africa occupies 15 leadership positions in international STI governance structures.



Part B:

STRATEGIC OBJECTIVES

The DST consists of the following programmes:

- Programme 1: Administration
- Programme 2: Technology Innovation
- Programme 3: International Cooperation and Resources
- Programme 4: Research Development and Support
- Programme 5: Socio-Economic Innovation Partnerships

Programme I: Administration

Purpose

To provide strategic policy and planning alignment, ensure effective governance, risk management and M&E, and provide strategic science communication with stakeholders on the activities of the DST and the NSI.

Strategic overview

The DST's efforts to ensure its administration and internal operational systems are effective and efficient has received external acknowledgement, with the Department being recognised as one of the country's two best performing departments (in terms of the management and performance assessment tool administered by the Department of Planning, Monitoring and Evaluation).

This drive for administrative excellence will continue as the DST develops new strategic interventions for greater effectiveness. The NDP identifies the need to build a capable and accountable developmental state that constantly strives to improve by building capacity and learning from experience. Programme 1 will remain engaged, proactive and innovative through the following activities and objectives.

Efficient information technology (IT)-driven operational and management functions

The Department needs to invest in the provision of reliable technology infrastructure to create a seamless administration capability. This will help increase efficiency, provide access to information and add value to productivity

and performance. It will require investment in a robust and capable IT unit that is able to respond to modernisation and change.

Strategic role for human resource management

It is important that the DST adopts a value-building and strategic approach to human resource management. The Department aims to source the best skills and invest in employee development to maximise productivity. The transactional and functional nature of the current human resources function has limited organisational ability to create an adaptable performance-driven enterprise.

A strategic approach to managing human resources will help the DST initiate and sponsor change management through the introduction of technologies that advance organisational performance and efficiency. It will also become a reliable source of information on HCD, talent management and productivity. Through a considered talent management plan, the DST will consolidate its position by recruiting a combination of high-level technical and professional skills.

Effective finance, audit and risk management functions

The finance, audit and risk management functions ensure that the DST's operations are ethical, efficient and compliant with legislation. In the past five years, the Department has established functional and effective finance and supply chain management, audit and risk management units. The DST will continue to enhance the units' scope and function over the next five years,

with clear improvements in the Department's audit status. Specifically, there needs to be a focus on supply chain management processes, and effective and integrated IT systems. The strategic focus of the Internal Audit Activity directorate is to achieve improved risk management, governance, internal controls and internal audit. The Enterprise Risk Management directorate ensures the Department has appropriate risk management policies and guidelines, and identifies and assesses risks.

A team-based, high-performing and client-centred organisation

It is necessary to build an organisational culture that is team-based, with high standards for each employee. The DST's values are embedded in the Batho Pele principles. New service standards are needed so that internal and external clients know their service needs will be met in a proactive, consistent and cooperative manner.

Effective planning, monitoring and evaluation

The DST is a medium-sized organisation, but it has a large mandate to coordinate the work of the NSI with limited capacity and resources. In the next five years, the DST will design a well-resourced planning unit with adequate skills to:

- Serve as a strategic planning unit and a knowledge resource unit for the DST and the STI
- Conduct evidence-based research to assist executive decision-making
- Communicate STI research trends
- Help the DST plan for the STI through forecast studies on issues such as talent management, and identify knowledge gaps and policy challenges.

An effective governance and compliance function

The DST has five public entities and three institutions that implement its various strategic goals and receive 92% of the budget. The Department requires a central unit to monitor the entities' regulatory compliance, accountability and implementation of agreed objectives. This is in alignment with the Public Finance Management Act (1999) and recommended in the NDP. The Governance directorate needs increased capacity and resources to

address this. In the next five years, the DST will build a governance and advisory unit that is well staffed with relevant skills. The unit will provide public entities and institutions with sound governance advisory services, and will play an oversight function while enabling accountability. The unit will promote best practice and design standardised reporting tools for all entities.

Strategic direction for the NSI research and interventions

The coordination of the NSI has been the DST's key function. However, the need to increase economic growth and address poverty, unemployment and inequality requires a new strategic focus for the NSI. The DST needs to restructure some of its programmes for this new direction.

Chief directorates

The Ministry and Office of the Director-General

The directorate provides the Minister, Deputy Minister and Director-General with professional and executive support. It is responsible for the development of systems for handling Parliamentary questions, Cabinet matters, correspondence, submissions and memoranda. It also coordinates activities within the Department to help steer the NSI.

Enterprise Risk Management

Enterprise Risk Management creates risk management awareness and elevates it to a strategic level in the Department. Its secondary role is to ensure that countering fraud is an integral part of the DST's strategy and operations.

Policy, Planning, Governance, Monitoring and Evaluation

This directorate supports DST leadership by ensuring effective planning and policy formulation, providing performance and governance analyses of DST entities, and tracking the implementation of government's programme of action.



Internal Audit Activity

Internal Audit Activity performs internal appraisal activities to improve the effectiveness of control and governance processes.

Human Resources

The directorate ensures that the Department is able to provide a professional service through accurate, consistent and best employment practices in all its activities; attract and retain employees who share the same organisational vision; champion change and transition; set performance standards and manage performance against them; promote an environment that supports the personal and career development of all employees; and instil a culture of service excellence.

Finance

This directorate ensures the effective, efficient and economic utilisation of financial resources through the development and implementation of systems, policies, frameworks and procedures. This includes budget planning and expenditure monitoring, and managing procurement, acquisition, logistics, assets and financial transactions.

Information Systems and Knowledge Management

The directorate is responsible for the effective use of IT to support the Department's Strategic Plan and individual units' objectives. It aligns IT and business strategies to ensure that resources are used optimally.

Science Communication

Science Communication ensures effective communication between the Department and its stakeholders, and creates awareness of its objectives and activities using public participation programmes, public lectures, and electronic and print media. It is also responsible for raising the DST's international profile, working with institutions such as Brand South Africa to attract R&D investment and profile the Department's work to a global audience. The directorate supports the South African Agency for Science and Technology Advancement's Science Engagement Strategy, and ensures the communication strategy's alignment with government's communication framework.

Legal Services

Legal Services is responsible for protecting the DST against any legal risk. It ensures legislative compliance and proactively avoids conflict or legal challenges.

Strategic objectives

Strategic objective	Alignment across various planning documents of the Department and its entities
Objective statement	To coordinate (the identification, formulation and implementation of strategic initiatives) and ensure that the priorities of the DST and its entities are aligned to national priorities
Baseline	<ul style="list-style-type: none"> DST planning documents not aligned DST entities' 2014/15 annual performance plans signed by the Minister and shareholder compacts signed by the Minister and chairpersons of the boards
Performance indicators	<ul style="list-style-type: none"> Percentage alignment of DST planning documents (strategic plan aligned to APP and APP aligned to Estimates of National Expenditure) submitted to Parliament DST public entities' strategic and annual performance plans approved by the Minister and shareholder compacts signed by the Minister and chairpersons of the boards
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> Public Finance Management Act National Treasury Framework for Strategic Plans and Annual Performance Plans

Strategic objective	Sound corporate governance, including M&E
Objective statement	To develop and maintain a corporate governance system for the Department and its entities
Baseline	<ul style="list-style-type: none"> In 2013/14, four DST quarterly reports and one annual report approved and signed by the Director-General Annual reports for nine DST entities submitted to Parliament
Performance indicators	<ul style="list-style-type: none"> Number of DST performance reports (quarterly and annual) approved and signed by the Director-General (quarterly reports within 60 days of the end of each quarter) Number of DST public entities' annual reports submitted to Parliament
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> Public Finance Management Act National Treasury Framework for Strategic Plans and Annual Performance Plans

Strategic objective	Adequate and appropriately skilled personnel
Objective statement	To make the DST an employer of choice and recruit and retain appropriately skilled personnel
Baseline	<ul style="list-style-type: none"> 90 days to fill vacancy after date of advertisement 8% vacancy rate 60% of DST personnel submitting performance contracts and reviews on time
Performance indicators	<ul style="list-style-type: none"> Turnaround time to fill vacancies Vacancy rate reduced to a set rate Percentage of DST personnel submitting performance contracts and reviews on time
Links (to government plans, policies and outcomes)	MTSF outcome 12: Efficient, effective and development-oriented public service and an empowered, fair and inclusive citizenship

Strategic objective	Efficient and effective IT service
Objective statement	To provide an efficient and effective IT service
Baseline	<ul style="list-style-type: none"> Two enterprise architecture development life-cycle steps developed and implemented Three IT governance framework components implemented
Performance indicators	<ul style="list-style-type: none"> Number of enterprise architecture development life-cycle steps developed and implemented Number of IT governance framework components implemented
Links (to government plans, policies and outcomes)	MTSF outcome 12: Efficient, effective and development-oriented public service and an empowered, fair and inclusive citizenship

Strategic objective	Equitable and sound financial and procurement services
Objective statement	To ensure effective and efficient financial and procurement services
Baseline	<ul style="list-style-type: none"> 2014 budget planning reports submitted to National Treasury Suppliers paid within 30 days and tender process completed within 90-day period Unqualified audit report on financial matters from Auditor-General
Performance indicators	<ul style="list-style-type: none"> Budget planning reports (MTEF and Estimates of National Expenditure) submitted to National Treasury Suppliers paid within 30 days of date of invoice and tender process completed within 90-day period Unqualified audit report on financial matters issued by the Auditor-General
Links (to government plans, policies and outcomes)	MTSF outcome 12: Efficient, effective and development-oriented public service and an empowered, fair and inclusive citizenship

Strategic objective	Science communication
Objective statement	To provide strategic communication for the DST and its entities through marketing, media, branding initiatives and the Science Engagement Strategy
Baseline	<ul style="list-style-type: none"> DST Communication Strategy and implementation plan approved 22 communication and media plans approved 13 public participation programmes held Four S&T media monitoring reports tabled
Performance indicators	<ul style="list-style-type: none"> Communication strategy and implementation plan approved Number of DST communication¹ and media plans approved Number of public participation programmes held Number of S&T media monitoring reports tabled Number of media articles written to profile the DST
Links (to government plans, policies and outcomes)	Government Communication and Information System Communication (GCIS) Framework, 2014–2019

¹ Communication and media plans are developed for specific DST initiatives such as the DST Budget Vote, National Science Week, the Innovation Bridge, Technology Top 100 and the SKA Shared Sky exhibition.

Programme 2: Technology Innovation

Purpose

To enable R&D in space S&T, energy security and the bioeconomy, and in the emerging and converging areas of nanotechnology, robotics, photonics and IKS; to promote the realisation of commercial products, processes and services from these R&D initiatives. In addition, through the implementation of enabling policies and interventions along the entire innovation value chain, to promote the protection and utilisation of IP, technology transfer and technology commercialisation.

Strategic overview

The programme's purpose is directly informed by the NRDS and the TYIP. Programme 2 provided substance to the NRDS Innovation Pillar by establishing and funding the implementation of the Biotechnology Strategy, which has since been replaced by the Bio-economy Strategy. The programme also continues to implement various initiatives in terms of HCD and transformation. The TYIP identified three “grand challenges” for which the programme is responsible:

- **Strengthening the Bio-economy Strategy.** The strategy initially focused on the development of technologies and services that would support science-based innovation in health, industry and agriculture. Now, the focus is on leveraging the expertise and competitive advantages gained to create a world-class biotechnology system of innovation that offers much more than project support.
- **Growing the local space industry.** Space S&T is an area in which South Africa intends to become a key global contributor. The DST, through SANSA, will grow the local space industry, champion the sector's contribution to development in Africa, and provide world-class space S&T facilities. The national space programme under development will ensure that

space S&T contributes to addressing socio-economic challenges and supports government planning, with a specific focus on natural resource management, agriculture, health and security.

- **Safe, clean, affordable and reliable energy.** The country needs to meet its medium-term requirements while innovating for the long term in clean coal technologies, nuclear energy, renewable energy and the promise of the hydrogen economy.

Programme 2 has embarked on various initiatives in the strategic areas of space S&T, energy security and the bioeconomy. A review of its work over the last MTEF period (2009–2014) identified the need to deepen and strengthen the implementation of these initiatives.

The review also highlighted the need to revise the programme's strategic objectives to ensure better alignment with DST goals and national priorities, and to enable the programme to clarify its priority areas. A key focus area will be promoting IP protection and utilisation, and technology transfer and commercialisation, especially in the context of publicly funded R&D and private-sector partnerships.

Chief directorates

The programme has four chief directorates and one specialised service delivery unit.

Bioeconomy

Bioeconomy leads the implementation of the national Bio-economy Strategy, approved by Cabinet in 2013, which incorporates the innovation needs of government and industry. The strategy focuses on:

- Strengthening the research and innovation competencies that form the strategic foundation for the bio-based NSI.

- Strategic RDI programmes that provide for new knowledge and innovation outcomes related to the government's priority requirement.
- Coordinating role players across the NSI to ensure that appropriate skills, knowledge and competencies are made available to maximise socio-economic impact.
- Mainstreaming applied indigenous knowledge systems R&D, inclusive innovation and local manufacturing to support commercialisation models for sustainable livelihoods and improved quality of life.

Over the 2015/16 to 2017/18 period, the directorate will focus on innovative solutions to health service delivery challenges in the areas of HIV/AIDS, tuberculosis and non-communicable diseases such as malaria and diabetes. A vaccine and biologic manufacturing facility will be established, accredited for good laboratory and manufacturing practices. At least one candidate drug for malaria will enter phase 2 clinical trials, and one medical device providing point-of-care diagnostics for HIV/AIDS and tuberculosis will enter the final phase. These initiatives will contribute directly to MTSF outcome 2 of a long and healthy life for all South Africans by focusing on sub-outcome 8 (HIV/AIDS and tuberculosis prevented and successfully managed) and sub-outcome 9 (maternal, infant and child mortality reduced).

With regard to agricultural biotechnology, the directorate will make progress in developing new resilient crop varieties, starting with the establishment of a wheat breeding platform. A diagnostic for foot-and-mouth disease and a plant-made biologics prototype will be developed and two indigenous knowledge-based manufacturing plants will be established and piloted.

New diagnostics and therapeutics for key diseases affecting livestock will be developed and trialled, and new disease-resistant crop varieties produced. The Eucalyptus Genome programme will develop protocols for the genetic engineering of eucalyptus trees, which can improve disease resistance and biomass qualities beneficial to industry.

HCD is a key focus in the industrial and environmental component of the strategy – both in applied research (biocatalysis) and in entrepreneurialism (bioprocessing/manufacturing). There will be continued development and commercialisation of indigenous knowledge-based products, including herbal infusions, cosmeceuticals, nutraceuticals and African traditional medicines, to mainstream products and ensure community beneficiation and direct commercial involvement. Efforts will be made to build relevant pilot and demonstration facilities to support industrial biotechnology.

Hydrogen and Energy

Hydrogen and Energy provides policy leadership for RDI initiatives in the energy sector. It plays a key role in developing a sustainable and globally competitive energy knowledge base and industry, especially in relation to the nascent global hydrogen economy, by helping to shape national energy policy. In particular, the Department plays an advisory role in the development of the Integrated Energy Plan and Integrated Resource Plan, with an emphasis on deploying and incentivising technologies that will address the country's energy needs.

The priority over the MTEF period will be to increase the rate at which low-carbon technologies are developed and deployed in the South African market. The DST will provide strategic support to existing Hydrogen South Africa centres of competence, hubs (for renewable energy, advanced battery technology and energy efficiency and demand-side management) and spokes (renewable energy) and new DST-funded energy RDI initiatives (solar and energy storage centres of competence). This is expected to lead to the development of eight pilot plants in the fields of lignocellulose, battery cell manufacturing, high temperature membrane electrode assembly, algae-based biofuels, lithium ion battery precursor material, metal hydrides, low temperature membrane electrode assembly catalysts and multipurpose centrifuge. These pilot plants will contribute directly to outcome 6: An efficient, competitive and responsive economic infrastructure network.

Space Science and Technology

Space S&T supports the creation of an environment conducive to the National Space Strategy and the South African Earth Observation Strategy, and helps develop innovative applications and human capital to respond to national priorities and boost socio-economic growth. The National Space Strategy and the South African Earth Observation Strategy are informed by the National Space Policy, developed by the Department of Trade and Industry, which aims to:

- Capture a global market share for small to medium-sized space systems by fostering and promoting innovation and industrial competitiveness.
- Empower better decision-making through the integration of space-based and ground-based systems.
- Use space S&T to develop applications for the provision of geospatial, telecommunication, timing and positioning products and services.

The TYIP identified the following goals for the South African space S&T sector:

- Ensure independent Earth observation high-resolution satellite data is available for Africa from a constellation of satellites designed and manufactured in Africa.
- Specify and co-build a domestic/regional communications satellite, and secure launch and International Telecommunication Union slots for its operations.

To achieve these outcomes, the Department will focus on developing South Africa's nascent satellite technology platforms and infrastructure – in particular, the manufacture, integration and testing of the Earth observation satellite. South Africa's first indigenous cube satellite constellation will also be manufactured and launched to provide automatic identification system services to Operation Phakisa (Ocean Economy) and the broader African continent.

There is a deficit of engineers in the space sector, with poor representation of black and female engineers. This

presents an opportunity for more rigorous and targeted HCD programmes such as the Cape Peninsula University of Technology's satellite engineering programme. The directorate will help drive an HCD programme that ensures students are taken up by SANSA and the broader industry.

To develop South Africa's satellite manufacturing and engineering capability, a fully operational assembly, integration and testing facility must be in place. The Houwteq facility will be fully migrated to SANSA and gradually upgraded to world-class standards.

Support will be given to the establishment of a space S&T node in South Africa for the Pan-African University, and to strengthening participation in global initiatives such as the Group on Earth Observation and the Committee on Earth Observation Satellites.

The directorate and SANSA will represent South Africa at forums such as the Group on Earth Observation and the Committee on Earth Observation Satellites, the United Nations Committee on the Peaceful Uses of Outer Space, the International Telecommunication Union and other key international gatherings in order to position the country as a peaceful user of space. In response to the Group on Earth Observation, the directorate has established a voluntary group of South African Earth observers organised around communities of practice, whose activities are administered by the National Earth Observation and Space Secretariat. The secretariat was established to encourage collaboration and data sharing, and to coordinate Earth observation user needs across a number of areas to benefit society.

The satellite technology platforms and infrastructure in space S&T will contribute towards the following:

- Outcome 7: Vibrant, equitable rural communities contributing towards food security for all
- Outcome 9: Responsive, accountable and efficient developmental local government system

- Outcome 10: Protect and enhance South Africa's environmental assets and natural resources.

Innovation Priorities and Instruments

Innovation Priorities and Instruments supports and strengthens the innovation policy package, which aims to create and sustain an enabling environment for innovation, technology development and the commercialisation of publicly funded R&D initiatives. It identifies, develops and supports structures that facilitate technology development and its progression into national and international markets.

This includes the conceptualisation, piloting and M&E of instruments such as those centred on the Department's commercialisation framework and the Emerging Industries Action Plan. The component supports the development and implementation of emerging and converging technologies in areas such as synthetic biology, structural biology, systems biology and functional genomics (collectively comprising the South African Biodesign Initiative), nanotechnology, photonics and robotics.

Over the next three years, the focus will be on fostering technology development and its progression into national and international markets by implementing enabling policies and initiatives. Policy directives, including inputs into the Industrial Policy Action Plan and a Cabinet memorandum, will be formulated to address innovation and technology commercialisation policy needs. The commercialisation framework, the Emerging Industries Action Plan and actions relevant to the Industrial Policy Action Plan and the DST will be implemented, monitored and evaluated.

The directorate will also host the second biennial Innovation Bridge Technology Showcase and Matchmaking Event and launch the Innovation Bridge Portal. Both aim to build awareness of South Africa's publicly funded innovations and connect key participants across the innovation value chain. In addition, a new three-year technology-oriented industry partnership programme will be conceptualised and implemented with the private sector. This will see

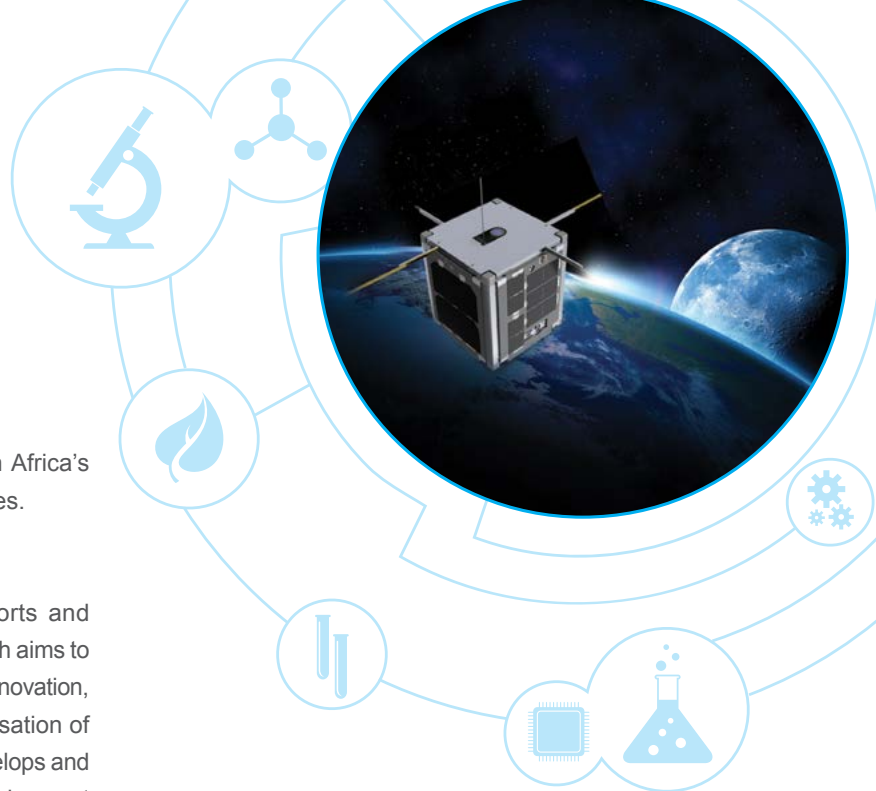
90 postgraduate students supported, 90 peer-reviewed publications generated and one IPR filed.

National Intellectual Property Management Office

NIPMO is located within the Department as a specialised service delivery unit to provide for the more effective use of IP emanating from publicly financed R&D. The office:

- Facilitates the establishment of offices of technology transfer at 26 higher education institutions and 10 schedule 1 institutions, which are mostly science councils, and supports associated capacity development.
- Ensures recipients of publicly financed R&D comply with the Intellectual Property Rights from Publicly Funded Research and Development Act and regulations.
- Provides funding, through the IP Fund, for the protection and maintenance of IP emanating from publicly financed R&D.
- Provides incentives for IP creators to disclose, protect and commercialise their creations.

By providing incentives, support, funding and compliance services, NIPMO is expected to contribute towards increasing the rate of knowledge utilisation from publicly funded R&D. In particular, six offices of technology transfer will be supported for capacity development annually and 1 100 candidates will be trained in IP and specialised technology transfer skills. All eligible claims from institutions will be awarded a rebate annually from the IP Fund and a total of 1 600 disclosures will be received from publicly funded institutions (higher education institutions and science councils).



Strategic objectives

Strategic objective	Facilitate and resource R&D in strategic STI areas
Objective statement	To facilitate and resource STI investments in space S&T, energy, bioeconomy, nanotechnology, robotics, photonics, IKS, IP management, technology transfer and technology commercialisation
Baseline	<ul style="list-style-type: none"> • 2008 acts (TIA Act, Intellectual Property Rights from Publicly Funded Research and Development Act and SANSA Act) • Bio-economy Strategy approved by Cabinet in 2014 • 20 policy instruments² developed • Seven research chairs supported • 29 research and development initiatives³ financially supported • 16 offices of technology transfer funded • 24 institutions awarded a rebate for IP prosecution and maintenance costs from the IP Fund
Performance indicators	<ul style="list-style-type: none"> • Number of innovation-enabling programmes⁴ implemented • Number of policy directives developed and approved by government • Number of knowledge products⁵ generated
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • MTSF outcome 4: Decent employment through inclusive growth • Cross-cutting areas of the New Growth Path, the NDP and the Industrial Policy Action Plan • The innovation pillar in the NRDS • The energy security “grand challenge” in the TYIP

Strategic objective	Oversee relevant Departmental agencies and initiatives ⁶
Objective statement	To oversee, monitor and regulate key policy initiatives, including institutions/agencies, and support interventions in the key strategic areas of space S&T, energy, bio-innovation, nanotechnology, robotics and photonics
Baseline	<ul style="list-style-type: none"> • Two annual performance plans and strategic plans submitted each year since the establishment of TIA and SANSA in 2010 • 682 disclosures received in total by NIPMO for IP generated after 2 August 2010
Performance indicators	<ul style="list-style-type: none"> • Number of new disclosures reported by publicly funded institutions • Number of evaluation and assessment reports developed and approved
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • MTSF outcome 4: Decent employment through inclusive growth • MTSF outcome 12: An efficient, effective and development-oriented public service • Cross-cutting areas of the New Growth Path, the NDP and the Industrial Policy Action Plan • The innovation pillar in the NRDS • The bioeconomy, energy security and space S&T “grand challenges” in the TYIP

2 Policy instruments include policies, acts, regulations, strategies, implementation plans, policy briefs, research/technical reports and concept notes.

3 R&D initiatives include centres of competence, research chairs, hubs and spokes, as well as R&D programmes supported in hydrogen and energy, biotechnology and health.

4 Innovation-enabling programmes include the hosting of the Innovation Bridge Technology Showcase and Matchmaking Event, the implementation of the Innovation Bridge Portal, the implementation of public-private sector initiatives such as the industry internship programme, the implementation of the Commercialisation Framework Programme (and any associated strategies that emerged as a consequence), the Emerging Industries Action Plan, and initiatives in support of offices of technology transfer activities.

5 Knowledge products include patents, prototypes, technology demonstrators or technology transfer packages.

6 This includes the monitoring, evaluation, verification and coordination of the performance of institutional arrangements and support interventions in line with strategies, annual performance plans and implementation plans, as well as relevant legislative requirements. These will be measured and evaluation and assessment reports issued, as well as disclosures (provision of full details of potential intellectual property to NIPMO) in terms of the Intellectual Property Rights from Publicly Funded Research and Development Act.

7 Support interventions are institutional arrangements such as coordinating committees, partnerships, joint ventures and other strategic arrangements undertaken to drive the implementation of national, specifically DST, policies and strategies.

Strategic objective	Coordinate and support high-end skills development
Objective statement	<ul style="list-style-type: none"> To coordinate and support high-end skills development in: <ul style="list-style-type: none"> the strategic and emerging S&T areas of synthetic biology, structural biology, systems biology and functional genomics (collectively the South African Biodesign Initiative), space S&T, energy, bio-innovation, nanotechnology, robotics, photonics and indigenous knowledge systems IP management, technology transfer and technology commercialisation
Baseline	<ul style="list-style-type: none"> 115 postgraduates (PhD and MSc) supported in total 120 candidates trained in specialised IP and technology transfer skills
Performance indicators	<ul style="list-style-type: none"> Number of postgraduate students (MSc and PhD) supported through DST-funded R&D initiatives Number of trainees supported in strategic and emerging research areas
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> MTSF outcome 4: Decent employment through inclusive growth MTSF outcome 5: Skilled and capable workforce to support an inclusive growth path Cross-cutting areas of the New Growth Path, the NDP and the Industrial Policy Action Plan The innovation pillar in the NRDS The space S&T and energy security "grand challenges" in the TYIP

Strategic objective	Support the development and translation of scientific R&D outputs into commercial products, processes and services
Objective statement	To support, promote and advocate the development and translation of scientific R&D outputs into commercial products, processes and services that will contribute towards economic growth and a better quality of life
Baseline	<ul style="list-style-type: none"> 25 new technology products, processes and/or services commercialised 95 products, processes and/or services developed for commercialisation
Performance indicators	<ul style="list-style-type: none"> Number of new technology products, processes and/or services developed Number of new technology products, processes and/or services commercialised
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> MTSF outcome 2: A long and healthy life for all South Africans MTSF outcome 4: Decent employment through inclusive growth MTSF outcome 5: Skilled and capable workforce to support an inclusive growth path MTSF outcome 6: Efficient, competitive and responsive economic infrastructure network MTSF outcome 7: Vibrant, equitable rural communities contributing towards food security for all MTSF outcome 9: A responsive, accountable, and efficient developmental local government system MTSF outcome 10: Protect and enhance South Africa's environmental assets and natural resources Cross-cutting areas of the New Growth Path, the NDP and the Industrial Policy Action Plan The innovation pillar in the NRDS The space S&T, bioeconomy and energy security "grand challenges" in the TYIP

Programme 3: International Cooperation and Resources

Purpose

To strategically develop, promote and manage international partnerships that strengthen the NSI and enable an exchange of knowledge, capacity and resources between South Africa and its international partners, with a focus on supporting STI capacity-building in Africa. Furthermore, to support South African foreign policy through science diplomacy.

Strategic overview

International cooperation that increases access to global knowledge, capacity and resources is essential for the DST to achieve its strategic objectives in support of the NDP. The Department will prioritise cooperation with African partners through initiatives that support STI capacity-building on the continent.

The programme will target international support for the building of strategically relevant national STI capabilities aligned with national priorities. Opportunities include international HCD programmes such as postgraduate training for South Africans abroad and schemes for South African researchers to access global research infrastructure.

The DST's activities to leverage STI for economic and social development will also benefit significantly from actions such as the strategic promotion of joint ventures with international public- and private-sector partners. It will enable the sharing of costs and expertise, facilitate foreign investment and technical assistance available and bolster the Department's own initiatives to ensure a greater return on national investments.

The programme is also the custodian for the country's science diplomacy – the use of international STI cooperation to advance South Africa's foreign policy agenda.

Chief directorates

International Resources

International Resources works to increase the flow of international funding into South African STI initiatives as well as African regional and continental programmes. It does this by promoting investment and fostering strategic partnerships with, for example, the European Union, foundations and philanthropic organisations.

Multilateral Cooperation and Africa

The directorate advances South Africa's participation in bilateral STI cooperation initiatives with other African partners, as well as in African multilateral programmes and broader multilateral STI partnerships, with a strategic focus on South-South cooperation.

Overseas Bilateral Cooperation

Overseas Bilateral Cooperation promotes and facilitates South Africa's bilateral STI cooperation with partners in Europe, the Americas, Asia and Australasia, especially for STI HCD and collaborative research and innovation. This directorate also secures their support for cooperation with other African partners.

Strategic objectives

Strategic objective	Access international funds to support the growth and development of the NSI
Objective statement	To secure international funds to complement South Africa's national investments in STI, including resources for DST initiatives requiring external investments
Baseline	No baseline (new performance indicators)
Targets	<ul style="list-style-type: none"> • R2 billion in international funds invested in South Africa by 31 March 2019 • R1 billion invested by international partners by 31 March 2019
Performance indicators	<ul style="list-style-type: none"> • Amount (expressed in millions of rands) of international funds directly invested in research, innovation and STI HCD programmes, as well as research infrastructure investments in South Africa accounted for as part of cooperation initiatives implemented by the DST • Amount (expressed in millions of rands) of funds invested by international partners in their own organisations and initiatives, but targeted at cooperation in research, innovation and STI HCD with South African partners accounted for as part of cooperation initiatives implemented by the DST
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • NDP's Chapter 7 on "South Africa's positioning in the world" • MTSF outcome 11: Creating a better South Africa and contributing to a better and safer Africa in a better world

Strategic objective	Enhance South Africa's national STI capabilities through access to international knowledge, capacities and resources
Objective statement	To access international knowledge, capacities and resources with the aim of enhancing South Africa's national STI capabilities, contributing to the attainment of the DST's targets for HCD, especially for international PhD training
Baseline	No baseline (new performance indicators)
Targets	<ul style="list-style-type: none"> • 900 South African students participating in international training programmes offering a postgraduate qualification as part of cooperation initiatives facilitated by the DST by 31 March 2019 • 1 600 international partner organisations collaborating with South African partners as part of cooperation initiatives facilitated by the DST by 31 March 2019 • 75 capacity-building interventions to build or reinforce South Africa's capacities in key STI domains, specifically referenced in the DST Strategic Plan, and undertaken with the support of international partners and facilitated by the DST by 31 March 2019
Performance indicators	<ul style="list-style-type: none"> • Number of South African students accepted into international training programmes offering a postgraduate qualification as part of cooperation initiatives facilitated by the DST • Number of international partner organisations (legal entities) collaborating with South African partners within the formalised framework of collaborative research, innovation or STI HCD projects as part of cooperation initiatives facilitated by the DST • Number of dedicated international technical exchanges such as workshops, seminars or training programmes to reinforce South Africa's capacities in key STI domains specifically referenced in the DST Strategic Plan, undertaken with the support of international partners facilitated by the DST
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • NDP's Chapter 7 on "South Africa's positioning in the world" • MTSF outcome 11: Creating a better South Africa and contributing to a better and safer Africa in a better world

Strategic objective	Strengthen STI cooperation in Africa
Objective statement	To strengthen cooperation in STI in Africa to build capacities and support initiatives of the SADC and AU, for the advancement of both South Africa and Africa's growth and development agenda
Baseline	No baseline (new performance indicators)
Targets	<ul style="list-style-type: none"> • 180 research, innovation and STI HCD cooperation initiatives co-funded by DST and other African partners by 31 March 2019 • R300 million in international funds directly invested in African regional and continental research, innovation, STI HCD or research infrastructure programmes as a result of DST facilitation by 31 March 2019 • 45 approved AU or SADC STI initiatives, including programmes, projects or governance frameworks, endorsed at AU or SADC ministerial level and supported by the DST by 31 March 2019
Performance indicators	<ul style="list-style-type: none"> • Number of research, innovation and STI HCD cooperation projects, co-funded or supported in kind by DST and at least one other African government • Amount (expressed in millions of rands) of international funds directly invested in African regional and continental research, innovation, STI HCD or research infrastructure programmes as a result of DST facilitation • Number of approved AU or SADC STI initiatives, including programmes, projects or governance frameworks, endorsed at AU or SADC ministerial level supported (financially, in-kind or politically) by the DST
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • NDP's Chapter 7 on "Positioning South Africa in the world" • MTSF outcome 11: Creating a better South Africa and contributing to a better and safer Africa in a better world

Strategic objective	Support South Africa's foreign policy through science diplomacy
Objective statement	To maximise South Africa's strategic interests in international cooperation in STI, in support of South Africa's foreign policy objectives, and international trade and investment partnerships, creating a better South Africa, contributing to a better and safer Africa in a better world
Baseline	No baseline (new performance indicators)
Targets	<ul style="list-style-type: none"> • By 2019, 20 decisions made in intergovernmental STI forums, with a direct bearing on resource allocation to support the priorities of government's programme of action following specific DST intervention • By 2019, 15 leadership positions occupied by South Africa in international STI governance structures relevant to influencing resource allocations, to support the priorities of government's programme of action following specific DST intervention
Performance indicators	<ul style="list-style-type: none"> • Number of formally recorded decisions made in intergovernmental STI forums (such as multilateral organisations) with a direct bearing on resource allocations to support the priorities of government's programme of action following specific DST intervention • Number of leadership positions occupied by South Africa in international STI governance structures relevant to influencing resource allocations to support the priorities of government's programme of action following specific DST intervention
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • NDP's Chapter 7 on "Positioning South Africa in the world" • MTSF outcome 11: Creating a better South Africa and contributing to a better and safer Africa in a better world



Resource considerations

The programme requires access to a budget for strategic co-investment with international partners. Such co-investments are a sign of commitment and sustainability and play an important part in securing major international investments in the NSI. DST funds invested in this manner can have a leveraging factor as high as 1:10 (every R1 invested by the DST secures R10 from an international partner).

Bilateral and multilateral cooperation initiatives also require resources, where South Africa is expected to fund its own costs under bilateral agreements and cover its membership in multilateral organisations. Organising events with international partners in South Africa, or marketing the country abroad is a major budget item, especially costs for international travel, even when limited to essential trips.

Programme 4: Research Development and Support

Purpose

To provide an enabling environment for research and knowledge production that promotes the strategic development of basic sciences and priority science areas through science promotion, HCD and the provision of research infrastructure and relevant research support, in pursuit of South Africa's transition to a knowledge economy.

Strategic overview

This programme ensures that South Africa's research base is strengthened and grown to contribute to the modernisation of the economy and its move toward being more knowledge-based. This requires high-level human capital and research infrastructure, ongoing support for research activities and the development of specific support measures for basic sciences and priority science areas, especially those where the country enjoys a geographic advantage.

The programme's impact will be monitored through the following indicators:

- The contribution of South Africa's research output to global research
- The global impact of South Africa's research output
- The percentage of postgraduate research students enrolling in science, engineering and technology programmes
- The annual number of doctoral graduates.

The NDP identifies education, training and innovation as being central to long-term development, and states that "inadequate capacity will constrain knowledge production and innovation unless effectively addressed".

Programme 4 directly addresses this imperative by supporting HCD, providing research and innovation infrastructure, and promoting knowledge generation. The NDP recommends that South Africa produce more than 100 doctoral graduates per million population per year by 2030 (the country currently produces only 33). The NDP calls for double the number of postgraduate and NRF A-rated scientists, more African and women postgraduates (especially PhDs), and improved academic staff by increasing the percentage of PhD-qualified higher education teachers from 43% to more than 75% by 2030. In conjunction with the NRF, programme 4 is the key source of research funding for higher education institutions. This programme also manages the DST's research and innovation infrastructure initiatives, which give funds to public research institutions and universities for equipment and facilities.

Chief directorates

Human Capital and Science Promotion

The directorate formulates and implements policies and strategies that address HCD for STI and provide fundamental support for research activities. The directorate provides strategic direction and support to institutions mandated to develop human capital and increase knowledge production. In addition, it is responsible for science engagement, including science and youth activities.

The Human Capital Development Strategy for Research Innovation and Scholarship was approved by the Minister of Science and Technology in 2014/15, and an implementation framework is being developed, which will be updated as funding and other conditions change. Relationships with key stakeholders such as the Department of Higher Education and Training will be managed to maximise delivery.

The Department has instruments to strengthen research capacity at higher education institutions, including the South African Research Chairs Initiative and the centres of excellence, both managed by the NRF. Special attention will be paid to these HCD programmes.

The DST-NRF Internship Programme places recently qualified graduates and postgraduates at various institutions in the NSI, greatly improving their chances of being retained in the science system. The internship programme also addresses unemployment and skills development. Equity targets have been exceeded – more than 90% of interns placed are black and 60% are women. The DST supports a number of other work preparation programmes and the intention is to grow, streamline and systematise these programmes, and improve the consolidated reporting on implementation.

DST initiatives such as the annual National Science Week, aim to promote public engagement with science. The Department's science engagement framework was approved in 2014/15 and an implementation plan is being developed. The DST will monitor and grow support for the science centres, which are the key institutions for driving science awareness. A science centre will be established in the Cofimvaba district in the next two to three years. The Youth into Science Strategy will be reviewed between 2014/15 and 2015/16. The Minister approved a framework for DST activities in basic education in 2013/14, and in the next five years the Department will work with the Department of Basic Education to ensure delivery on all learner-related activities.

Basic Sciences and Infrastructure

Basic Sciences and Infrastructure facilitates the strategic implementation of research and innovation and helps secure equipment and infrastructure. The directorate also promotes the development of foundational sciences, such as physics, chemistry, biological and life sciences, geographical and geological sciences, and human and social sciences.

The South African Research Infrastructure Roadmap and the National Integrated Cyberinfrastructure Initiative are priority projects. Both plans need to be finalised, followed by extensive consultation with the National Treasury to develop feasible financial plans for implementation.

The directorate will support the provision of RDI infrastructure across the NSI by awarding 300 research infrastructure grants (2014/15 to 2018/19) to the research community. Most of the funding will go to higher education institutions, national facilities, science councils and museums through the NRF's national equipment programme. Funds will also be used to develop pilot plants, technology demonstrators and specialised facilities. The Department will help students and researchers access global infrastructure such as the Large Hadron Collider at CERN in Switzerland, the Joint Institute for Nuclear Research in Russia and the European Synchrotron Radiation Facility in France.

The directorate will continue to support the roll-out of a Gbps capacity broadband network through the South African National Research Network, providing data transmission to all research and academic institutions. The average bandwidth per network site per year will be increased from 3 500 Mbps in 2014/15 to 8 000 Mbps in 2018/19.

The directorate will continue to support about 23 research chairs in the human and social sciences, the National Institute for Theoretical Physics and the African Institute for Mathematical Sciences. A basic sciences development and support framework and implementation plan will be developed to ensure targeted support for this part of the science system.

Science Missions

Science Missions promotes research development, knowledge production and human capital in science areas in which South Africa enjoys a geographic advantage, including the dynamics of climate change and its impact

on earth systems, Antarctic and marine research, the palaeosciences and indigenous knowledge systems.

Parliamentary approval for an act to protect, promote, develop and manage indigenous knowledge systems is a key deliverable. The National Recordal System will be rolled out in all nine provinces by 2017, completing the development phase. The framework for the accreditation and certification of indigenous knowledge practitioners will be published for public consultation during 2015.

The new Marine and Antarctic Research Strategy, produced with the Department of Environmental Affairs, will play a key role in coordinating research in support of Operation Phakisa.

The research landscape for the Earth systems sciences will be shaped by the five-year review of the global change “grand challenge”, the review of the Applied Centre for Climate and Earth System Science and the new international collaboration programme “Future Earth 2025 Vision”. The DST is also responsible for two deliverables under MTSF outcome 10 (as shown in the table below), as well as a project under Operation Phakisa.

Astronomy

The directorate supports the development of astronomical sciences around a new multiwavelength astronomy strategy and provides guidance and support to relevant astronomy institutions. Of particular relevance are the Southern African Large Telescope, the MeerKAT, the High Energy Stereoscopic System, and the African Very Long Baseline Interferometry Network and SKA projects. The construction of SKA phase 1 is expected to start in 2018. Leading up to this, South Africa will build the 64-dish MeerKAT demonstrator telescope. The first of the 64 antennae of the MeerKAT was installed in 2013/14 and the project is due for completion in 2016/17. Preparations for the roll-out of SKA phase 1 have been classified as a SIP under the Presidential Infrastructure Coordinating Committee.



The African Very Long Baseline Interferometry Network initiative will be enhanced by the DST’s partnership with Ghana to set up a radio telescope/observatory in that country. A similar initiative is being pursued with Kenya and Zambia to convert existing 32 metre dishes for undertaking radio astronomy and space geodetic observations and other partnerships will follow.

Over the next 10 years, the Multiwavelength Astronomy Strategy will begin consolidating relevant HCD initiatives and optical, radio and gamma ray astronomy facilities under a single astronomy sub-agency in the NRF.

The directorate’s key challenge is protecting the astronomy reserves against radio, dust and light pollution, including monitoring possible effects on astronomy activities from hydraulic fracturing in the Northern Cape and from wireless, telecommunication and broadcasting activities. The relevant stakeholders and experts will be consulted as new regulations and standards are proposed.

Strategic objectives

Strategic objective	Contribute to human capital development
Objective statement	To contribute to the development of representative, high-level human capital able to pursue locally relevant, globally competitive research and innovation activities
Baseline	<ul style="list-style-type: none"> A total of 9 771 postgraduate students supported by DST through the NRF by 2013/14 1 010 graduates and students enrolled in SETI programmes by 2013/14
Targets	<ul style="list-style-type: none"> 24 658 BTech and honours students awarded bursaries 27 411 master's students supported 15 209 PhD students supported 3 682 postdoctoral fellows supported 4 200 graduates and students placed in DST-funded work preparation programmes in SETI institutions
Performance indicators	<ul style="list-style-type: none"> Total number of postgraduate students (BTech and honours, master's and PhD students, and postdoctoral fellows) awarded bursaries using DST funding Total number of graduates and students placed in DST-funded work preparation programmes in SETI institutions
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> MTSF outcome 4: Decent employment through inclusive economic growth MTSF outcome 5: Skilled and capable workforce to support an inclusive growth path NDP TYIP NRDS Human Resource Development Strategy

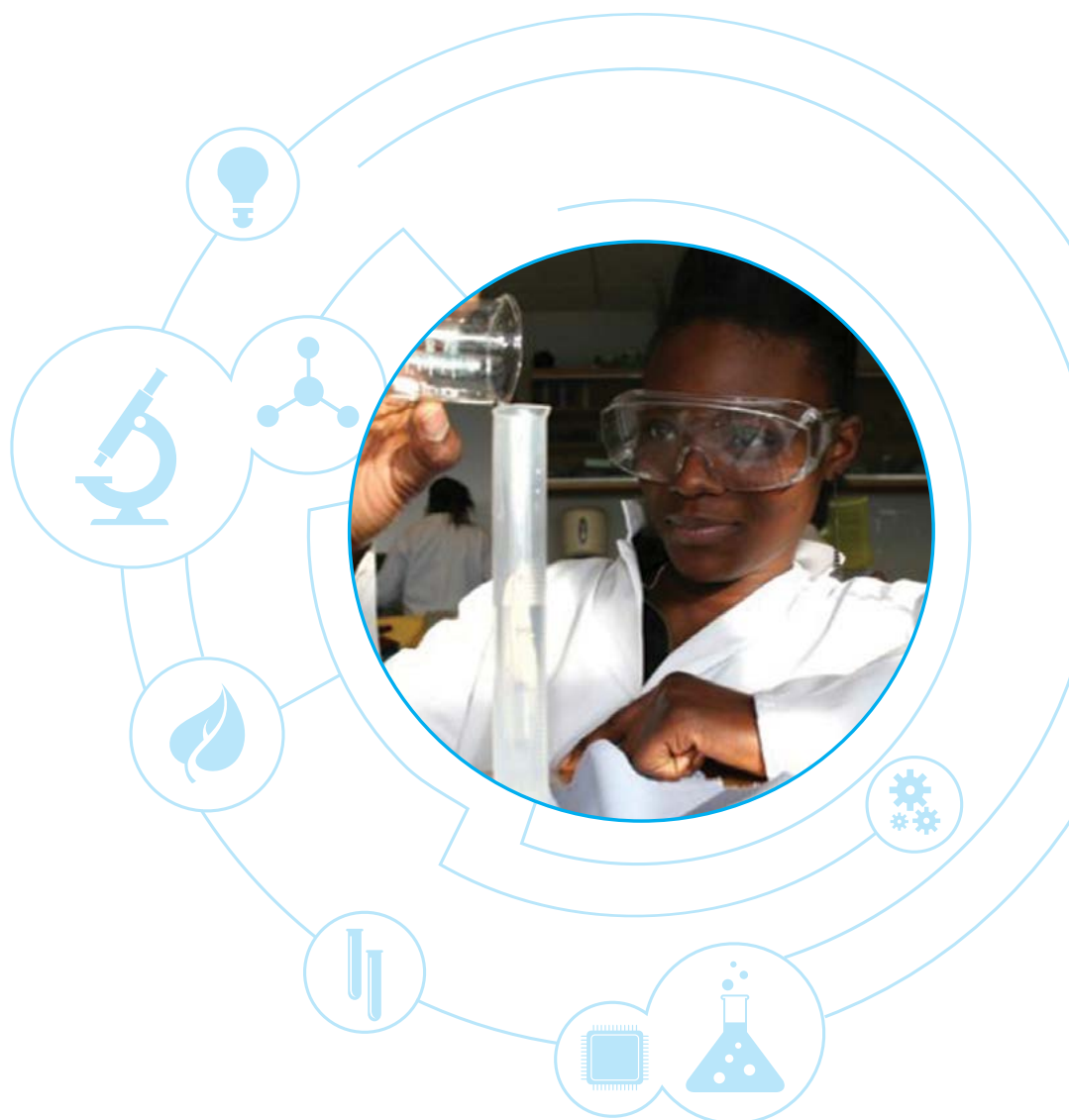
Strategic objective	Provision of research and innovation infrastructure
Objective statement	To ensure the availability of, and access to, internationally comparable research and innovation infrastructure in order to generate new knowledge and train new researchers
Baseline	<ul style="list-style-type: none"> 61 research infrastructure grants awarded in 2013/14 2 200 Mbps average bandwidth capacity available per SANReN site in 2013/14
Targets	<ul style="list-style-type: none"> 330 research infrastructure grants awarded Increase the average bandwidth per SANReN site to 3 500 Mbps
Performance indicators	<ul style="list-style-type: none"> Number of research infrastructure grants awarded as per award letters Average amount of bandwidth per SANReN site per year
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> MTSF outcome 5: Skilled and capable workforce to support an inclusive growth path MTSF outcome 6: An efficient, competitive and responsive economic infrastructure network TYIP NRDS National Infrastructure Plan (SIP 15 and 16)

Strategic objective	Production of new knowledge
Objective statement	To support and promote research that develops basic sciences through the production of new knowledge and relevant training opportunities
Baseline	<ul style="list-style-type: none"> • 3 569 researchers awarded research grants in 2013/14 • 5 641 ISI-accredited research articles published by NRF-funded researchers in 2013/14
Targets	<ul style="list-style-type: none"> • 22 032 researchers awarded research grants • 33 700 ISI-accredited research articles published
Performance indicators	<ul style="list-style-type: none"> • Total number of researchers awarded research grants through NRF-managed programmes as reflected in the NRF project reports • Number of ISI-accredited research articles published by NRF-funded researchers as reflected in the NRF project reports
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • MTSF outcome 5: Skilled and capable workforce to support an inclusive growth path • NRDS • TYIP • NDP

Strategic objective	Development of priority science areas
Objective statement	To strategically develop priority science areas in which South Africa enjoys a competitive advantage by promoting internationally competitive research and training activities and outputs
Baseline	<ul style="list-style-type: none"> • One MeerKAT antenna installed in 2013/14 • The Karoo Central Astronomy Advantage Area and Sutherland Central Astronomy Advantage Area declared central astronomy advantage areas in terms of the Astronomy Geographic Advantage Act by the Minister in 2013/14 • Science Engagement Strategy approved in 2013/14 • Implementation plan for Palaeosciences Strategy approved in 2013/14 • Marine and Antarctic research strategies presented to Exco in 2013/14
Targets	<ul style="list-style-type: none"> • 64 MeerKAT antennae designed and installed • Regulations on astronomy advantage areas gazetted • A functional climate research network • Two biennial reports approved by Cabinet • Implementation plan for marine and Antarctic research strategies • Basic sciences development and support framework and implementation plan • A bill for the protection, promotion, development and management of IKS approved by Parliament • Implementation plan for multiwavelength astronomy strategy
Performance indicators	<ul style="list-style-type: none"> • Number of MeerKAT antennae installed • Number of regulations gazetted • A functional⁸ climate change research network in place • Number of biennial reports on climate research approved by Cabinet • Number of strategy documents approved
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • MTSF outcome 10: Protect and enhance South Africa's environmental assets and natural resources • TYIP • NDP

⁸ A functional climate change network would be a DST-approved network of organisations undertaking climate change research and bound by a memorandum defining a joint effort.

Strategic objective	Promote science engagement
Objective statement	To promote public engagement on STI
Baseline	1 054 221 people directly participated in science awareness and engagement programmes in 2013/14
Targets	Approximately 5 500 000 participants in science awareness and engagement programmes as reflected in the project reports of the NRF and other service providers
Performance indicators	Approximate number of participants in science awareness and engagement programmes as reflected in the project reports of the NRF and other service providers
Links (to government plans, policies and outcomes)	<ul style="list-style-type: none"> • NDP • NRDS • TYIP



Programme 5: Socio-economic Innovation Partnerships

Purpose

To enhance the growth and development priorities of government through targeted S&T-based innovation interventions and the development of strategic partnerships with other government departments, industry, research institutions and communities.

Strategic overview

The programme's work is guided by the need to invest public funding wisely, through value-adding partnerships, in STI initiatives that are aligned with the NDP and support the social and economic development priorities of the country.

Interventions include high-potential R&D-led industrial development programmes, technology support for industry, new approaches to service delivery and planning, strengthening science-based policy development and decision-making, demonstrating technology-led opportunities for creating sustainable jobs and wealth, and strengthening technology's contribution to sustainable human settlements.

In recent years, the programme facilitated the development of strategies and roadmaps with research organisations, key government departments and business in areas such as ICT, waste, water, advanced metals and fluorochemicals. Others are expected to be finalised in the next 18 months, including innovation for inclusive development, advanced manufacturing and the aerospace

sector. These strategies and roadmaps guide multi-year investments in focused projects related to the development of appropriate high-level human capital and promising technologies, the implementation of demonstration projects and the production of knowledge and evidence. The programme represents the Department in a range of interdepartmental and business forums, monitors and evaluates the impact of investments made and assists in clearing blockages stopping the conversion of investments into social and economic benefits.

In any particular year, most of the available resources are directed to existing multi-year investments. The completion of existing initiatives and additional public funding enables the programme to support new multi-year initiatives. In 2015/16, the programme will focus on assessing how various initiatives contribute towards the proxy indicators included in the 2015–2020 Strategic Plan.

The programme also oversees national surveys of R&D and innovation measurement to help the Department monitor the performance of the NSI and shape policy development. The programme has added new strategic objectives, including strengthening provincial and rural innovation and production systems, and managing incentive programmes to encourage private-sector R&D investment.

At the level of the NSI, the programme aims to:

- Through knowledge, evidence and learning, to inform and influence⁹ how S&T can be used to achieve inclusive development.

⁹ One of the DST's responsibilities is to facilitate the use of new approaches to address a range of social challenges. This involves using good science or deploying promising technologies that are available but may not be in use for a variety of reasons. However, the DST does not have the mandate or responsibility to support the adoption of promising technology (for example, alternative building technologies). This is normally done by government departments with service delivery responsibilities (for example, providing water and energy services or building houses in a new way). The approach used by service delivery departments, whether through direct procurement or through some policy instrument (such as subsidies, regulations or standards), has a significant impact on what technologies are used. The role of the DST is to invest in projects and processes that can generate appropriate knowledge and evidence, and to package this in ways that support decision-making by government, communities and other role players. In many instances, knowledge and evidence need to be shared through structured learning opportunities such as conferences, workshops and decision-support systems.

- To identify, grow and sustain niche high-potential STI capabilities for sustainable development and the greening of society and the economy.
- To identify, grow and sustain niche high-potential STI capabilities that –
 - improve the competitiveness of existing industries with growth potential in aerospace, advanced manufacturing, chemicals, advanced metals, mining, ICTs and sector innovation funds;
 - facilitate the development of R&D-led new targeted industries.
- To enhance understanding and analysis that support improvements in the functioning and performance of the NSI.
- To strengthen provincial and rural innovation and production systems through analysis and catalytic interventions.
- To introduce and manage interventions and incentive programmes that increase the level of private-sector investment in scientific or technological R&D.

Chief directorates

Technology Localisation, Beneficiation and Advanced Manufacturing

The directorate funds technology and innovation programmes to advance sustainable economic growth and sector development priorities, as well as government service delivery, through the following:

- Investing in the medium and long-term knowledge-generation capabilities of the NSI in targeted innovation areas.
- Exploiting knowledge capabilities for economic benefit in partnership with other government departments and economic actors. This includes the development of advanced technologies and industries, improved government service delivery, improved productivity and competitiveness, and technology transfer and support to SMEs and manufacturing firms supplying large-scale public procurement programmes.

Sector Innovation and Green Economy

Sector Innovation and Green Economy provides policy, strategy and support for R&D-led growth of strategic economic sectors and enhances S&T capacity to support a transition to a green economy through the following:

- Facilitating the implementation of high-impact S&T interventions.
- Identifying and initiating S&T programmes that support the growth of the environmental technologies and services sector in South Africa.
- Facilitating policy and strategy development on R&D interventions that support the growth of the ICT sector (excluding the retail sector).
- Providing innovation policy and planning support to economic actors in priority economic sectors and provincial and local governments.

Innovation for Inclusive Development

The directorate supports S&T-based innovations for tackling unemployment, poverty and inequality by creating sustainable job and wealth opportunities, building sustainable human settlements and enhancing the delivery of basic services. The component supports the demonstration of promising innovations not yet in widespread use but seen as having potential to support government's objectives. The component prioritises the generation of practical knowledge and insights to support evidence-based decision-making, introducing decision-support tools to enhance service delivery, and building capacity in relevant state institutions and communities.

Science and Technology Investment

Science and Technology Investment leads and supports the development of indicators and instruments for measuring and monitoring investments in S&T and the performance of the NSI. This includes an annual R&D survey, innovation measurement, the development of S&T indicators, the development of databases and information systems such as the Research Information Management System and the national S&T expenditure tables, and the implementation of section 11D of the Income Tax Act (1962) to promote private-sector R&D investment.

Strategic objectives

Strategic objective	Innovation for rural and socio-economic development
Objective statement	Through knowledge, evidence and learning, to inform and influence how S&T can be used to achieve inclusive development
Baseline	<ul style="list-style-type: none"> One knowledge product on technology-led opportunities for sustainable livelihoods published in 2013/14 In 2013/14, two additional decision-support systems were introduced to improve sanitation and basic education service delivery (a cost-of-ownership tool to assist in technology procurement decisions for basic education, and a sanitation technology assessment and evaluation tool), and two existing decision support systems (Spatial Temporal Evidence for Planning in South Africa and the Risk and Vulnerability Atlas) were maintained
Targets	<ul style="list-style-type: none"> 26 knowledge products to be published on innovation for inclusive development Eight decision-support systems maintained and improved
Performance indicators	<ul style="list-style-type: none"> Number of knowledge products¹⁰ on innovation for inclusive development published Number of decision-support interventions¹¹ introduced and maintained
Links (to government plans, policies and outcomes)	The DST does not have direct delivery responsibility for outcomes such as improved basic education and health, sustainable human settlements or rural development. However, technology and innovation are vital enablers in achieving better outcomes in the delivery of basic education, health, human settlements and rural development. The DST provides information on how these priority outcomes can be better achieved with technology and innovation through appropriate knowledge products and decision support. The contribution of the DST is therefore not in support of specific indicators in the MTSF, but it helps shape underlying service-delivery models and arrangements that contribute to various MTSF targets

Strategic objective	S&T for sustainable development and a green economy
Objective statement	To identify, grow and sustain niche high-potential STI capabilities for sustainable development and the greening of society and the economy
Baseline	No baseline. The focus of the previous year's indicators was on the niche areas of global change. This area of work has been moved to Programme 4. The focus on the indicators over the next five years is on greening the economy and sustainable development
Targets	<ul style="list-style-type: none"> 300 master's and PhD students fully funded or co-funded in designated niche areas that support the greening of society and the economy and sustainable development. 15 knowledge and innovation products¹² (patents¹³, prototypes¹⁴, technology demonstrators¹⁵ or technology transfer packages) added to the IP portfolio through fully funded or co-funded research
Performance indicators	<ul style="list-style-type: none"> Number of master's and PhD students fully funded or co-funded in designated niche areas that support the greening of society and the economy and sustainable development Number of knowledge and innovation products (patents, prototypes, technology demonstrators or technology transfer packages) added to the IP portfolio through fully funded or co-funded research

¹⁰ Knowledge products include case studies, policy briefs and technology briefs. Different knowledge products may be required to provide the knowledge and evidence required by decision-makers in order to adopt a new technology-based approach. A policy brief is a document that outlines the rationale for selecting a particular policy alternative and aims to convince the target audience that an existing problem can be addressed by adopting an alternative policy or course of action. A case study is a detailed description and exploration of a particular project, with a specific focus on challenges, lessons, and success factors, and is usually targeted at people involved in implementation. A technical brief refers to a range of knowledge products providing performance data, that deals with specifications or which deal with a specific technical challenge that can impact on the adoption of a particular technology. A single project or initiative can support the production of several of the knowledge products described above. Knowledge products can also be supported by a decision-support intervention. A knowledge product has to meet the needs of a particular user-community and therefore requires significant interaction to determine what would be of value.

¹¹ Decision-support interventions help people think about choices they face; they describe where and why choice exists, and provide information about options including, where reasonable, the option of taking no action. These interventions aim to help people to deliberate about options, independently or in collaboration with others, by considering relevant attributes to help them consider short, intermediate and long-term outcomes with relevant consequences. Decision-support interventions assist the process of constructing preferences and eventual decision-making in a particular situation.

Links (to government plans, policies and outcomes)	Chapter 5 of the NDP envisages that the transition to a green economy will be well under way by 2030. Specifically, the NDP notes that “Government has a key role to play in developing the necessary skills and institutional and cultural capacity to support the transition”. This includes the development of scientific and technological skills, capabilities and institutions. The NDP further identifies the need for building a credible evidence base to support decision-making. This strategic objective contributes to the development of skills, data, evidence, capabilities and institutions that enable the achievement of the plans of the NDP and those outlined in MTSF outcome 10. STI activities will be geared towards supporting sub-outcome 1 of this outcome, which focuses on sustaining ecosystems and the efficient use of natural resources, in particular, the “restoration of the ecological integrity of water resources through improvement in water quality”. Sub-outcome 2 will be supported through targeted STI interventions in waste minimisation, recycling, reuse and recovery.
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Strategic objective	Support the development of new and existing R&D-led industries in aerospace, advanced manufacturing, chemicals, advanced metals, mining, ICTs and sector innovation funds
Objective statement	To identify, grow and sustain niche high-potential STI capabilities that – <ul style="list-style-type: none"> • improve the competitiveness of existing industries with growth potential in aerospace, advanced manufacturing, chemicals, advanced metals, mining, ICTs and sector innovation funds; • facilitate the development of R&D-led new targeted industries.
Baseline	<ul style="list-style-type: none"> • 264 master’s and doctoral students fully funded or co-funded in designated niche areas (advanced manufacturing, aerospace, chemicals, mining, advanced metals and ICTs) in 2013/14 • 190 interns fully funded or co-funded in R&D related to design, manufacturing and product development by 31 March 2014 • 16 patents, prototypes, technology demonstrators or technology transfer packages added during 2013/14
Targets	<ul style="list-style-type: none"> • Number of high-level graduates (master’s and PhD students) fully funded or co-funded in designated niche areas (advanced manufacturing, aerospace, chemicals, mining, advanced metals, ICTs and sector innovation funds) • Number of interns fully funded or co-funded in R&D related to design, manufacturing and product development • Number of knowledge and innovation products (patents, prototypes, technology demonstrators or technology transfer packages) added to the IP portfolio through fully funded or co-funded research initiatives • Number of instruments funded in support of increased localisation, competitiveness and R&D-led industry development in aerospace, advanced manufacturing, chemicals, mining, advanced metals, ICTs and sector innovation funds
Performance indicators	<ul style="list-style-type: none"> • 1 204 high-level research graduates (master’s and PhD students) fully funded or co-funded in designated niche areas (advanced manufacturing, aerospace, chemicals, mining, advanced metals, ICTs and sector innovation funds) • 800 interns fully funded or co-funded in R&D related to design, manufacturing and product development • 100 knowledge and innovation products added to the IP (patents, prototypes, technology demonstrators or technology transfer packages) portfolio through fully funded or co-funded research initiatives • 11 instruments funded in support of increased localisation, competitiveness and R&D-led industry development in aerospace, advanced manufacturing, chemicals, mining, advanced metals, ICTs and sector innovation funds

12 The knowledge and innovation products will be identified in consultation with implementing agencies during the financial year, as expressed in the quarterly targets.

13 Patents include formal disclosures (made within an entity) and provisional patent applications.

14 A prototype is a representative model that can perform the required functions of the intended product.

15 A technology demonstrator is a model that demonstrates the functional capability of a specific technology. It is at a lower level of technological maturity than a prototype because it demonstrates only the technology functionality.

Links (to government plans, policies and outcomes)	MTSF outcome 4: Decent employment through inclusive economic growth. This objective aims to improve South Africa's long-term economic competitiveness. It addresses the DST strategic goals of developing/maturing technologies for competitiveness and creating a critical mass of science, engineering, technology and innovation human capital to meet society's needs; demonstrating the potential of RDI-led socio-economic development; and increasing and enhancing knowledge-generation capability
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Strategic objective	Support provincial and rural innovation
Objective statement	To strengthen provincial and rural innovation and production systems through analysis and catalytic interventions
Baseline	No baseline (new indicator)
Targets	Number of innovation support interventions funded or co-funded that strengthen provincial or rural innovation systems
Performance indicators	Nine innovation support interventions that strengthen provincial or rural innovation systems funded or co-funded
Links (to government plans, policies and outcomes)	The NDP acknowledges that the apartheid spatial divide continues to dominate the landscape. Chapter 6 calls for the development of inclusive rural economies. The NDP also calls for a capable and developmental state, which cannot be legislated into existence, but needs to be built brick by brick and institution by institution. An important feature of successful modern states is the ability to manage innovation effectively for economic development

Strategic objective	Facilitate the provision of data on the NSI's performance
Objective statement	To enhance understanding and analysis that support improvements in the functioning and performance of the NSI.
Baseline	Five reports and policy briefings approved/published in 2013/14
Targets	Number of reports and policy briefings on the innovation system and innovation policy approved/published
Performance indicators	25 reports and policy briefings on the innovation system and innovation policy approved/published
Links (to government plans, policies and outcomes)	MTSF outcome 4: Decent employment through inclusive growth. This objective aims to improve the long-term competitiveness of the South African economy. It also addresses the DST strategic goal of increasing R&D investment in South Africa

Strategic objective	Increased private-sector investment in RDI
Objective statement	To introduce and manage interventions and incentive programmes that increase the level of private-sector investment in scientific or technological R&D
Baseline	New strategic objective
Targets	Turnaround time in providing preapproval decisions on applications for the R&D tax incentive
Performance indicators	Preapproval decisions provided within 90 days of date of receipt of application for the R&D tax incentive
Links (to government plans, policies and outcomes)	The NDP calls for a closer partnership between government and business to increase the level of R&D



Part C:

LINKS TO OTHER PLANS

Links to other plans

Links to the long-term infrastructure and other capital plans

Project name	Programme	Municipality	Project description	Outputs	Estimated project cost	Expenditure to date	Project duration	
							Start	End
New and replacement assets								
SKA	4	Kareeberg Local Municipality (part of the Pixley ka Seme District Municipality)	Phase 1 of the SKA will include the construction of 64 MeerKAT antennae	The completion of 64 MeerKAT antennae	R3,67bn	R1,32bn	2006/7	2018/19

Public entities

Name of public entity	Mandate	Outputs	Current annual budget (2015/16)	Date of next evaluation
Council for Scientific and Industrial Research	Foster industrial and scientific development in the national interest and in fields which it believes should receive preference, either by itself or in cooperation with the public or private sector, to contribute to the improvement of South Africans' quality of life. It also performs any other functions that may be assigned to it by the Scientific Research Council Act (1945)	Research, development and innovation outputs: <ul style="list-style-type: none"> • Peer-reviewed publications • Research technologies • Patents • Research reports 	1 150 775	2016
Human Sciences Research Council	<ul style="list-style-type: none"> • Initiate, undertake and foster strategic basic and applied research in the human sciences, and gather, analyse and publish data relevant to developmental challenges in South Africa, elsewhere in Africa and in the rest of the world, especially through projects linked to public-sector oriented collaborative programmes • Inform the effective formulation and monitoring of policy, and evaluate the implementation of policy • Stimulate public debate through the effective dissemination of fact-based research results • Help build research capacity and infrastructure for the human sciences in South Africa and the rest of Africa • Foster and support research collaboration, networks and institutional linkages within the human sciences research community • Respond to the needs of vulnerable and marginalised groups by researching developmental problems • Develop and make publicly available new datasets to underpin research, policy development and public discussion of key development issues, and develop new and improved methodologies 	<ul style="list-style-type: none"> • Public dialogue and publications (dissemination of knowledge) • Research and analysis of developmental problems • Promote African research agenda and collaborative research • Research capacity for human sciences • Policy briefs (inform formulation of government policy and evaluate its implementation) 	288 706	2015

Name of public entity	Mandate	Outputs	Current annual budget (2015/16)	Date of next evaluation
National Research Foundation	Support and promote research through funding, human resource development and the provision of research facilities to facilitate the creation of knowledge, innovation and development in all fields of S&T, including indigenous knowledge	<ul style="list-style-type: none"> Provision of research infrastructure and funding (research funding [bursaries], research infrastructure grants, infrastructure investment funding) National Research Facilities (students supported by National Research Facilities, ISI publications from National Research Facilities). 	2 850 216	2015
Technology Innovation Agency	Support the state in stimulating and intensifying technological innovation to improve economic growth and the quality of life of all South Africans	<ul style="list-style-type: none"> Technology development funding (technology-based companies, jobs created by companies established through TIA funding) Enabling environment for technology innovation (jobs created, increased companies turnover, technology support funding for SMEs) 	385 188	2015
National Advisory Council on Innovation	Advise the Minister of Science and Technology and government on the role and contribution of innovation in promoting and achieving national objectives	<ul style="list-style-type: none"> A high-level document providing a framework for a decadal plan Feedback report on the White Paper on Science and Technology and associated policies review process A model for a data innovation portal Rapid policy advice on pertinent innovation topics 		2015
Academy of Science of South Africa	<ul style="list-style-type: none"> Promote common ground in scientific thinking across all disciplines, including the physical, mathematical and life sciences, as well as the human, social and economic sciences Encourage and promote innovative and independent scientific thinking Promote the optimum intellectual development of all our people Provide effective advice and facilitate appropriate action in relation to the collective needs, opportunities and challenges of all South Africans Link South Africa with scientific communities of the highest levels, within the SADC, the rest of Africa and the world 	<ul style="list-style-type: none"> Collaborations among global science organisations Promotion of young scientists and women for science activities STI policy advice for government Scientific writing for publishing of research 	22 991	2015
South African National Space Agency	<ul style="list-style-type: none"> Promote the peaceful use of space Support the creation of an environment conducive to industrial development in space technology Foster research in space S&T, communications, navigation and space physics Advance scientific, engineering and technological competence through HCD outreach programmes and infrastructure development Foster international cooperation in space-related activities 	<ul style="list-style-type: none"> Provision of space services and products Increasing national space research output (sourced researching, publications, student funding) Develop national human capacity and transformation (student and interns funding, young people engaged in space science activities) Competitiveness of South African space industry. 	124 355	2015

Appendix A

List of case studies on biotechnology and hydrogen and fuel cells technology initiatives

The bioeconomy

Under the National Biotechnology Strategy (2001), R2 billion was invested between 2003 and 2009 in developing the South African biotechnology-related system of innovation. The top seven biotechnology companies invested in at that time now generate just under R1 billion per year. This time frame is typical of biotechnological life cycles, and the fact that this turnover comes primarily from one of these seven is entirely expected. Over time, however, and with continued investments, the turnover is likely to become more broadly based.

These are the top examples of successful investment in the bioeconomy:

Eucalyptus Genome Programme

The DST supported South African participation in a project sequencing the Eucalyptus genome through the University of Pretoria. Working with the forestry industry, the project results allow the identification/development of genetic markers, which enables much faster marker-assisted breeding. Industry has estimated that this makes a saving of about R81 million possible for every 30 000 hectares over a period of 15 years. This technology advancement is maintaining the competitiveness of the forestry sector rather than merely driving increased profits.

Umbiflow

This is an ultrasound device developed by the CSIR designed specifically to provide for foetal development monitoring in remote and resource-poor environments. The device is simple to operate and costs 14 times less than devices used in secondary hospitals. It also means

that pregnant and resource-poor women do not have to travel to hospitals.

mTriage

This is a mobile device application that allows a simpler, quicker and more accurate way of assessing the urgency of the need for treatment, particularly in emergency room settings. As with many health applications in the developing world, the success of this product will not be measured in terms of financial returns, but through improved treatments and lives saved.

XSIT

This company has used sterile insect technology to create male-sterile False Codling Moths – a major pest in the citrus industry. The moths are currently applied over 13 000 hectares, dramatically reducing the pest population, and allowing farmers to realise an additional harvest benefit of up to R512 million. If this technology were to be used across the citrus-growing area of South Africa, the possible additional income for farmers could be nearly R2 billion (compared to income in periods of severe pest infestation).

Hydrogen and fuel cells

In the area of energy and fuel cells, the ultimate goal for the hydrogen and fuel cell technologies RDI strategy for South Africa is to capture 25% of the global demand for fuel cell catalysts by 2020. The global fuel cell market is estimated to be worth US\$2.237 billion, and 25% therefore equates to US\$559.25 billion.

However, since the strategy aims to capture the global market through component manufacturing, the following projections can be made:

Membrane electrode assembly

The current cost of producing a membrane electrode assembly is US\$120 per unit. Assuming South Africa produces 1 million units per year, and sells them at US\$150 per unit, this would result in revenue of US\$30 million per year.

Metal hydride hydrogen storage material

Current costs are US\$140 per kilogram. Assuming South Africa produces 1 million kilograms of metal hydride per year and sells this at US\$120 per kilogram, this would result in revenue of US\$120 million per year.

Combined heat and power units

Current costs are US\$30 000 per kilowatt. Assuming South Africa produces 1 000 1 kilowatt units per year and sells them at \$15 000 per kilowatt, this would result in revenue of US\$15 million per year.



Abbreviations

AU	African Union
CSIR	Council for Scientific and Industrial Research
DST	Department of Science and Technology
Gbps	Gigabits per second
HCD	Human capital development
ICT	Information and communication technology
IP	Intellectual property
ISI	Institute for Scientific Information
IT	Information technology
M&E	Monitoring and evaluation
Mbps	Megabits per second
MRC	Ministerial Review Committee
MTEF	Medium-term expenditure framework
MTSF	Medium-term strategic framework
NDP	National Development Plan
NIPMO	National Intellectual Property Management Office
NRDS	National Research and Development Strategy
NRF	National Research Foundation
NSI	National System of Innovation
R&D	Research and development
RDI	Research, development and innovation
S&T	Science and technology
SADC	Southern African Development Community
SANSA	South African National Space Agency
SKA	Square Kilometre Array
SME	Small or medium enterprise
STI	Science, technology and innovation
TIA	Technology Innovation Agency
TYIP	Ten-Year Innovation Plan

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Strategic Plan for the Fiscal Years 2 0 1 5 - 2 0 2 0

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