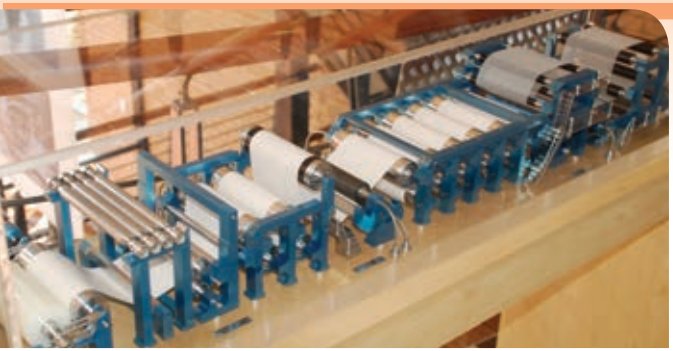


Science and Technology

The National Development Plan identifies the important role of science, technology and innovation in achieving the country's longer term vision. As approved in the Medium Term Expenditure Framework, the Department of Science and Technology (DST) allocated the additional R87 million, R310 million and R401 million in the 2012/13, 2013/14 and 2014/15 financial years, respectively, to relevant National Research Foundation (NRF) programmes.

New-generation researchers are set to get R450 million; emerging researchers will get R196 million, and postgraduate bursaries are allocated R340 million. The NRF's internship programme will receive an increased allocation of R110 million over the next three years.

The DST has four main programmes. These programmes represent distinct but complementary ways of promoting the National System of Innovation, and harnessing science and technology to benefit all South Africans.

In June 2014, the Science and Technology Laws Amendment Act of 2014, was signed. The Act deals with amendments to a battery of Acts, which govern the operations of entities (science councils) that were established. The Act seeks to streamline the process for the nomination and appointment of members as well as the filling of vacancies on the boards or councils of such entities. In strengthening Parliament's oversight role, the Act seeks to release Parliament from certain executive responsibilities relating to the appointment of members and filling of vacancies to such boards or councils.

Research, Development and Innovation

This is at the heart of the department's efforts to drive innovation in scientifically strategic areas.

The programme has five subprogrammes:

- space science and technology
- hydrogen and energy
- biotechnology and health innovation
- innovation planning and instruments
- radio astronomy advances.

Astronomy

In March 2013, South Africa officially launched the first of 64 antennas that will make up the MeerKAT radio telescope, the one of the precursors to the Square Kilometre Array (SKA) telescope, and will later be incorporated into the mid-frequency component of SKA Phase 1 when that instrument is being constructed at the SKA South Africa site outside Carnarvon

A group of more than 40 students from the CubeSat Programme at the French South African Institute of Technology at the Cape Peninsula University of Technology made history in November 2013. They participated in building Africa's first cube satellite. The ZACUBE-1 satellite was launched from Yasny in Russia. The Department of Science and Technology funded the project with R22 million.

in the Northern Cape. The MeerKAT Karoo Array Processor Building, a cutting-edge data centre for the MeerKAT that has been built in an underground bunker at the Karoo observatory site, was officially opened at the same time. The SKA will be the world's largest radio telescope, located in Australia and Africa but shared by astronomers around the globe.

Standing 19,5 metres tall and weighing 42 tons, the new MeerKAT antenna towers above the antennas of the nearby KAT-7 instrument, an engineering prototype for the MeerKAT, which is now routinely used for scientific research. The full MeerKAT array will consist of 64 identical receptors, digitisers and other electronics installed. Forty-eight of the antennas will be packed closely together in a one-kilometre diameter area, with the rest located up to four kilometres from the core.

Connected by 170 km of underground fibre-optic cable, the 64 receptors will operate as a single, highly sensitive astronomical instrument, controlled and monitored remotely from the MeerKAT control room in Cape Town.

Square Kilometre Array

The SKA project could act as a catalyst for science, technology and engineering business opportunities, jobs and innovation, and has the potential to put South Africa and Africa on the map as a world Big Data and analytics hub.

The multibillion rand SKA will extend into eight African countries. It is also one of the biggest-ever scientific projects and multinational collaborations in the name of science. The project has already entered its first phase, with radio astronomy scientists and engineers finalising its design, with construction to start in 2016.

The radio telescope should be operationally mature by 2020. With thousands of linked radio wave receptors in Australia and in southern Africa, the SKA radio telescope will constantly scan space and feed the data to astronomers around the world. The amounts of data being collected and transmitted by the SKA in a single day would take nearly two million years to play back on an iPod. This means the project requires supercomputing power and Big Data management and analytics capabilities on an unprecedented scale.

The SKA is working with the world's most significant ICT powerhouses on the project.

One aspect of the project will see ASTRON, the Netherlands Institute for Radio Astronomy and IBM collaborating to research extremely fast, but low-power exascale computer systems, data transport and storage processes, and streaming analytics that will be required to read, store and analyse all the raw data that will be collected daily.

The SKA project will also have unprecedented data connectivity needs. Meeting the advanced technological and engineering needs of this project will result in significant local skills development, revolutionise science and technology research and enable innovative new businesses and employment in the science, technology and engineering fields.

Aside from the benefits to African science, Big Data capabilities could be the biggest spin-off from the SKA project. The innovations, skills development and commercial potential emerging as a result of the project are huge. The potential is not just academic – the taxpayer-funded intellectual property (IP) is developed to a point where it is ready to become commercialised and benefit the economy.

Human capital development is already taking place as a result of the SKA project, with bursaries and scholarships being granted to allow students to learn the necessary cutting-edge science, technology, maths and engineering skills to support the project. Because the SKA is a long-term project over decades, its impact will increase. Going forward, there will be a strong drive to leverage the SKA as a spearhead for other programmes – including next generation high performance computing challenges and Big Data challenges.

Since 2005, the African SKA Human Capital Development Programme has awarded close to 400 grants for studies in astronomy and engineering from undergraduate to post-doctoral level, while also investing in training programmes for technicians. Astronomy courses are being rolled out in other African countries, including Kenya, Mozambique, Madagascar and Mauritius. Career opportunities will increase substantially and new business opportunities will emerge.

The project has already changed the world's view of South Africa's scientific capability.

Nanotechnology

Nanoscience and nanotechnology are the study and application of extremely small things and can be used across all

The first-ever evidence of a comet entering Earth's atmosphere and exploding was discovered by a team of South African scientists and international collaborators in October 2013. Professor David Block of Wits University, Professor Jan Kramers of the University of Johannesburg, Dr Marco Andreoli of the South African Nuclear Energy Corporation, and Chris Harris of the University of Cape Town, conducted highly sophisticated chemical analyses on black pebble found years earlier by an Egyptian geologist in the area of the impact. They came to the conclusion that it represented the first known hand specimen of a comet nucleus, rather than simply an unusual type of meteorite.

the other science fields, such as chemistry, biology, physics, materials science, and engineering.

Microscopy – the technical field of using microscopes to view samples and objects that cannot be seen with the unaided eye – was a boon to emerging research areas such as nanotechnology. This was aligned with the objectives of the National Nanotechnology Strategy. The growth of microscopy is essential to help government expand its research capabilities in important health- and economy- related fields. The NRF has been supporting the microscopy community.

The DST funded the establishment of the state-of-the-art specialised facility, the Centre for High Resolution Transmission Electron Microscopy, based at the Nelson Mandela Metropolitan University in Port Elizabeth.

The department has invested R84 million in support of the centre through which South Africa is firmly positioned as a global player in the high resolution arena. This investment is expected to translate into cutting-edge research and development capacity, providing young scientists with high-end skills and attracting beneficial collaborative partnerships internationally. Given the importance and growth of microscopy, the DST regards it as crucial in addressing some of the strategic priorities in the areas of human capital development by training competent technicians to do research into HIV, mining and many other fields, using the high-end microscopes that the department has funded.

Indigenous Knowledge Systems (IKS)

The indigenous knowledge of many communities embodies a deeply spiritualised and ancient relationship with the Earth's systems and cycles. The National Recordal System is the largest fingerprint initiative of the region to document and record indigenous knowledge. The department established IKS documentation centres in all the provinces by 2013.

Council for Scientific and Industrial Research (CSIR)

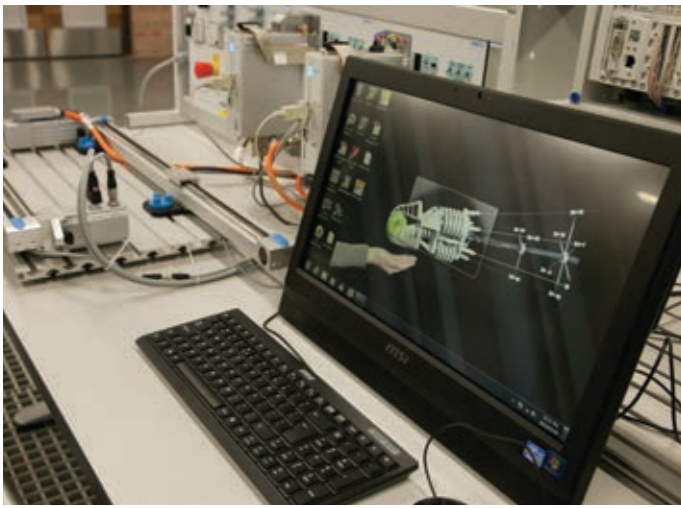
In September 2013, researchers at the CSIR developed the world's first digital laser. The team of researchers behind the innovation describe the development of the digital laser as a "disruptive technology," which will help to create a new market and value network, and eventually disrupt the existing market and value network over time.

The innovation, according to CSIR researchers, is regarded as a milestone in laser technology and could spur future laser-related innovations. Researchers said the development of the digital laser could have possible applications predominantly in the health, manufacturing and communications sectors, and other industries.

South African National Space Agency (Sansa)

In March 2013, the Sansa and the Russian Federal Space Agency (Roscosmos) signed the RadioAstron space satellite agreement. The agreement paved the way for the two countries to work together on the development of science and space technologies.

If considered as a single, virtual telescope, RadioAstron would be the world's largest radio telescope, with a "dish" measuring about 390 000 km (almost 30 times the Earth's



diameter or about the same size as the distance between the Earth and the moon).

Telkom has made an 18-m C-Band antenna available for RadioAstron tracking and acquisition in South Africa.

Under the agreement, Roscosmos will provide the hardware for upgrading the tracking station for compatibility with RadioAstron, while Sansa will install and maintain the upgraded hardware and operate the tracking station.

Through Sansa, the country's capacity to design, build, maintain and possibly even launch satellites is being developed. As part of the four-country African Resource Management Constellation, South Africa has begun work on the ZA-ARMC1 satellite and R232 million has been budgeted over the next three years for this project. This satellite will enhance Africa's ability to monitor and manage its precious natural resources. A business rescue plan for Sunspace was put in place, and the process of transferring its capabilities and IP into the Sansa satellite programme is continuing.

Council for Geoscience (CGS)

The Minister of Science and Technology paid a courtesy visit to the Helmholtz Centre for Geosciences in Berlin. The DST committed R4 million towards improving the skills base in South Africa, aimed at understanding the earth system, in a major research programme in partnership with Germany.

A joint initiative between the DST and the German Federal Ministry of Education and Research, the Year of Science, celebrated 16 years of successful cooperation on science and technology between the two countries.

The Africa Earth Observatory Network is the leading network of the cooperation programme on South Africa's side with Germany led by the German Research Centre for Geosciences.

Research bodies and areas

South African Bureau of Standards (SABS)

The SABS produces, maintains and disseminates standards. It promotes standardisation in business and government, and administers compulsory standards on behalf of the State. The SABS also certifies international quality standards.

Technology Innovation Agency (TIA)

TIA invests in the following technology sectors: advanced manufacturing, agriculture, industrial biotechnology, health,

mining, energy, and information and communications technology.

National Intellectual Property Management Office (Nipmo)

Nipmo protects intellectual property emanating from publicly financed research and development from appropriation and ensure that it is available to the people of South Africa.

Agricultural Research Council (ARC)

The ARC conducts fundamental and applied research with partners to generate knowledge, develop human capital, and foster innovation in agriculture by developing technology and disseminating information.

Mintek

Mintek, South Africa's national mineral research organisation, is one of the world's leading technology organisations specialising in mineral processing, extractive metallurgy and related areas.

Medical Research Council (MRC)

The MRC is an independent statutory body that coordinates health and medical research activities throughout South Africa.

National Research Foundation

The NRF provides services to the research community, especially at higher education institutions and science councils, with a view to promote high-level human capital development.

Human Sciences Research Council (HSRC)

The HSRC conducts large-scale, policy-relevant, social-scientific projects for public-sector users, non-governmental organisations and international development agencies.

National Advisory Council on Innovation (Naci)

Naci advises the Minister of Science and Technology on the role and contribution of innovation (including science and technology) in promoting and achieving national objectives.

Eskom

Eskom's Technology Services International group is a multidisciplinary industrial laboratory and consulting organisation.

In July 2013, the Minister of Science and Technology launched the South African version of the Scientific Electronic Library Online (SciELO-SA). It is a searchable full-text journal database that is completely open-access. It is part of the Brazilian SciELO project, which is driven by Fundação de Amparo à Pesquisa do Estado de São Paulo (The Foundation for Research Support of the State of São Paulo) in partnership with the Latin American and Caribbean Centre on Health Sciences Information. The project is funded by the Department of Science and Technology, maintained by the Academy of Science of South Africa and endorsed by the Department of Higher Education and Training. In April 2013, SciELO-SA received certification as a fully operational collection indexed in the global SciELO portal.

Sasol

Sasol's culture of innovation began in the 1950s when it developed its unique blend of coal gasification and Fischer-Tröpsch (FT) technology for its original coal-to-liquids operations at Sasolburg. Focused FT research and development in the 1980s and 1990s led to the development of the low temperature FT Sasol Slurry Phase process used at Sasolburg, and the high-temperature Sasol Advanced Synthol™ process used at Secunda.

ArcelorMittal

ArcelorMittal, a global steel-maker, is a leader in research and development and technology; holds sizeable captive supplies of raw material, and operates extensive distribution networks with an industrial presence in 27 countries.

National Health Laboratory Service (NHLS)

The NHLS forms a national network of integrated pathology laboratories throughout the country. The NHLS has 265 laboratories and employs about 6 500 people. All laboratories provide laboratory diagnostic services to the Department of Health, provincial hospitals, local authorities and medical practitioners.

Bureau for Economic Research (BER)

The BER, located at the University of Stellenbosch, Western Cape, renders a service to organisations ranging from small one-person businesses to policy-makers at the highest level of government.

National Institute for Tropical Diseases

The National Institute for Tropical Diseases in Tzaneen, Limpopo, is responsible for the ongoing assessment of malaria-control programmes carried out by various authorities in South Africa. A malaria-reference service is also provided. Malaria tests are carried out by the institute, and statistical analyses of data pertaining to the programme is undertaken.

South Africa's National Energy Development Institute (Sanedi)

The departments of science and technology, minerals and energy are joint custodians of Sanedi and assist in providing political and strategic focus for the company. The institute is entrusted with the coordination and undertaking of public interest energy research, development and demonstration.

Mine-safety research

The Safety in Mines Research Advisory Committee is a statutory tripartite subcommittee of the Mine Health and Safety Council. It has a permanent research-management office managing the engineering, rock engineering and mine occupational health fields of research.

National Agricultural Research Forum (Narf)

Narf coordinates agricultural research and development within the national agricultural research system.

Water Research Commission

The main areas of research are surface hydrology, groundwater, hydrometeorology, agricultural water-use, water pollution, municipal effluents, industrial water and effluents, drinking water, membrane technology, water ecosystems, hydraulics, mine-water management, water policy, developing communities and the transfer of technology.

Institute for Water Research (IWR)

The IWR is a multidisciplinary research department of Rhodes University. Its main objective is to contribute to sustainable water-resource management in southern Africa.

Coastal and marine research

The NRF supports marine and coastal research in partnership with the Department of Environmental Affairs and the

South African Network for Coastal and Oceanic Research. Sustainable use and the need to preserve future options in using marine ecosystems and their resources are guiding objectives in the research and advice provided by the chief directorate.

South African Environmental Observation Network (Saeon)

Saeon is a research facility that establishes and maintains nodes (environmental observatories, field stations or sites) linked by an information management network to serve as research and education platforms for long-term studies of ecosystems that will provide for incremental advances in the understanding of ecosystems and the ability to detect, predict and react to environmental change.

Biotechnology

South Africa's research institutions and universities are conducting biotechnology research to understand the nutritional components of food indigenous to South Africa, with the aim of making those with a high nutritional value available and accessible to the majority of people.

Academy of Science of South Africa (ASSAf)

ASSAf is the official national Academy of Science of South Africa and represents the country in the international community of science academies.

Africa Institute for South Africa (Aisa)

Aisa's mandate is to produce knowledge aimed at informing sustainable political and socio-economic development in Africa. Its vision is to be an indispensable African voice on African affairs, and its 2011 – 2015 research agenda is to seek solutions for Africa's developmental challenges.

Natural-resource development

South Africa's fluorspar chemicals sector has enormous economic potential. The DST has implemented a fluorochemicals development programme targeting human-capital development, new business formation and novel processes and products. A multipurpose fluorination pilot plant was completed and launched in 2012.

The department secured a commitment of R60 million for the period 2013 to 2015 from the competitiveness fund announced by the Minister of Finance in 2012. This enabled it to increase the companies on its register by a further 50 by the end of 2012/13, with an additional 100 planned by the end of 2014/15.

Women in Science Awards (WISA)

The WISA, which is part of government's efforts to recognise and create incentives for women scientists and researchers in the country and to profile successful women scientists, has been an annual event since 2003.

The theme of the 2013 awards was: "The Role of Science and Research against Violence towards Women."

This is rooted in the United Nations Commission on the Status of Women's 2013 theme: "Elimination and prevention of all forms of violence against women and girls, a topic of high interest in South Africa, given the high levels of violence against girls and women in society."

In August 2013, the awards were made in the life sciences and humanities categories and included distinguished women scientists and distinguished young women in science.