SAccess
ACCESS4EU – South Africa
(Contract Number 243851)

"Supporting the EU access to South Africa's research and innovation Programmes"

Report on South African research and innovation capacity

The SAccess project has received funding from the European Community's Seventh Framework Programme FP7 (2007-2013), Theme: INCO-2009-5, under Grant Agreement no 243851

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Executive Summary

The Department of Science and Technology (DST) in South Africa is responsible for scientific research in the country and oversees's the management of the country's relatively well-developed science system. DST seeks to realise the full potential of science and technology (S&T) in social and economic development, through the development of human resources (HR), research and innovation. The primary focus is on implementing the National Research and Development Strategy (NRDS), which provides for an integrated approach to HR development, knowledge generation, investment in infrastructure and improving the strategic management of the public S&T system.

DST promotes South African science and innovation by developing science, technology and innovation policies, funding Research and Development (R&D) at public research institutes and universities and establishing new institutions and instruments aimed at enhancing the impact of science society. The Department also partners with other government department in particular those having oversight responsibilities over science performing agencies.

Information on existing South African research and innovation programmes was compiled and has been packaged in this report for dissemination in Europe through the SAccess project to encourage participation of European researchers in appropriate South African research and innovation programmes, to help build South Africa's research capacity.

This report shows that most South Africa programmes are currently being accessed by only South African researchers and funding is only for South Africans. European researchers' participation is mainly through joint programmes that are developed as part of South Africa's bilateral agreements with individual European member states. In such cases, each partner country pays for their researchers' participation. There is however, willingness in some research managing organisations to open up their programmes to European researchers.

1. Introduction to the report

This report presents information on South Africa's science and technology landscape, and the bilateral programmes provided for reciprocal access to South African science, technology and innovation programmes. It gives an overview of research, development and innovation programmes funded by South Africa. These programmes have been divided into local and international initiatives, with the former being programmes where only South African researchers participate and the latter being programmes where international researchers currently collaborate with South African researchers. The report is by no means comprehensive; more information still exists in some organisations that are responsible for managing some research and innovation programmes in South Africa. Due to time constraints, it was not possible to get information on all research and innovation programmes. Nevertheless, the report gives a snapshot of existing South African programmes.

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2. Research and political background with respect to the report

The Department of Science and Technology (DST) derives its mandate from the 1996 White Paper on Science and Technology. The basic premise is that science, technology and innovation (STI) play a critical role in economic growth and socio-economic development. The South African 2009-2014 Medium Term Strategic Framework (MTSF) identifies technology innovation as one of the critical policy areas required to speed up growth and transform the economy to create decent work and sustainable livelihoods. The MTSF emphasises the need to build on the current range of strategies and programmes that are already supporting innovation in firms and research and development (R&D) in the private and public sectors, with emphasis on biotechnology and pharmaceuticals, space science and technology, energy security, and other opportunities presented by climate change. In this regard, the appropriate, continuous and effective implementation of the indicator-based 2002 National Research and Development Strategy (NRDS) and 2007 Ten-Year Innovation Plan (TYIP) is crucial.

The NRDS emphasises an integrated approach, which includes human resource development, knowledge generation, investment in science and technology infrastructure, and improving the strategic management of the public science and technology system. The TYIP seeks to transform the South African economy into a knowledge-based one, in which the production and dissemination of knowledge will lead to economic benefits and enrich all fields of human endeavour. The success of the Technology Innovation Agency Act and the Intellectual Property Rights from Publicly Financed Research and Development Act (IPR Act) will be important to address the failure to commercialise and protect the results of scientific research. This will strengthen the innovation capacity of the country.

DST promotes South African science and innovation by funding Research and Development (R&D) at public research institutes and universities. The Department also, when necessary, establishes new institutions and support instruments for Science, Technology and Innovation (STI).. R&D promotes the growth of knowledge-intensive activity in the South African economy. The intensity of R&D expenditure - measured as the percentage of GDP spent on R&D - is a good indication of the competitiveness of a country's economy. The most recent R&D survey in South Africa (for 2008/09) reveals a gross investment in R&D of R21.041 billion, continuing a decade-long trend of growth and a 12.9% nominal annual increase on the previous year. There is a clear connection between R&D intensity and competitiveness. DST's aim is to improve the competitiveness of the country's economy significantly. At the moment, South Africa is ranked 45 out of 134 countries on the World Economic Forum's Global Competitiveness Index (2009).

The investment will build a larger base of scientific expertise than currently exists, thus enhancing South Africa's international reputation in research and innovation. The DST is part of the Economic Sectors and Employment Cluster that has prioritised cross-cutting interventions to promote decent work. These include leveraging procurement to support industrialisation, and the strategic use of regulation to

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promote economic efficiencies and industrial financing. The DST's vision is to enter into closer partnerships with organised business over strategies to increase R&D expenditure, improve institutional mechanisms that support commercialisation, and improve exploitation of large-scale science-based initiatives to support local manufacturing.

To make progress in these areas, South Africa seeks to strengthen its international partnerships - both to enhance its knowledge and to create an environment conducive to the transfer of technology. Knowledge-based economies are connected through a growing international research and cooperation network.

The project, SAccess is key in helping South Africa achieve its objective of strengthening international partnerships and developing human capital, which will in turn contribute to economic growth. South African researchers' collaboration with European counterparts will facilitate the flow of knowledge and other resources to the South African system of innovation. Also, dissemination of information on South Africa R&D programmes in Europe through the project will help market South Africa as an important player in global science and a partner of choice in Europe.

2.1 The Ten-Year Innovation Plan (2008-2018)

This part of the report presents the main ideas of the Ten-Year Innovation Plan as presented by the DST[1].

The TYIP proposes a vision for South Africa between 2008 and 2018 in relation with the "grand challenges" that are described below.

- Be one of the top three emerging economies in the global pharmaceutical industry, based on a expansive innovation system using the nation's indigenous knowledge and rich biodiversity;
- Deploying satellites that provide a range of scientific, security and specialised services for the government, the public and the private sector;
- A diversified, supply secured sustainable energy sector;
- Achieving a 25 percent share of the global hydrogen and fuel cell catalysts market with novel platinum group metal (PGM) catalysts;
- Being a world leader in climate science and the response to climate change;
- Having met the 2014 Millennium Development Goals to halve poverty.

The 5 "grand challenges" of the TYIP are accompanied by a set of indicators to measure the progress towards the above mentioned vision. To meet these challenges international cooperation in R&D should be reinforced. The indicators reflect the interesting aspects of the South African R&D system and these indicators can be considered by European partners to assess their potential cooperation programmes with respect to South African priorities.

[1] http://www.dst.gov.za/publications-policies/strategies-reports/The%20Ten-Year%20Plan%20for%20Science%20and%20Technology.pdf

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2.1.1 The Grand Challenges

The Bio-economy: life sciences and health

This challenge is based on some strengths of the country, namely, a large biodiversity base, as well as human capital, indigenous knowledge and the industrial base (there are currently 106 biotechnology South African companies).

Among the priorities of this challenge are:

- **Pharmaceutical solutions** to attack particularly the disease burden that is further worsened by poverty. South Africa's rich biodiversity can be used to attract multinational pharmaceutical companies.
- **Agricultural biotechnology** with focus on genetic modification of plants to improve food security as well as the production of medically and industrially compounds.

To implement this challenge, South Africa intends to improve the networking and collaboration at the national and international level as well as the development of business skills, to focus on selected platforms and markets and to close the gap between research and commercialisation through investment in platforms and infrastructures and improving funding mechanisms.

Indicators related to Bioeconomy that can be of the interest to European researchers and institutions

By 2018 South Africa will:

- Be one of the top three emerging economies in the global pharmaceutical industry, based on an expansive innovation system using the nation's indigenous knowledge and rich biodiversity
- Have created and funded **five theme-specific consortium–based centres of competence that focus on the five top national health priorities**, linked to the growth of the local pharmaceutical industry
- Increased **foreign investment** in South African health-related R&D (excluding clinical trials) through reinvigorated **health research, with particular emphasis on pharmaceutical R&D**
- Have designed and created a **platform in 3rd generation biotechnology** for application to plant/animal improvement and biofarming
- Have **created an active biosafety platform** providing regulatory guidance and support for product development in 3rd generation plant and animal biotechnology.

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Space Science

Through this challenge, South Africa intends to address three strategic objectives (Environment and resource management, Safety and Security, Innovation and economic growth) as well as increase its participation in the global satellite industry.

Six thematic programmes are targeted:

- Space sciences: concerning the study of the atmosphere to astronomy, space physics and geodesy, among others.
- Earth observation: understanding the planet to provide data for decision-making in support to social benefits (health, energy, climate variability and change, water, weather, protection of ecosystems, agriculture, conserving biodiversity).
- Communication: development of technologies including technologies applied to
- Navigation (Civil applications): assistance to movement of people and goods, civil protection, management of natural resources, development of land infrastructures, urban planning, etc.
- Engineering services in support of the National Research Facilities.
- Expertise development: development of a critical mass in areas such as radio-frequency engineering, system engineering, software development and propulsion systems.

Indicators related to Space Science that can be of the interest to European researchers and institutions

By 2018 South Africa will have:

- Independent earth observation high-resolution satellite data available for all of Africa from a constellation of satellites designed and manufactured in Africa
- Undertaken at least **one launch from South African territory** in partnership with another space nation, and have in place a 20-year launch capability plan
- Specified and **co-built a domestic/regional communications satellite** and secured a launch date and ITU slot for its operations
- **Become the preferred destination for major astronomy projects** and associated international investment in construction and operations
- Constructed a **powerful radio-astronomy telescope** and used it for world-class projects.

Energy Security

Through this challenge South Africa expects to respond to the needs of the country in a context of economic growth.

To do so, major thrusts have been identified:

- **Clean coal technologies** for environmentally friendlier processes.
- **Nuclear energy** revisited to have 20% to 25% of electricity produced by nuclear power.

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- **Renewable energy technologies** with focus on commercialisation and coherent policy interventions.
- **Hydrogen**. The goal is to place South Africa – which holds 87% of the known platinum reserves - in the emerging fuel cell market.

Indicators related to Energy Security that can be of the interest to European researchers and institutions

By 2018 South Africa will have:

- **Expanded the energy supply infrastructure**, with 80 percent of new capacity coming from clean coal technologies and nuclear plants
- **Expanded the knowledge base for building nuclear reactors** and coal plants parts; source more than 50 percent of all new capacity locally
- Successfully integrated **uranium enrichment** into the fuel cycle and feeding into the commercial reactors
- A **25 percent share of the global hydrogen infrastructure and fuel cell market** with novel PGM catalysts
- Demonstrated, at pilot-scale, the production of hydrogen by water splitting, using either nuclear or solar power as the primary heat source.

Global change

Given its advantageous geographical position, South Africa can play an important role to the understanding of the climate change.

Through this challenge the Country is looking to prevent the negative impacts of climate change on the environment, including protection of ocean resources and biodiversity. Research will be developed to develop prevention and early warning systems, field detection and treatment, public health infrastructure, etc.

In addition, South Africa expects to take advantage of the opportunities of the “green

Indicators related to Global change that can be of the interest to European researchers and institutions

By 2018 South Africa will have:

- An internationally recognised science centre of excellence with climate change research and **modelling capability**, benefiting the entire continent
- **Robust regional scenarios for the rate and impact of climate change and extreme weather conditions** for South Africa and the continent
- **I**nitiated climate change adaptation and mitigation actions
- An internationally recognised centre of excellence focused on the Southern Ocean and its contribution to global change processes
- Strengthened research and **global monitoring capabilities on Marion Island**, Antarctica

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economy".

Human and Social dynamics

With this challenge the country expects to better anticipate and understand the consequences of social change as well as the dynamics of human behaviour.

To provide evidence-based for intervention, the TYIP will support research in **paleoanthropology**, **archaeology** and evolution **genetics**. **Computer modelling** will be applied to cognitive, socio-cultural, developmental and neurobiological studies to understand how people learn. Studies related to **responses, perceptions and the treatment of risk** will be also developed.

A special effort will be devoted to research applied to chronic **poverty**.

Indicators related to Human and Social dynamics that can be of the interest to European researchers and institutions

By 2018 South Africa will have conducted/developed:

- Applied science and technology activities to achieve the **Millennium Development Goals** on livelihoods and affordable access to services
- **Recognition as a "knowledge hub" in social sciences** research in Africa
- Socio-culturally based models that accurately reflect the **learning behaviour** of the South African national system of innovation.

2.1.2 Implementation of the Plan

Implementation of the plan will follow an all-inclusive approach. It will be implemented by various National System of Innovation stakeholders, mostly led by entities (like Research Councils, Technology innovation Agency, etc) that report to DST. Implementation plans for the carious challenges are currently not available publicly.

3. Country characteristics: Strengths and weaknesses

According to the United Nation's classification South Africa is a middle-income country with an abundant supply of resources, well-developed financial, legal, communications, energy, and transport sectors, a stock exchange that ranks among the top twenty in the world, and a modern infrastructure supporting an efficient distribution of goods to major urban centres throughout the entire region. South Africa is ranked 25th in the world in terms of GDP as of 2008.

South Africa has the most resource rich economy in Sub-Saharan Africa. The country's currency is undervalued with moderate investment flow potential, high purchase price potential, and interest rate parity potential. The leading industry commodities are uranium, palladium, diamonds, coal and platinum.

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3.1 Economy

South Africa is a middle-income, emerging market with an abundant supply of natural resources; well-developed financial, legal, communications, energy, and transport sectors; a stock exchange that is 17th largest in the world; and modern infrastructure supporting an efficient distribution of goods to major urban centres throughout the region. Growth was robust from 2004 to 2008 as South Africa reaped the benefits of macroeconomic stability and a global commodities' boom, but began to slow in the second half of 2008 due to the global financial crisis' impact on commodity prices and demand. However, unemployment remains high and outdated infrastructure has constrained growth.

Principal international trading partners of South Africa besides other African countries include the United States, Germany, China, Japan, Spain, and the United Kingdom. The main exporting commodities are corn, diamonds, fruits, gold, metals and minerals, sugar and wool. Machinery and transportation equipment make up more than one-third of the value of the country's imports. Other imports include chemicals, manufactured goods, and petroleum.

3.2 Communication

As a general assessment the system is the best developed and most modern in Africa,
domestic combined fixed-line and mobile-cellular teledensity is nearly 110 telephones per 100 persons; consisting of carrier-equipped open-wire lines, coaxial cables, microwave radio relay links, fiber-optic cable, radiotelephone communication stations, and wireless local loops..Key centres are Bloemfontein, Cape Town, Durban, Johannesburg, Port Elizabeth, and Pretoria, the country's international: country code is 27; the SAT-3/WASC and SAFE fiber optic cable systems connect South Africa to Europe and Asia; satellite earth stations - 3 Intelsat (1 Indian Ocean and 2 Atlantic Ocean).

3.3 Flora and fauna

South Africa is ranked sixth out of the world's seventeen mega diverse countries with more than 20,000 different plants, with about 10% of all the known species of plants on Earth, making it particularly rich in plant biodiversity. The most prevalent biome in South Africa is the grassland, particularly on the highveld of the country, where the plant cover is dominated by different grasses, low shrubs, and acacia trees, mainly camel-thorn and whitethorn. Vegetation becomes even more-sparse towards the northwest due to low rainfall. There are several species of water-storing succulents like aloes and euphorbias in the very hot and dry Namaqualand area. The grass and thorn savannah turns slowly into a bush savannah towards the north-east of the country, with denser growth. There are significant numbers of baobab trees in this area, near the northern end of the Kruger National Park.

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The Fynbos Biome, which makes up the majority of the area and plant life in the Western Cape Province, one of the six floral kingdoms, is located in a small region of the Western Cape and contains more than 9,000 of those species, making it among the richest regions on earth in terms of floral biodiversity. The majority of the plants are evergreen hard-leaf plants with fine, needle-like leaves, such as the sclerophyllous plants. Another uniquely South African plant is the Protea genus of flowering plants. There are around 130 different species of Protea in South Africa. The Protea is South Africa's national plant.

3.4 Electricity challenges

After unsuccessful attempts by the government to encourage private construction of electricity generation capacity, in 2007 the state-owned electricity supplier Eskom started experiencing a lack of capacity in the electrical generation and reticulation infrastructure. This led to an inability to meet the routine demands of industry and consumers, resulting in countrywide rolling blackouts. Initially the lack of capacity was triggered by a failure at Koeberg nuclear power station, but since then a general lack of capacity due to increased demand became evident. However, the country has not experienced any major blackouts since. The power utility (Eskom) plans to have 20 000 MW of nuclear power in its grid by 2025.

Secure energy provision has become one of the country's biggest priorities and a lot of effort has been put by key stakeholders to ensure availability of spare capacity. Eskom is currently planning to build new power stations.

3.5 Demographics and language

South Africa is a nation of about 50 million people of diverse origins, cultures, languages, and religions. The last census was held in 2001 and the next will be in 2011.

South Africa has eleven official languages which are Afrikaans, English, seTswana, seSotho, sePedi, isiXhosa, isiZulu, isiNdebele, xiTsonga, tshiVenda, and siSwati. In this regard it is third only to Bolivia and India in number. While all the languages are formally equal, some languages are spoken more than others. According to the 2001 national census, the three most spoken first home languages are isiZulu (23.8%), isiXhosa (17.6%) and Afrikaans (13.3%). Despite the fact that English is recognised as the language of commerce and science, it was spoken by only 8.2% of South Africans at home in 2001, an even lower percentage than in 1996 (8.6%).

4. South Africa's Research and Development Profile

What are the main features of the South African research and innovation system? Who does research in the country? In which fields does South Africa perform research? These and other questions will be addressed in this section of the report in order to provide European researchers interested in South Africa with an overview on

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the context in which their potential collaborations with South African institutions will be developed.

This section presents information obtained through interviews that were conducted in South Africa between November 17 and December 16 (2010) as well as statistical information from documents provided by the interviewees. The interviewees were managers of South African research and innovation programmes. This information has been completed and verified through a desktop study whose main sources are listed below.

Analyses are presented in 3 parts:

- Introduction to the Country profile
- A set of indicators that shows South African R&D activity compared, where possible, to other countries and regions;
- A description of the R&D performers and their contribution to the national R&D activity.

4.1 Introduction to the Country R&D Profile

Several important scientific and technological developments have originated in South Africa. The first human-to-human heart transplant was performed by cardiac surgeon Christian Barnard at the Groote Schuur hospital in December 1967. Marx Theiler developed a vaccine against Yellow Fever, Allan McLeod Cormack pioneered X-Ray computed tomography, and Aaron Klug developed crystallographic electron microscopy techniques. These advancements were all recognised with Nobel Prizes, with Sydney Brenner wining the 2002 prize for his pioneering work in molecular biology.

Mark Shuttleworth founded an early Internet security company Thawte that was subsequently bought out by world-leader VeriSign. Despite government efforts to encourage entrepreneurship in biotechnology, IT and other high technology fields, no other notable groundbreaking companies have been founded in South Africa. The expressed objective of the government to transition the economy to be more reliant on high technology, based on the realisation that South African cannot compete with Far Eastern economies in manufacturing, nor can the republic rely on its mineral wealth in perpetuity.

South Africa has cultivated a burgeoning astronomy community. It hosts the Southern African LargeTelescope (SALT), the largest optical telescope in the southern hemisphere. South Africa is currently building the Karoo Array Telescope as a pathfinder for the $20 billion Square Kilometre Array (SKA) project. South Africa is a finalist, with Australia, to be the host of the SKA.

4.2 Key facts and Indicators

Gross Domestic Expenditure on R&D (GERD)

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In 2008/2009[2] the GERD was equivalent to **21 041 Million Rands** which represent **0.92% of the Gross Domestic Product (GDP)**[3].

In South Africa the total amount of the GERD has increased continuously between 1997/98 and 2008/09. An increase of 1.3% (real terms) was registered between 2007/08 and 2008/09, from 18 624 Million in 2007/08 to 21 041 Million in 2008/09. The GERD as a percentage of GDP has also steady increased between 1997/98 and 2006/07 (0.93% in this fiscal year) but a first slight decrease has been showed in the 2008/09 (-0.01%).

Memento
R&D Expenditure – Definition according to the OECD Classification of Statistical Themes

Research and development expenditure is the money spent on creative work undertaken on a systematic basis to increase the stock of knowledge and the use of this knowledge to devise new applications.

Expenditure on Research and Development (R&D) refers to all expenditure on research performed at universities and at other institutions of tertiary education, regardless of whether the research is funded from general institutional funds or through

As Brazil in Latin America, South Africa is the country with the major R&D Expenditure in its region. In 2005, Africa accounted for 0.7% of the world share of R&D expenditure, South Africa representing 0.5% of the region's share. In the same year Brazil accounted for 1.3% of the Latin America share (2.4%)[4].

GERD as a percentage the GDP in other countries were as follows in 2008[5]:

→Brazil: 1.1%

→**Europe (average 2007): 1.77%**

→OCDE (average 2007): 2.28%

→United States: 2.8%

→Japan: 3.44%

→Sweden: 3.75%

The Government is the main funder of R&D in South Africa with 45.7% of the GERD, while the business sector contributes with 42.7% of the GERD. This structure for funding is more common in developed countries given the key role played by the

[2] Human Sciences Research Council (HSRC), *National Survey of Research and Experimental Development (2008/2009 Fiscal Year*), September 2010, Page 7.
[3] Human Sciences Research Council (HSRC), *National Survey of Research and Experimental Development (2008/2009 Fiscal Year*), September 2010, Page 8.
[4] Jacque Gaillard, IRD, *Measuring Research and Development in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, Science, Technology and Society 15:1 (2010). Page 97.
[5] OECD, *Science,Technology and Industry Outlook 2010*. URL: http://www.oecd.org/document/36/0,3343,en_2649_34273_41546660_1_1_1_1,00.html#contents

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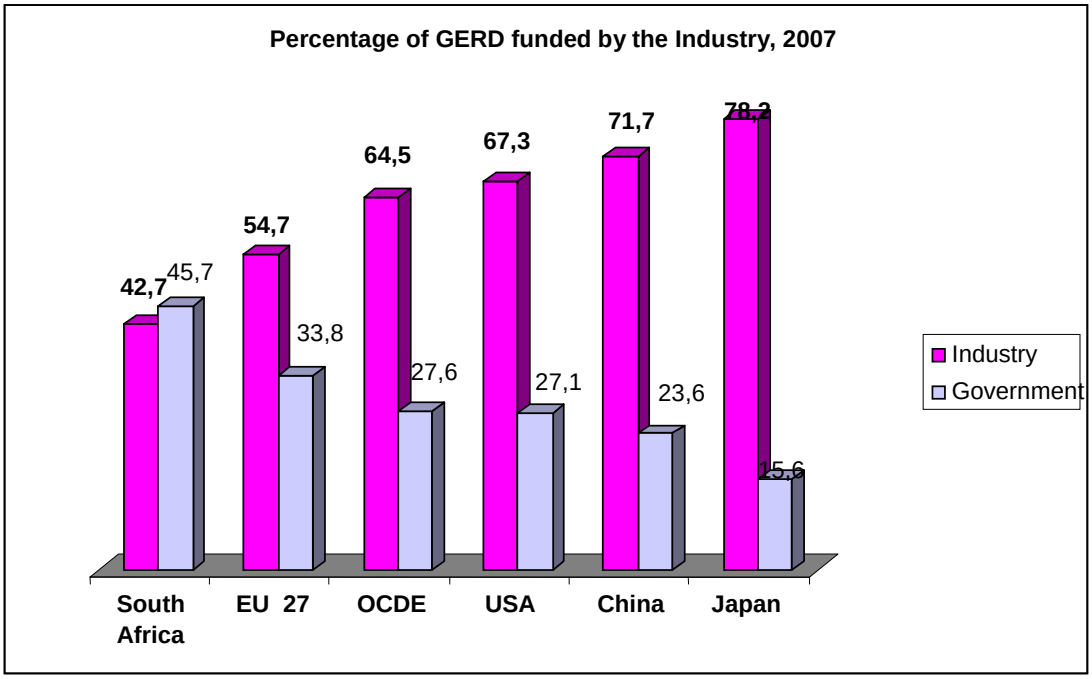
business sector. As observed in figure 1, countries and regions with higher GERD show a high contribution of industries to the GERD[6].

FIGURE 1



OECD, Main Science and Technology Indicators (MSTI): 2010/1 edition

With regards to R&D Expenditure by research fields (Figure 2), in South Africa around 70% of the GERD is dedicated to Engineering Sciences (24.4%), Natural Sciences (20.6%), Medical and Health Sciences (14.8%) and Information and communication technologies (13.1%). The latter showed a slight decrease compared to its share of R&D Expenditure in 2008/07. The Expenditure in Social Sciences and Humanities remained stable at 12.5%.

[6] OCDE, *Main Science and Technology Indicators (MSTI): 2010/1 edition*
http://www.oecd.org/document/26/0,3746,en_21571361_31938349_1901082_1_1_1_1,00.html

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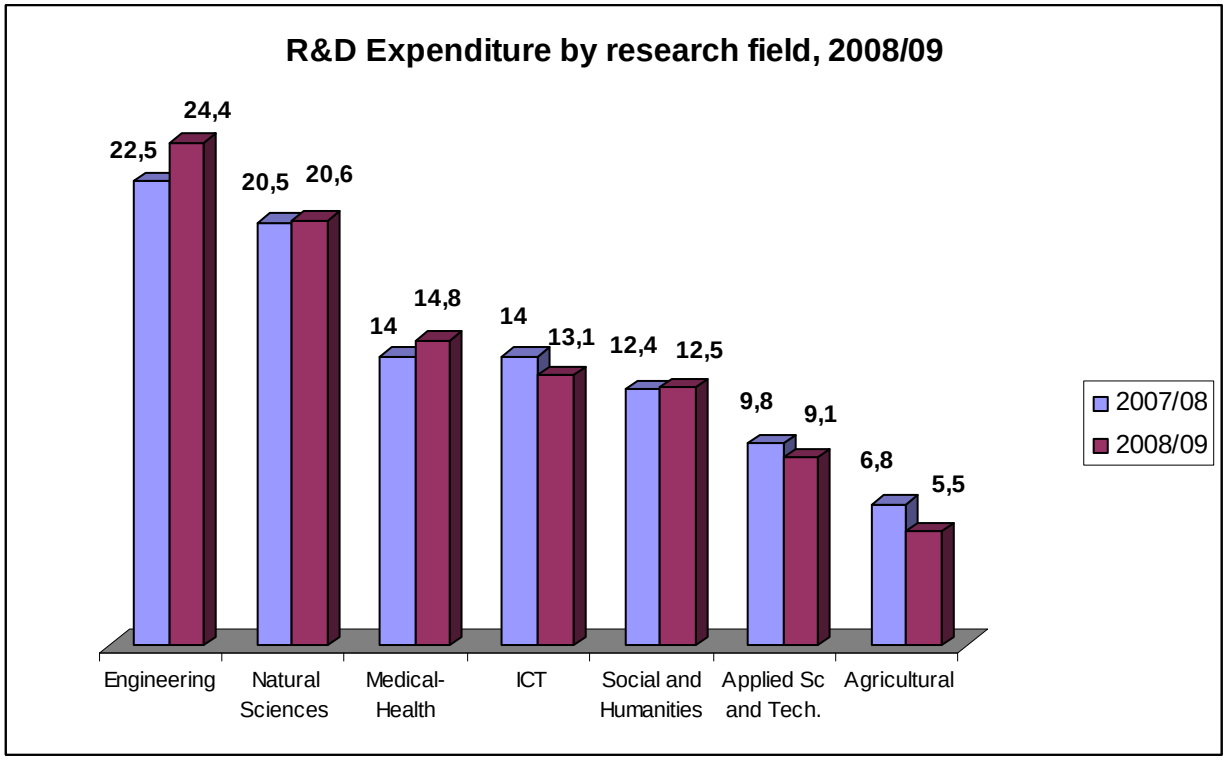
FIGURE 2



HSRC, National Survey of Research and Experimental Development, 2008/09

Figures 3, 4, 5 and 6 show the R&D expenditure in 2007/08 by R&D performers (except the Non-for-Profit organisations). It should be especially noted that:

- More than 70% of the business enterprise sector R&D expenditure is devoted to Engineering Sciences, Medical and Health Sciences, Information computer and communication technologies and Applied Sciences and technologies. This pattern is consistent with the distribution of total R&D expenditure.
- Government R&D expenditure is currently distributed differently: more than 50% of the expenditure is dedicated to Social, Agricultural and Medicine-Health Sciences. Hearth Sciences (14%) and biological Sciences (9.8%) represent also an important field for the Government R&D expenditure.
- With regards to universities, more than 50% of the R&D expenditure is dedicated to Social (22%), Medical-Health Sciences (21.7) and Humanities (12%). 8.1% of the expenditure is devoted to Engineering Sciences and 7.5% to Biological Sciences.

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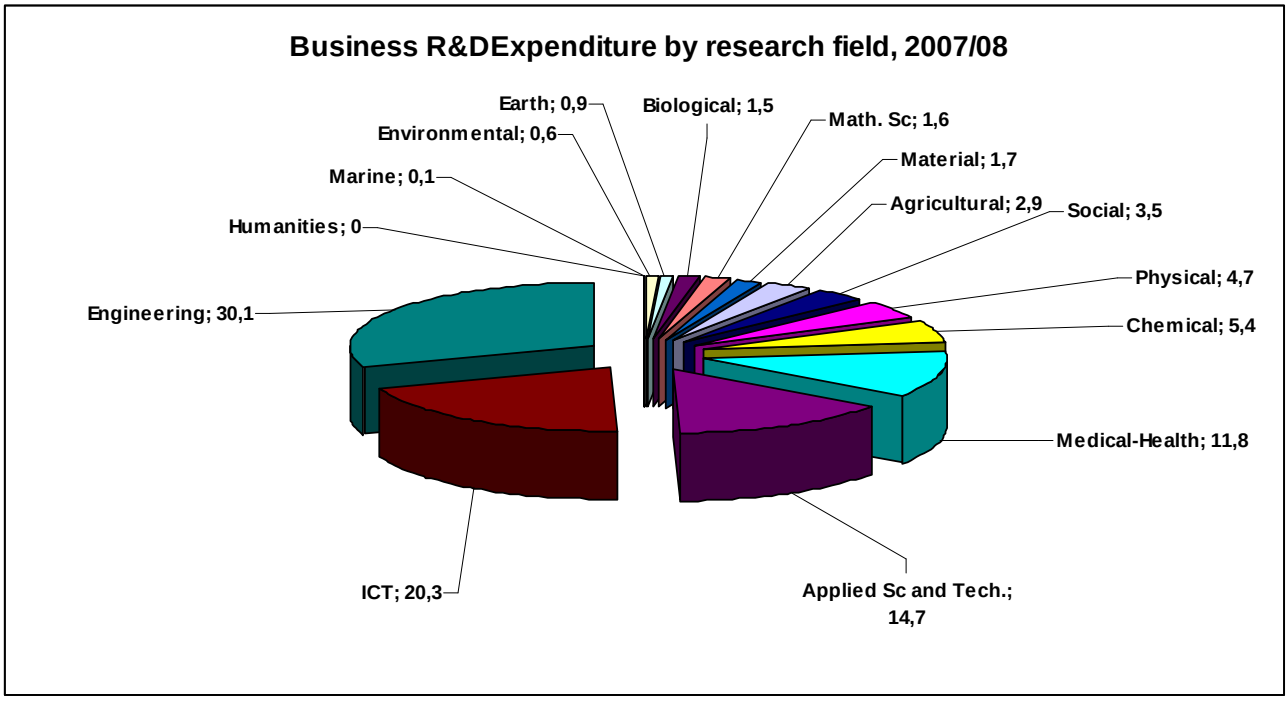
- In the business sector, Engineering Sciences represented the most funded field for Sciences R&D expenditure (22.3%), followed by the Agricultural Sciences (19.6%) and the Medical-Health Sciences (12.4%).

FIGURE 3



HSRC, National Survey of Research and Experimental Development, 2008/09

FIGURE 4

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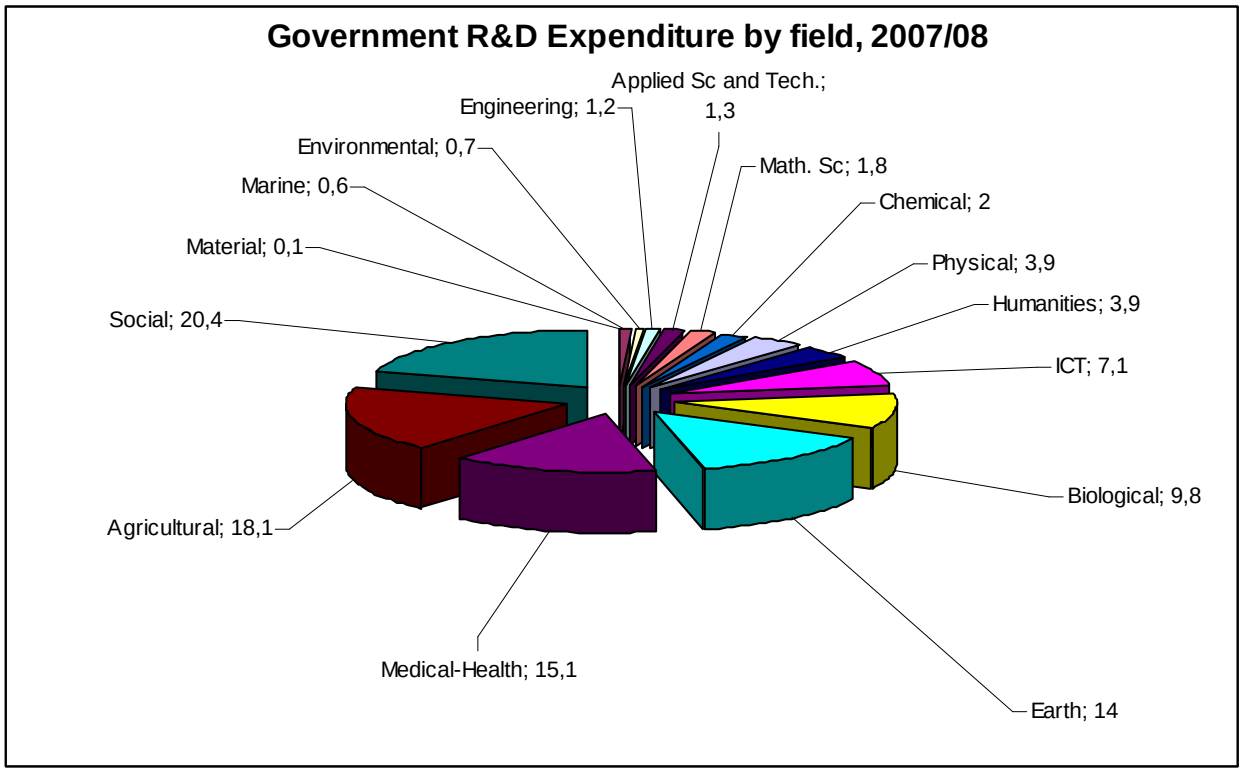
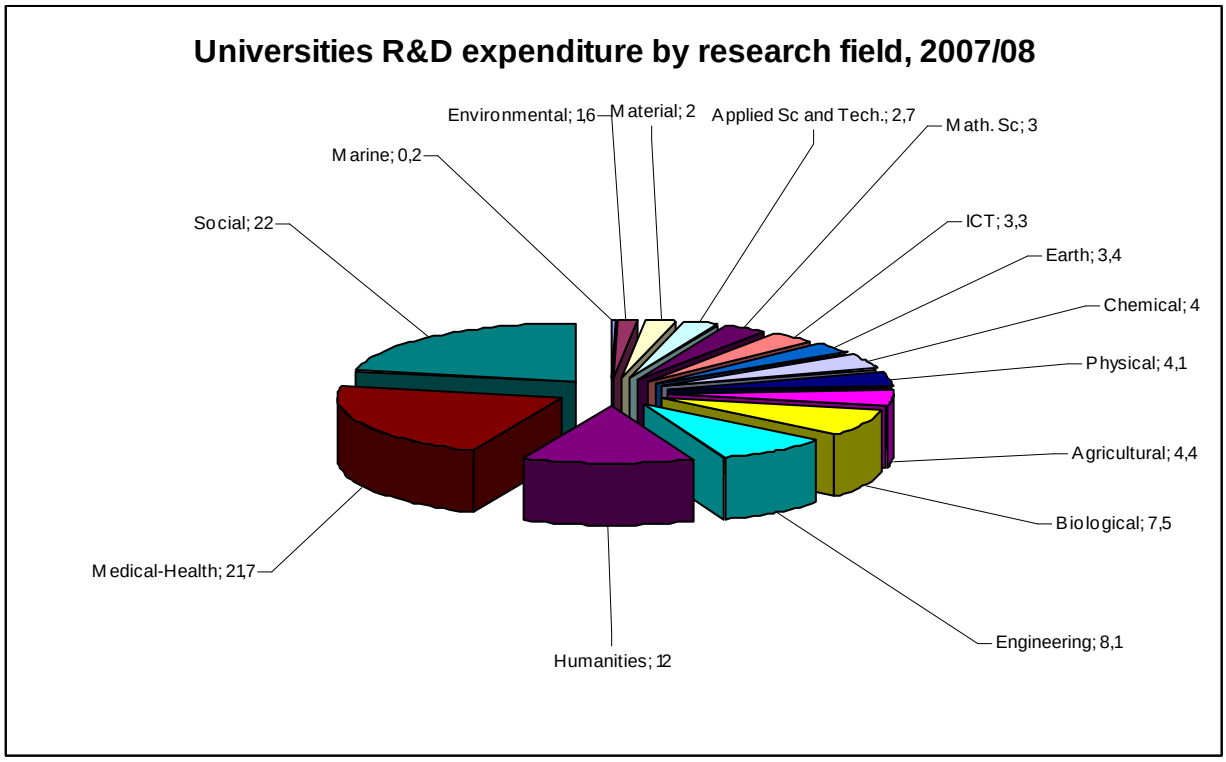


HSRC, National Survey of Research and Experimental Development, 2008/09

FIGURE 5



HSRC, National Survey of Research and Experimental Development, 2008/09

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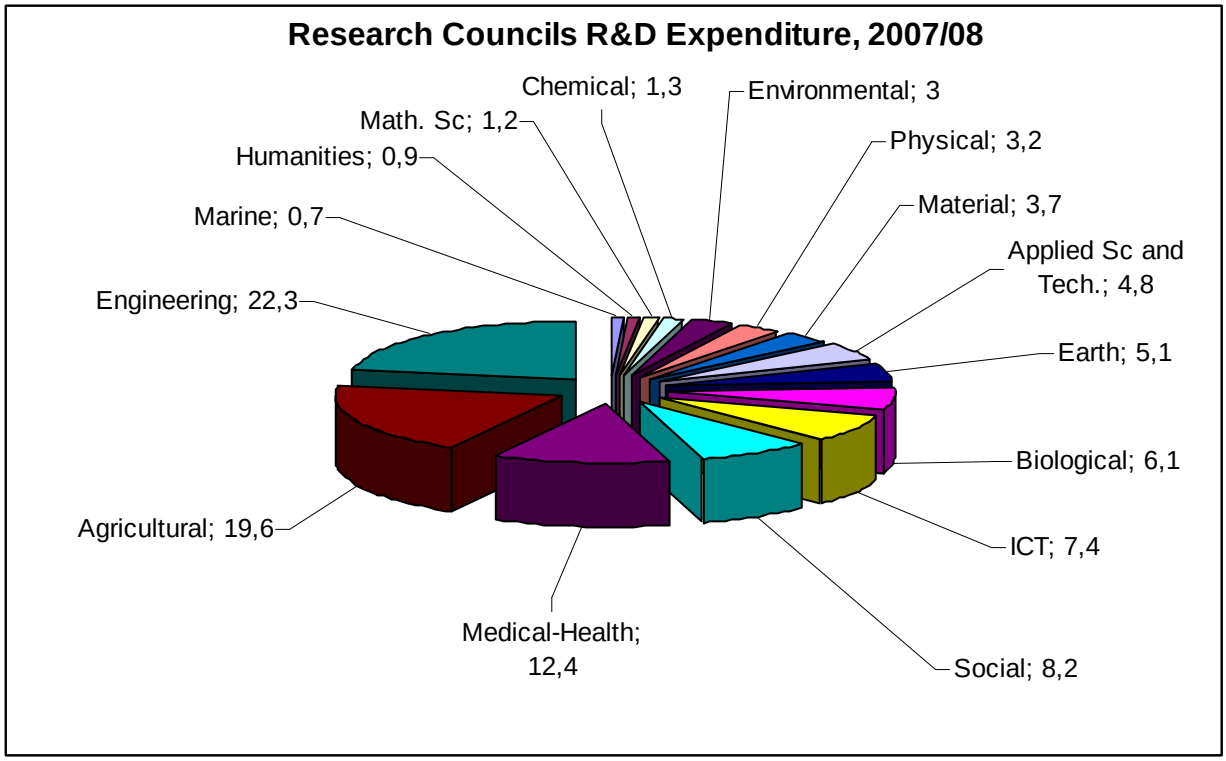
FIGURE 6



HSRC, National Survey of Research and Experimental Development, 2008/09

Researchers

In 2008, South Africa had a total of **19 320 researchers**[7] full time equivalent (FTE) representing 1.41 researchers per 1 000 employees.

Other countries' or regions' numbers of researchers for the same period as follows:

→Mexico: 37 930 researchers

→China: 1 592 420 researchers

→OCDE: 4 128 008 researchers

→**Europe (EU27): 1 494 093 researchers**

→United States: 1 412 639 researchers[8]

According to Gaillard (2010)[9], estimates suggest that in 2005 FTE researchers in South Africa represented 0.3% of the world share and more than 13.8% of the FTE

[7] Human Sciences Research Council (HSRC), *National Survey of Research and Experimental Development (2008/2009 Fiscal Year*), September 2010, Page 7.

[8] OECD, *Science,Technology and Industry Outlook 2010*. URL: http://www.oecd.org/document/36/0,3343,en_2649_34273_41546660_1_1_1_1,00.html#contents.

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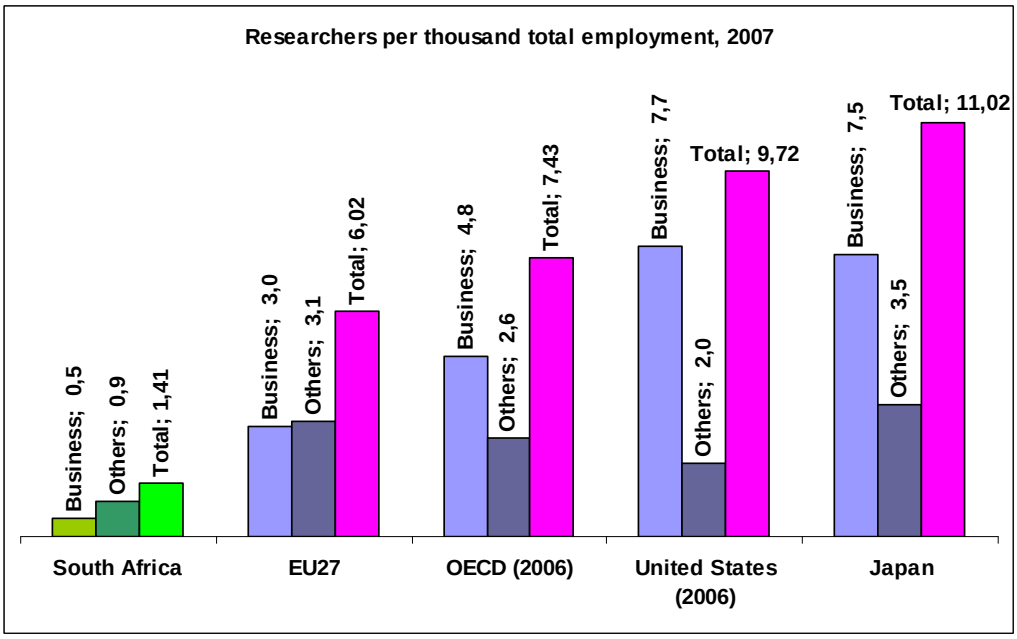
scientists in Africa. He explains that the increase in the number of scientists in Africa between 1998 and 2003 (+52%) would be explained essentially by the augmentation of FTE researchers in South Africa (+66%).

Since the early 1980s, business researchers have grown faster than total industrial workers in the OECD area[10]. Although the low proportion of researchers in business enterprises per thousand employment in South Africa compared to developed countries or regions (0.5 researchers per thousand employment in South Africa, 3 in the EU27, 4.8 in the OECD area, 7.7 in the USA - Figure 7), **the number of business researchers has progressed strongly in this country between 1997 and 2007 at an average annual rate of 19%** (Figure 8). This is five times the increase in Europe for the same period and the highest increase registered by the OECD after Portugal (21.9%), well above the OECD average (3.3%).

FIGURE 7



OECD Science, Technology and Industry Scoreboard 2009

FIGURE 8

[9] Jacque Gaillard, IRD, *Measuring Research and Development in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, Science, Technology and Society 15:1 (2010). Page 90.
[10] OECD, *Science, Technology and Industry Scoreboard 2009*, URL: http://www.oecd-ilibrary.org/sites/sti_scoreboard-2009-en/01/10/index.html?contentType=/ns/Book,/ns/StatisticalPublication&itemId=/content/book/sti_scoreboard-2009-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html

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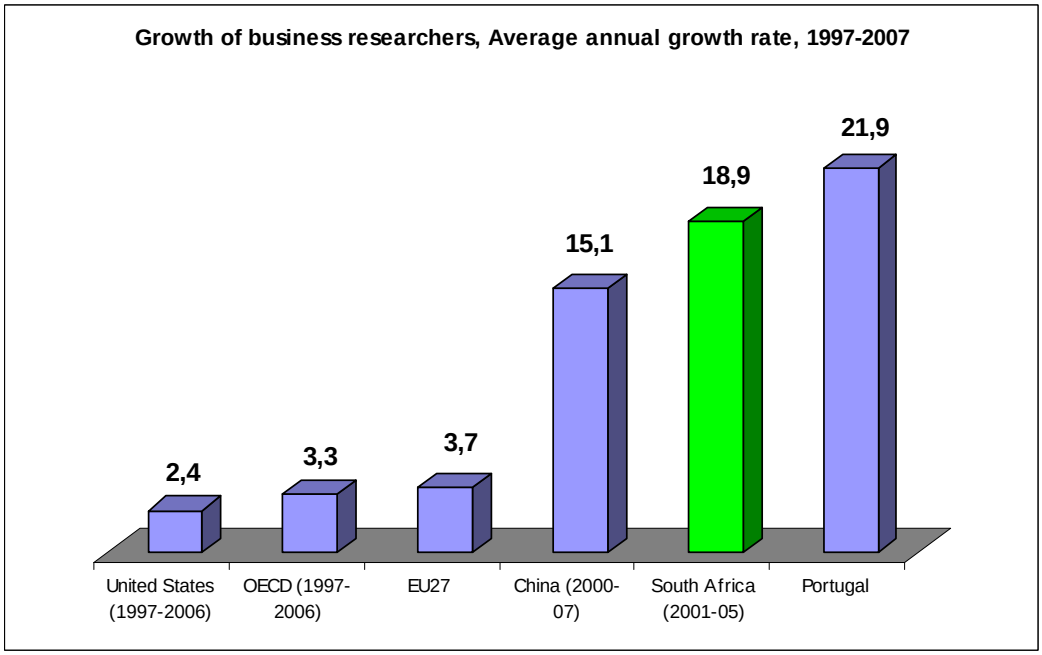
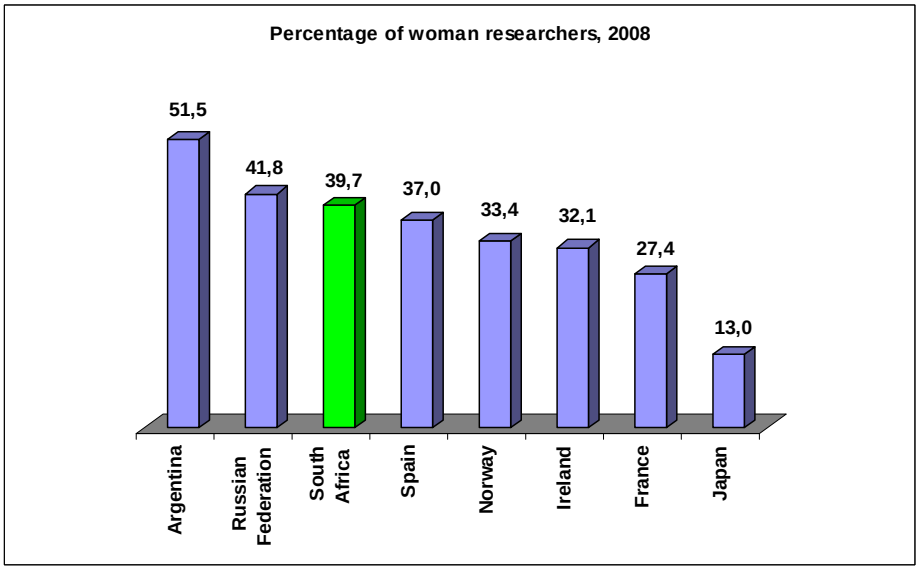


OECD Science, Technology and Industry Scoreboard 2009

In 2008/09, **women represented 39% of total researchers** in South Africa[11], more than in France (27.4%), for example. 73% of woman researchers in South Africa are employed in the higher education sector while their representation in the business sector is only of 29.5% of total researchers[12].

FIGURE 9



[11] HSRC, Idem.
[12] HSRC, Idem.

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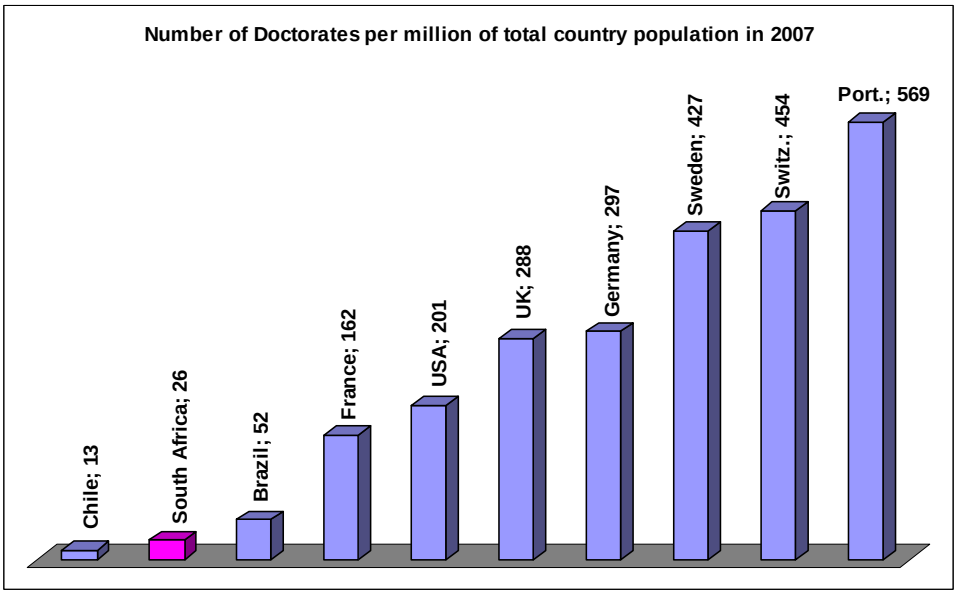
Human Sciences Research Council (HSRC), National Survey of Research and Experimental Development, 2010

South Africa has a total of **1 274 doctoral graduates** or **26 doctorates per million of the country's population**[13]. This is a low performance compared to other countries (see below) and one of the major challenges of the South African system.

FIGURE 10



ASSAF, The PhD study, 2010

Scientific publications

[13] Academy of Science of South Africa (ASSAF), *The PhD Study*, September 2010.

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With regards to scientific publications, only three African countries are among the top twenty publishing countries in Asia (excluding Japan), Latin America and Africa[14]: They are South Africa, Egypt, Morocco and Tunisia.

In the African continent, **scientific production is dominated by South Africa with 47 000 papers** produced between 1999 and 2008. In the same period, Egypt -who leads North African scientific publications- produced 30 000 papers while Nigeria -leading the middle Africa region- produced 10 000 papers[15].

As a share of world publications, **the highest African performance is for South Africa in the field "Plant and Animal Science"** (1.55%) followed by the same country's percentage of "Environment/Ecology" (1.29%)[16].

In 2008, South Africa published 110 scientific articles par million population. While relatively low compared to other countries, South Africa's scientific publications have grown by an annual average of 4.5% since 1998[17]. Publications abroad are as follows:

→Brazil: 141 per million population (26 806 in total)

→United States: 911 per million population in 2008 (277 446, the highest in the world)

Although Africa's total scientific publications are lower than Brazil's[18], **the impact factor of South Africa's publications is above China, Brazil and the Latin America average**. The impact factor reflects the average number of citations to articles published in science and social science journals.

Finally, it is noteworthy that the number of articles co-published in South Africa with European co-authorship has not stopped increasing since 1987 and is above the total of articles co-published with other countries since 1997 (Figure 10 and Table 1)[19].

FIGURE 11

[14] Jacque Gaillard, IRD, *Measuring Research and Development in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, Science, Technology and Society 15:1 (2010). Page 83.
[15] Thomson Reuters, *Global Research Report, Africa*, April 2010.
[16] Thomson Reuters, *Global Research Report, Africa*, April 2010.
[17] OECD, *Science,Technology and Industry Outlook 2010*. URL: http://www.oecd.org/document/36/0,3343,en_2649_34273_41546660_1_1_1_1,00.html#contents
[18] Jacque Gaillard, IRD, *Measuring Research and Development in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, Science, Technology and Society 15:1 (2010). Page 86.
[19] Jacque Gaillard, IRD, *Measuring Research and Development in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, Science, Technology and Society 15:1 (2010). Page 102.

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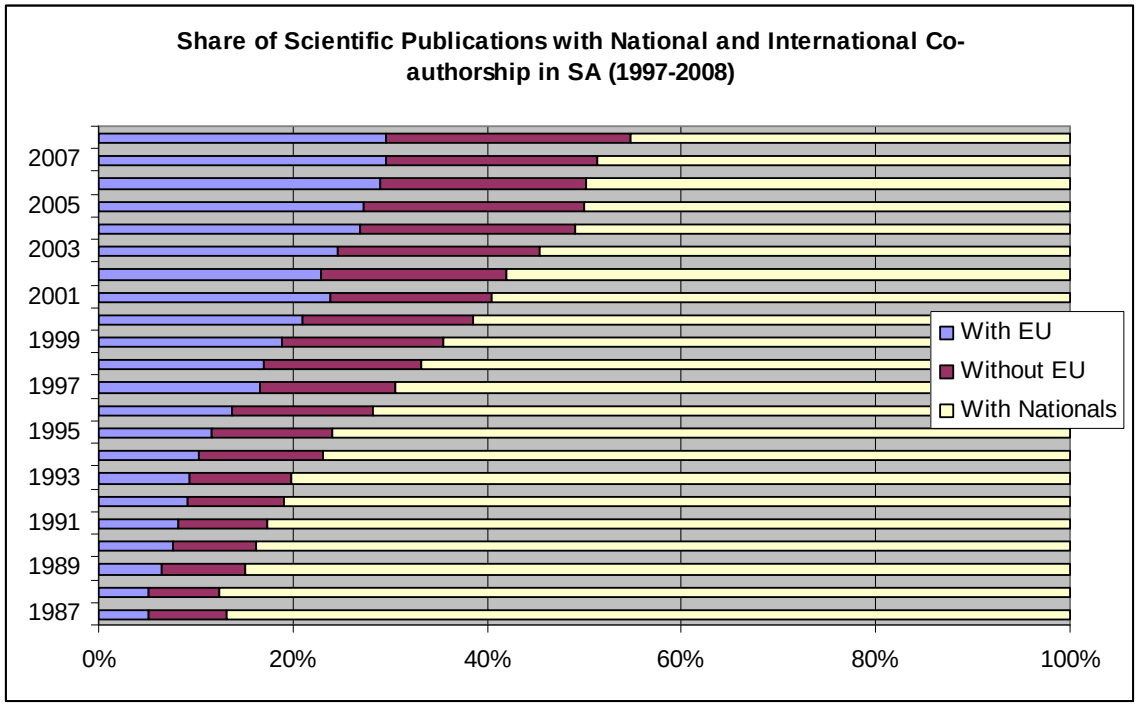

Thomson Reuters, IRD analysis

TABLE 1

ARTICLES WITH INTERNATIONAL CO-AUTHORSHIP IN SOUTH AFRICA (1987-2008)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
With EU	191	186	203	224	249	273	289	313	380	415	514	537
Without EU	303	266	266	247	276	293	320	395	396	441	434	505
With Nationals	3260	3189	2626	2433	2496	2392	2451	2356	2463	2171	2155	2103

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
With EU	514	537	620	669	789	782	820	946	994	1164	1293	1161
Without EU	434	505	546	560	552	650	699	781	835	852	954	986
With Nationals	2155	2103	2127	1955	1978	1980	1824	1796	1824	1997	2126	1776

Thomson Reuters, IRD analysis

The analysis of co-publications with European countries and European research institutions will be further developed in D4.1 (Monitoring of EU participation in South African programmes).

International cooperation and openness of the system

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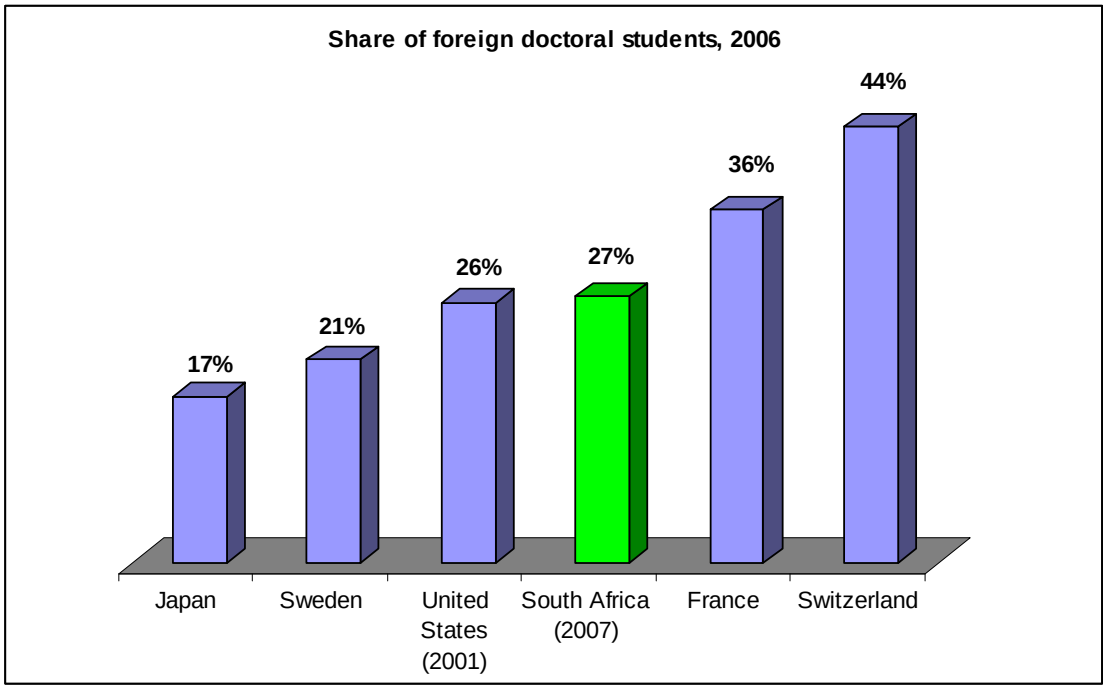
Different indicators confirm the increasing internationalisation of the South African S&T system.

In 2007, foreign students represent more than 7% of enrolment in public South African universities[20]. **27% of doctoral graduates in 2007 were non South Africans** and among them 18% came from other African countries[21]. The percentage of foreign doctoral graduates in South Africa in 2007 is superior to the share of foreign doctoral students (2006) in Japan (16.8%), Sweden (20.6%) and United States (26.3%)[22].

FIGURE 12



[20] Moodie A., *SOUTH AFRICA: New funds to boost PhD production*, University World News, 12 December 2010. URL: http://www.universityworldnews.com/article.php?story=20101210212934604

[21] ASSAF, *The PhD Study*, 2010, P. 129.

[22] OECD, *Science, Technology and Industry Scoreboard 2009*, http://www.oecd-ilibrary.org/sites/sti_scoreboard-2009-en/04/09/index.html?contentType=/ns/Book,/ns/StatisticalPublication&itemId=/content/book/sti_scoreboard-2009-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html

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Sources: OECD, Science, Technology and Industry Scoreboard 2009

ASSAF, The PhD Study

According to *The PhD Study* published by the Academy of Sciences of South Africa (ASSAF, 2010), **the number of non South African doctoral graduates has increased significantly from 86 in 2000 to 338 in 2007**. The same report indicated that a third of non South-African doctoral students intend to stay in South Africa after graduation, especially students from the SADC[23].

The *Open Doors Report on International Educational Exchange 2010*[24], which evaluates annually the destination of Americans studying abroad, informed that **South Africa is among the 25 top destinations of American students** with an increase of 12% compared to the previous year.

The openness of the South African S&T system is also demonstrated by the increasing percentage of co-publications with international co-authorship, especially with Europe, as presented above in Table 1. Co-publications produced only with national co-authorship dropped from 87% in 1987 to 45% in 2008. At the same time, **co-publications with Europe increased from 5% to 30%** of articles with co-authorship and co-publications with other countries passed from 8% to 25%[25].

In addition, **11.16% of South African applications filed under the Patent Co-operation Treaty (PCT) involved international co-invention**. This percentage is above the OECD average (7.7%) and it is still over the EU27 (10.82%) and USA (10.84%) percentage of PCT applications with co-inventions (Figure 13).

As an interesting indicator, it was established by the OECD[26] that among the South African patent applications filed under the Patent Co-operation Treaty (PCT) that involved international co-invention (PCT patent applications with co-inventors located abroad), **Europe represent the most important partner in co-inventions among the three major regions** (USA, Europe, Japan) with 5.19% in comparison with the United States (3.2%) and Japan (0.07%). Figure 13 shows this comparison.

FIGURE 13

[23] Academy of Sciences of South Africa (ASSAF), *The PhD Study*, September 2010

[24] Report published annually by the Institute of International Education (USA) with funding from the U.S. Department of State's Bureau of Educational and Cultural Affairs.

[25] Jacque Gaillard, IRD, *Measuring Research and Development in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, Science, Technology and Society 15:1 (2010). Page 86.

[25] Idem, Page 98.

[26] OECD, *Science, Technology and Industry Scoreboard 2009*, URL: http://www.oecd-ilibrary.org/sites/sti_scoreboard-2009-en/01/10/index.html?contentType=/ns/Book,/ns/StatisticalPublication&itemId=/content/book/sti_scoreboard-2009-en&containerItemId=/content/serial/20725345&accessItemIds=&mimeType=text/html

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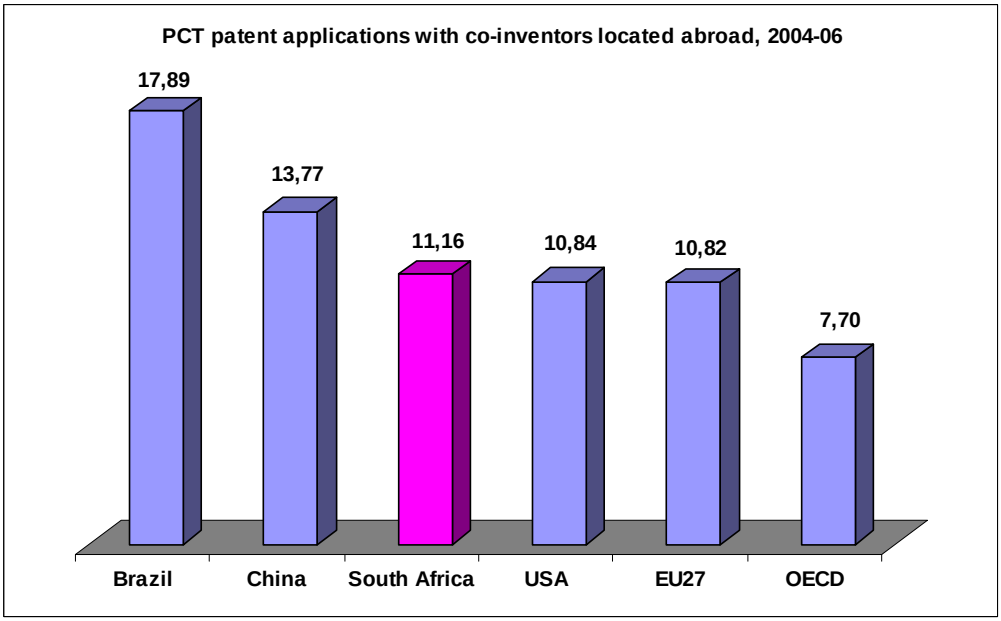

OECD, Science, Technology and Industry Scoreboard 2009

Compared to the BRIC (Brazil, Russian Federation, India, China), South Africa has the highest percentage of co-inventions registered with Europe (47%) followed by Brazil (43%). On the contrary, the percentage of co-inventions with Europe is considerably less important for China and India where the co-inventions with the United States represent 48% and 63% of total co-inventions with partners located abroad[27]. See Figure 14.

[27] OECD, *Science, Technology and Industry Scoreboard 2009.*

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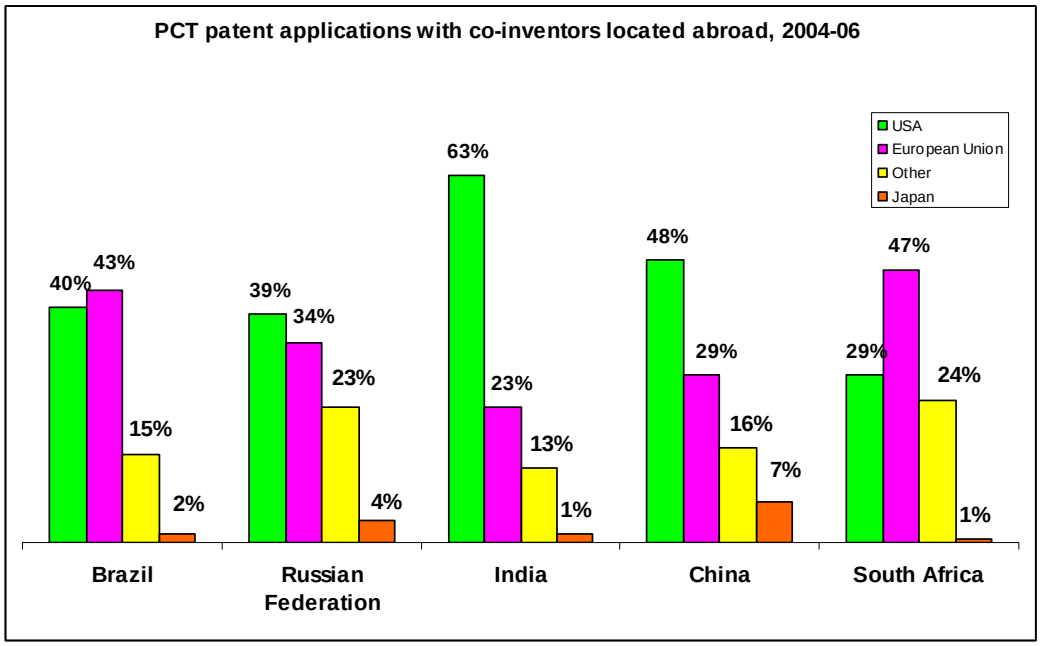
FIGURE 14



OECD, Science, Technology and Industry Scoreboard 2009

An analyses of co-publication and co-inventions with European partners will be integrated in - report D4.1 (Monitoring of the European participation in South African S&T programmes).

Regional impact

As a result of the openness of South African universities, the country is playing a dynamic role in Africa, especially in the Southern region, contributing to the capacity building of students from other African countries.

South Africa is the **second among the Top 10 host countries for African students**[28]. In fact, South Africa (which hosts 55 405 African students in 2008) is only behind France (104 823 African students) and ahead United States (33 924) and UK (30 884) among others. In the period between 2003 and 2008 the number of African students in South Africa increased up to 29, 2%.

It should be noted that there is a high representation of non-South African doctoral graduates among the black doctoral graduates. In 2007, 338 of the 405 black doctoral students in South Africa were non South African. In the same year, 27% of the doctoral students in South Africa were from abroad. Among them 9% comes from the Southern Africa Development Community (SADC[29]) and 9% comes from other African Countries.

[28] Campus France, International Student Mobility: Key Figures, 2010

[29] The SADC SADC has a membership of 15 Member States: ; Angola, Botswana, Democratic Republic of Congo (DRC), Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, United Republic of Tanzania, Zambia and Zimbabwe.

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For European researchers and institutions this can be an attractive factor since their cooperation with South African partners can have an impact at the regional level. However, the appeal of South Africa for high skilled students from other African countries can lead to brain drain in least developed African countries.

These questions will be further explored in Report 2.3.

4.3 Research and innovation performers within the National Innovation System

In this part, the research and innovation performers are described according to the classification of the OECD, also used by the Human Science Research Commission (HSRC) in charge of the National Survey of Research and Experimental Development in South Africa.

4.3.1 Business enterprise sector

58.6 % of the R&D expenditure in South Africa (2008/09)[30]

39.7 % of R&D personnel (FTE) [31]

31.30% of researchers (FTE) = **6 047.5** researchers (FTE) [32]

The business enterprise sector is the highest R&D performer in South Africa in terms of R&D Expenditure: the private sector's of the R&D expenditure is 58.6%, and has been increasing in the past few years. It increased from 8 243 millions Rands in 2005/06 to 12 332 million Rands in 2008/09.

The business enterprise expenditure in R&D (BERD) is funded essentially by private companies (67.62%) but also by the government (20.81%) and foreign sources (11.32%). The BERD is allocated for the bulk to Experimental research (62.7%)[33].

The *OECD Science, Technology and Industry Outlook 2010* emphasises the increase in the country's trade in high technology by 4 percentage points between 1997 and 2007. In addition, it pointed out that during 2002-04, 61% of firms in South Africa engaged in non-technological innovations, i.e. marketing and organisational innovations that go along with a new production techniques or the commercialisation of new products. Finally the report highlighted that for the same period, 21% of firms introduced new-to-market product innovations, being above the OECD average.

[30] National Survey of Research and Experimental Development 2008/09 Fiscal Year, page 21.
[31] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 14.
[32] Idem, page 8.
[33] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 56 and 57.

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4.3.2 Higher education sector

19.9 % of the R&D expenditure in South Africa (2008/09)[34]

36.7 % of R&D personnel (FTE) [35]

51.75% of researchers (FTE) = **9 999.4** researchers (FTE) [36]

The higher education sector consists of more than half of researchers full-time equivalent (FTE) and 69.23% of researchers' headcount in South Africa (27 752 researchers among the 40 084 researchers' headcount). However, the share of R&D expenditure in this sector (19%, 4 191 millions rands) is around 30% lower than in the Business enterprise sector (58.6%)[37].

Universities perform an important activity of basic research (47.2% of the total universities' expenditure in R&D), but also applied research (34.9%). Unlike business research, experimental research seems to be less important in Universities with only 17.9% of their R&D expenditure.

The R&D expenditure of the higher education sector is funded essentially by the government (76.99%) but the higher education sector also receives funding from the business sector (10.83%), foreign partners (9.7%) and others (2.38%).

The R&D personnel FTE – researchers, technicians and other personnel directly supporting R&D - in the higher education sector (36.7%) is slightly lower compared to the business sector R&D total personnel (39.7%)[38].

The higher education sector consists of 23 Universities classified into three groups:

Traditional universities

University of Cape Town: http://www.uct.ac.za/

University of Fort Hare: http://www.ufh.ac.za/

University of the Free State: http://www.ufs.ac.za/

University of KwaZulu-Natal: http://www.ukzn.ac.za/Homepage.aspx

University of Limpopo: http://www.ul.ac.za/

North-West University: http://www.nwu.ac.za/

University of Pretoria: http://web.up.ac.za/

[34] National Survey of Research and Experimental Development 2008/09 Fiscal Year, Page 21
[35] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 8.
[36] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 8.
[37] National Survey of Research and Experimental Development 2008/09 Fiscal Year, page 23
[38] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 37

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Rhodes University: http://www.ru.ac.za/

University of Stellenbosch: http://www.sun.ac.za/

University of the Western Cape: http://www.uct.ac.za/

University of the Witwatersrand: http://web.wits.ac.za/

Comprehensive universities

University of Johannesburg: http://www.uj.ac.za/EN/Pages/home.aspx

University of South Africa: http://www.unisa.ac.za/

Nelson Mandela Metropolitan University: http://www.nmmu.ac.za/Default.asp?bhcp=1

University of Venda: http://www.univen.ac.za/

Walter Sisulu University for Technology and Science: http://www.wsu.ac.za/

University of Zululand: http://www.uzulu.ac.za/

Universities of technology

Cape Peninsula University of Technology: http://www.cput.ac.za/

Central University of Technology: http://www.cut.ac.za/

Durban University of Technology: http://www.dut.ac.za/site/default.asp

Mangosuthu University of Technology: http://www.mut.ac.za/

Tshwane University of Technology: http://www.tut.ac.za/

Vaal University of Technology: http://www.vut.ac.za/new/

As explained below, South African universities receive a huge number of international students each year. Universities present are greatly attractive to European researchers and they are a key entry point for scientific cooperation with this country (this aspect will be further discussed in the D2.3). Many South African universities are world-class and three of them are included in the Academic Ranking of World Universities 2010:

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TABLE 2

ACADEMIC RANKING OF WORLD UNIVERSITIES, 2010[39]

Institution	National Rank	Regional Rank (Africa)	World Rank
University of Cape Town	1	1	201-300
University of the Witwatersrand	2	2	301-400
University of KwaZulu-Natal	3	3	401-500

A characteristic of the South African higher education sector is the concentration of resources and doctoral students in a small number of universities. 5 of the 24 universities presented in the report 2007/08 of the HSRC (Cape Town, Witwatersrand, KwaZulu-Natal, Pretoria and Stellenbosch) concentrate more than 65% of the total universities' R&D Expenditure, more than 50% of researchers and 56% of total doctoral students. The table 3 shows the percentage of R&D expenditure, the number of researchers and doctoral students for 24 universities.

TABLE 3

UNIVERSITIES R&D EXPENDITURE, RESEARCHERS AND DOCTORAL STUDENTS, 2007/08

	% of total Universities R&D expenditure	Researchers (headcount)	Doctoral students (headcount)
Universities			
University of Cape Town	15,79%	2321	1203
University of the Witwatersrand	15,50%	1630	1105
University of KwaZulu-Natal	12,85%	1910	1162
University of Pretoria	11,48%	1996	1585
University of Stellenbosch	9,99%	1034	1001
North-West University	6,17%	1328	866
University of Johannesburg	4,12%	683	565
University of the Free State	3,93%	193	632
University of South Africa	3,47%	1106	771
Nelson Mandela Metropolitan University	2,69%	444	346
Rhodes University	2,62%	291	256
University of the Western Cape	2,47%	516	353
Tshwane University of Technology	1,93%	509	146
University of Limpopo	1,29%	745	154
Universities of Science and Technology			
Cape Peninsula University of Technology	1,17%	171	90
Durban University of Technology	0,93%	299	53
Walter Sisulu University for Technology and Science	0,83%	526	13
Central University of Technology	0,74%	134	59
University of Zululand	0,59%	231	151
Vaal University of Technology	0,52%	287	29
University of Fort Hare	0,31%	292	155
University of Venda	0,24%	278	49

[39] Academic Ranking of World Universities http://www.arwu.org/ARWU2010_2.jsp

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	% of total Universities R&D expenditure	Researchers (headcount)	Doctoral students (headcount)
Mangosuthu University of Technology	0,11%	37	0
Private universities			
Monash University	0,27%	47	0

Report D2.3 will present a list of departments of South African universities classified by research field.

4.3.3 Research Councils

15.5 % of the R&D expenditure in South Africa (2007/08)

16.1 % of R&D personnel (FTE)

11.9% of researchers (FTE) = **2 300** researchers (FTE) [40]

The research councils funded substantially by the responsible Ministry, are research institutes that perform sector specific-research and, in some cases, act as a funding agency (e.g. the Medical Research Council and the National Research Foundation (NRF)). They may also be responsible for coordinating and setting research priorities that can be considered at the policy level[41].

The NRF is included among Research Councils given the fact that this institution manages the National Research Facilities (described below and in D2.3). Since the NRF manages these facilities, it appears within the National Innovation System not only as an "Agency" but also as a "Research and Innovation performer": 91 researchers[42] are part of the NRF's staff and 446 postgraduates were trained within the facilities[43].

There are in total nine (10) Research Councils in South Africa:

- Africa Institute of South Africa (AISA): www.ai.org.za
- Agricultural Research Council (ARC): www.arc.agric.za
- Council for Scientific and Industrial Research (CSIR): www.csir.co.za
- Council for Geoscience (CGS): www.geoscience.org.za
- Human Sciences Research Council (HSRC): www.hsrc.ac.za
- Medical Research Council (MRC): www.mrc.ac.za
- Council for Mineral Technology (Mintek): www.mintek.co.za
- South African Bureau of Standards (SABS): www.sabs.co.za
- National Research Foundation (NRF): www.nrf.ac.za
- Water Research Commission (WRC): www.wrc.org.za (WRC is included as the 10th research council as their mandate is basically to facilitate, coordinate, and fund water research as well as build capacity within the water sector).

[40] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 8.
[41] OCDE, *Review of Innovation Policy: South Africa*, 2007.
[42] National Research Foundation (NRF), *Annual Report*, 2010, Page 88.
[43] National Research Foundation (NRF), *Annual Report*, 2010, Page 39.

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Research Councils account for 15.5% of the R&D Expenditure in South Africa with 11.9% of researchers FTE. Applied research represents 45.6% of the Research Councils' expenditure[44] while basic research accounts for 27.9% and experimental research for 26.6%. This shows the place for the Science Councils within the Research and Development value chain: they work across all the value chain with an important role in development and technology or knowledge transfer. Compared to other sectors, the Research Councils are between the business sector -which allocate an important share of the R&D expenditure to experimental research - and the universities - for which the basic research represents the most important activity.

Main Research Councils and the National Research Facilities managed by the NRF will be described below as well as in the report concerning the opportunities for European researchers' participation in South African programmes (D2.3).

4.3.4 Government

6.2 % of the R&D expenditure in South Africa (2007/08)[45]

6.2 % of R&D personnel (FTE) [46]

3.9% of researchers (FTE) = **757.6** researchers (FTE) [47]

According to the HSRC the South African government is classified as "the national, provincial and local departments; government research institutes; and museums".

With 3.2% of total researchers, this sector performs 6.2% of the national R&D expenditure. This sector is funded essentially by government contribution including own funds, grants and contracts (74.5%. Own funds represent 63.1%). Some government research institutes are listed under the research councils above.

As explained above, some fields of research are predominant in the government R&D performance: Social Sciences and Humanities (24.3%), Agricultural Sciences (18.1%), Medical and Health Sciences (15.1%) and Earth Sciences (14%).

4.4 The strength and weaknesses of the South African S&T System

The first official innovation survey, covering the period 2002-2004 and commissioned by the DST, found that South Africa is not a "technology colony". The South African Innovation Survey 2005, commissioned from the HSRC by the DST, revealed that the proportion of South African companies engaged in innovative activities compares favorably with the EU average. Key facts presented above show this trend.

Yet not a lot of innovation is publicly funded. This is not only true of South Africa, but also of most OECD countries, as presented above. The report on the survey reads: "Despite governments' intention of stimulating innovation through funding, it is

[44] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 58.
[45] HSRC, National Survey of Research and Experimental Development: 2007/08, Page xii.
[46] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 8.
[47] HSRC, National Survey of Research and Experimental Development: 2007/08, Page 8.

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apparent that public funds do not have much penetration into the activities of innovative enterprises in most countries".

South Africa's prospects for improved competitiveness and economic growth rely to some extent on science and innovation. In addressing some of the issues mentioned above, the DST developed a Ten-Year Innovation Plan (see section 2). The Ten-Year Innovation Plan is a high-level presentation of the principle challenges identified by the DST looking into where South Africa needs to be a decade from now through the utilisation of science and technology. The core projection for 2018 are summarised as South Africa's "grand challenges" in S&T.

The government's broad developmental mandate can ultimately be achieved if further steps on the road to becoming a knowledge-based economy. Transformation in this direction will shift the proportion of national income derived from knowledge-based industries, the percentage of workforce employed in knowledge-based jobs and the ratio of firms using technology to innovate. This will be driven through the following four elements:

- Human capital development,
- Knowledge generation and exploitation,
- Knowledge infrastructure, and
- Enablers to address the "innovation chasm" between research results and socioeconomic outcomes.

South Africa, together with other African Heads of State set a target of investing 1%GDP into science and technology and despite the challenges that came with recession; South Africa was at 0.92% GDP in 2008/2009.

South Africa's investment in science and technology is not ideal, but given the countries other pressing social issues (poverty, unemployment, etc) most of the countries resources are thinly spread. There is however, strong political support for science and development as well as growing recognition of the roles science can play in solving some of these challenges.

In order for SA to succeed in meeting its scientific objectives there are a number of prerequisites which are state-of-the-art infrastructure, modern laboratories and research institutes and an NSI that is linked to the global scientific community and appropriate funding agencies. This will also requires maximization of existing international collaborations.

5. South African Research and Innovation (R&I) Programmes

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5.1 Introduction to South African R&I Programmes

This section of the report covers South African research and innovation programmes that are funded by the Department of Science and Technology (DST), agencies reporting to DST, science councils of other South African government departments.

To respond to its socio-economic needs, South Africa has established funding programmes which are focused on innovation and research excellence. A large part of the research funds are managed by the National Research Foundation (NRF) which administers the largest research and development investment in the country.

Other programmes are funded by South African government, through the Department of Water Affairs' Water Research Council, Department of Health's Medical Research Council, Department of Energy's South African National Research Institute, to mention a few.

5.2 Methodology

In compiling this report, a desktop study of South African Research and Innovation

Programmes was conducted, mostly relying on scarce information from the various

organisations' websites and publications. Currently a single database of research and innovation programmes does not exist in South Africa which is a challenge with respect to information gathering.

5.3 Programmes funded by the South African Department of Science and Technology and agencies of the Department

Research initiatives that are currently funded by DST are discussed below. Some of these, like the Technology Innovation Agency, have just recently been established.

5.3.1 Technology Innovation Agency

The Technology Innovation Agency (TIA) is set up as a public entity with the aim to enhance the countries capacity to translate a greater proportion of local research and development into commercial technology products and services. The ultimate goal of the TIA is to use South Africa's science and technology base to develop new industries, create sustainable jobs and help diversify the economy away from commodity exports towards knowledge based industries equipped to address modern global challenges. TIA currently involves integration of existing DST entities which are:

- Tshumisano;
- The Advanced Manufacturing Technology Strategy

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- Biotechnology Regional Innovation Centres; and
- The Innovation Fund

Tshumisano

Tshumisano Trust is the implementation agency for the Department of Science and Technology. The Trust provides technical and financial support to Technology Stations, which are based at (UoT) Universities of Technology.

Tshumisano through the TSP (Technology Stations Programme), experienced significant growth in enriching the Research and Development (R&D) of UoT (Universities of Technology) and in satisfying the needs of SME's, which are the over-aching goals of the Programme. The Technology Stations are world class service providers of Technology services to SME's,which are provided by technical experts with the requisite skills and expertise. The experts range from Professors, Lectures, Postgraduates and External Consultants, thus enriching the R & D of the host institution as well as solving technology based problems experienced by SME's.

The Advanced Manufacturing Technology Strategy

The Advanced Manufacturing Technology Strategy (AMTS) is a programme managed by the Technology Innovation Agency and funded by the Department of Science and Technology. The AMTS currently focuses on the automotive and aerospace industries and relies on collaboration between industry, academia, and the science councils. The AMTS Implementation Unit has the following objectives:

- Technology – development of technology platforms that increase current and create new competitive advantages;
- Partnerships – development of smart partnerships to ensure the development and uptake of SA technologies in the global arena; and
- Human Capital Development – development of relevant scarce skills and development of students for industry readiness.

The Implementation unit utilises a number of programmes and initiatives to achieve the set objectives through the following:

(i) The Light Materials Flagship Programme seeks to increase competency and capacity in South Africa in the R&D of composites and light metals. The projects focus on the identification of existing technologies and the development of new materials and manufacturing processes.

(ii) The Electronics Flagship Programme aims to address the increasing need for competency and capacity in autonomous sensor diagnostics, sensor fusion and networking. Central to this programme is the development of new, miniaturised sensors with the ability to be integrated into composites. The AMTS seeks to expand into the area of micro electro-mechanical systems and nano-technologies that exploit the need for smaller, more compact and faster responses.

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(iii) The Advanced Production Flagship Programme aims to support the development of affordable automation and control systems to increase efficiency, while reducing cost, in manufacturing environments. It includes future focus on digital or micro-manufacturing to ensure that South Africa is well positioned to compete in the manufacturing sector of tomorrow.

(iv) AMTS FabLabs are hands-on laboratories with advanced desktop manufacturing equipment that allow the building of “just about anything” from inexpensive and readily available materials. Skills created include design, fabrication, testing and debugging, monitoring and analysis and documentation of the process.

(v) Advanced Manufacturing Technology Laboratories (AMTLs) are world-class facilities that stimulate innovation through the design, development and prototyping of new products, and the development and transfer of relevant skills to support industry. The centres are created as resources for the entrepreneur, increasing development and use of local technologies, facilitating transfer of higher technology to industry and developing relevant skills.

(vi) Specific HCD interventions include The AMTS Programme for Industrial Manufacturing Excellence (PRIME), designed to enhance the competitiveness of industry by optimising manufacturing processes, introducing new manufacturing technologies and cutting costs of operation or production in SA manufacturing firms, while building critical knowledge and capacity; and the AMTS Leading Expert Access Programme (LEAP), enabling the dissemination of international expertise to South African industry and academia.

Biotechnology Regional Innovation Centres

The government adopted the Biotechnology Strategy in 2001, which gave birth to the establishment of the Biotechnology Regional Innovation Centres (BRICs). The aim was to provide financial and other support services appropriate to biotechnology projects that will be able to advance the development and provision of African biotech goods and services and biotech start-up companies. These include human and animal health, biopharmaceuticals, industrial bioprocessing, mining biotechnology, bioinformatics and plant biotechnology. The three BRICS that have since been established and located in the these provinces, Gauteng, Kwa-Zulu Natal and the Western Cape specialise in human and animal health, biopharmaceuticals, industrial bio-processing, mining biotechnology, bioinformatics and plant biotechnology. Each BRIC is comprised of an incubator, technology platform, and research programme.

The Gauteng BRIC known as BioPad covers mining, environment, industrial and animal health biotechnology. The Kwa-Zulu Natal which is called LifeLab is focused on human health which includes infectious diseases such as (HIV/AIDS, TB and Malaria), bio-processing, with a plant biotechnology focal area to contribute to plant biotechnology. The Western Cape known as Cape Biotech looks into drug delivery, combination and conjugate vaccines, and point of care diagnostics

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Innovation Fund

Working hand-in-hand with the government, the Innovation Fund aims to improve the lives of South Africans by helping anyone with ideas for technological innovation to enter the business world and contribute to its positive growth. This exciting initiative from the Department of Science and Technology was set up in 1999 and is managed by the National Research Foundation. The Innovation Fund is mandated to promote technological innovation through investing in late-stage research and development, Intellectual Property protection and commercialisation of novel and inventive South African technologies.

The reason for the Innovation Fund's existence is to promote the economic competitiveness of South Africa. This is done by investing in technological innovations and providing support to South Africans seeking Intellectual Property protection with the aim of establishing new enterprises and the expansion of existing industrial sectors to the benefit of all South Africans.

(a) Investment Instruments

The main funding instruments of the Innovation Fund are managed by specialist business units that service the needs of inventors, innovators and business start-ups.

(b) Research and Development

This unit consists of the Technology Advancement Programme (TAP) and Missions in Technology (MiTech). TAP offers public venture capital support for projects in the late stages of research and development (i.e. where proof-of-science already exists) and are open to higher education institutions, science councils, small and medium enterprises and consortia consisting of these entities.

MiTech invest in public-private partnerships aiming to develop technological platforms that will improve the entrepreneurial competitiveness of South Africa. The co-investments are with industry players on projects identified and driven by that industry.

(c) Commercialisation Office

The instrument of the Commercialisation Office is the Seed Fund**.** The Seed Fund invests in early commercialisation or business start ups so as to take a novel and inventive technology that is at the prototype stage through to the market. The Commercialisation Office also engages in strategy formulation, development of commercial route to market, due diligence and deal-structuring on behalf of the Innovation Fund.

(d) Intellectual Property Management Office (IP Support)

The Intellectual Property Management Office manages the Innovation Fund's Patent Support Funds which are instruments targeted at SMEs and techno-entrepreneurs.

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These instruments are meant to assist with the costs associated with Intellectual Property support and protection.

5.3.2 National Research Foundation

The National Research Foundation (NRF) which administers most of the DST's funding, also manages the following research initiatives:

South African Research Chairs Initiative

The South African Chairs Initiative (SARChi) was created to make interventions in knowledge and human resources base that will contribute towards helping universities realise their strategic research plans, and the initiative is intended to provide a base on which to consolidate and extend excellence in research. Although the programme aims to attract South African and other international research expertise from abroad, universities may nominate current staff members for Research Chairs. The objectives of SARChi are as follows:

- To increase the number of world-class researchers in South Africa;
- To retain or attract qualified research scientists to the higher education sector in order to help reverse the decline in research outputs, focus and capacity;
- To improve the capacity of institutions to generate and apply new knowledge;
- To stimulate strategic research across the knowledge spectrum;
- To create research career pathways for quality young and mid-career researchers that address historical racial, gender and age imbalances; and
- To improve and accelerate the training of highly qualified personnel through research.

It is envisaged that the initiative will make South Africa competitive in the international knowledge economy based on its existing and potential strength.

Centres of Excellence

The National Research and Development Strategy identifies the need to create 'centres and networks of excellence' in science and technology, including in the social sciences, as a key component of the human capital and transformation dimensions of government policy. It is envisaged that such centres will stimulate sustained distinction in research while simultaneously generating highly qualified human resource capacity in order to impact meaningfully on key national and global areas of knowledge.

The seven centres that passed the stringent test are:

- The Centre of Excellence in Biomedical TB Research
- The Centre of Excellence in Invasion on Biology
- The Centre of Excellence in Strong Materials
- The Centre of Excellence in Birds as keys to Biodiversity Conservation at the Percy FitzPatric Institute

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- The Centre of Excellence in Catalysis
- The Centre of Excellence in Tree Health Biotechnology at
- The Centre of Excellence in Epidemiological Modelling and Modelling Analysis

While recognising that the Department of Science and Technology may from time to time create additional centres of excellence, in order to meet its own specific strategic objectives, the National Research Foundation has been mandated to implementer this initiative.

(a) Centre of Excellence in Biomedical TB Research

Research at this Centre includes all aspects of TB diagnosis, testing & treatment. This includes the molecular and clinical point of view as well as genomic and proteomic studies of the TB Bacillus and its interaction with humans. With the third highest incidence rate and second highest mortality rate in the world, South Africa is facing a tuberculosis (TB) problem of such magnitude that this disease has been declared a national health emergency.

The rampant HIV co-epidemic plaguing this country has exacerbated the problem enormously. Although some improvements could be made in controlling TB through reform of existing control programmes, it is widely acknowledged that a quantum leap in the quality of tools for the diagnosis, prevention and treatment of TB will be required if there is to be any hope at all of eradicating this devastating disease.

(b) Centre of Excellence in Invasion Biology

This Centre is concerned with the biology of invasive species. Special attention is paid to the impact that invasive species have on southern Africa's biodiversity, agriculture and ecotourism. The key issues and questions that are being addressed are the following:

- Invasions and diversity - What are the determinants of invasion success and how do these vary through space?
- Invasions and ecosystem function - What are the impacts of invasive alien species and the consequences of remediation attempts?
- Invasions and ecosystem services - How can human resource requirements and conservation be integrated into a dynamic landscape planning framework that will enable long-term persistence of diversity whilst maintaining ecosystem services on which humans rely?
- Invasions and policy formulation - Ensuring that scientific information is made available for rational decision-making regarding invasive species, the actions to be taken to address invasions, particularly in a local context and the prioritisation of such actions given a well-developed set of alternative scenarios.

(c) Centre of Excellence in Strong Materials

This Centre studies materials such as hard metals, metal alloys, metal oxides, ceramics, diamond and diamond-like materials and composites including carbon

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nanotubes. Strong materials retain their distinctive properties under extreme conditions and thus have wide applications in the manufacturing and mining industries in South Africa and abroad.

It is extremely important to improve the properties of currently used materials for higher efficiency and cost reduction. In the longer term, the burgeoning fields of advanced strong materials being newly synthesised or in the process of further development are of great potential commercial value. This Centre will address both objectives and its various specific programmes fall within an area identified as being of major importance in the Advanced Manufacturing Technology Strategy of the South African Government.

(d) Centre of Excellence in Birds as Keys to Biodiversity Conservation at the Percy FitzPatrick Institute

This Centre acknowledges the outstanding contribution made by the Percy FitzPatrick Institute to the understanding of, amongst other things, biodiversity conservation. The research programme will be based on two inter-linked themes, understanding and maintaining biodiversity. The first investigates the composition and structure of biodiversity, the processes responsible for its generation and how relationships between organisms and their environments influence the form and functioning of biological systems.

The second builds on the strong theoretical and empirical foundation provided by the first to assess, predict and manage human impacts, with emphasis on understanding dynamic links that lead to biodiversity loss, developing effective strategies to stem this loss and discovering ways to use components of biodiversity sustainability to the benefit of South Africa.

(e) Centre of Excellence in Catalysis

Research at this Centre focuses on chemical catalysis (homo- and hetero-) mainly for the conversion of gas to liquid fuels and for downstream processing aimed at adding value to bulk chemicals. With the manufacturing sector being the largest contributor to South Africa's GDP and with chemical manufacturing the largest single contributor to the South African manufacturing sector, chemical processing is recognised as a distinct field for targeted innovation initiatives as emphasised in the National Research and Development Strategy - and catalysis lies at the heart of 90 % of all chemical transformation processes

(f) Centre of Excellence in Tree Health Biotechnology

This Centre acknowledges the outstanding contribution made by the Forestry and Agriculture Biotechnology Institute (FABI) to the field of biotechnology as applied to trees. This Centre will focus on the field of tree health, which is of tremendous importance, both nationally and internationally, yet which is not particularly well known outside the agricultural and forestry domain.

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Other than being highly relevant to South Africa, a country that depends heavily on agriculture and forestry, this field has the attraction of being strongly multidisciplinary. This is because the environment, the inherent nature of trees themselves and a wide range of organisms which impact negatively upon them, crucially affect tree health. Thus the fields of silviculture, agronomy, genetics, plant pathology, microbiology, entomology, molecular genetics and others are all important and relevant to this domain. The proposed Centre will seek to integrate research in these fields.

(g) Centre of Excellence in Epidemiological Modelling and Analysis

Research at this Centre is dedicated to modelling of disease transmission and progression, focusing on South Africa's major health challenges.

Epidemiology is a quantitative, interdisciplinary science using mathematical modelling and dynamical analysis to provide patterns of disease progression, in space and time, at population and within-hosts level, to identify the principal causes of diseases and to provide health policy makers with a sound scientific basis for their decisions. The research projects are all fuelled by the need to alleviate the effects of major diseases currently affecting people in South Africa, and in Africa as a whole, in particular the HIV/AIDS pandemic. The projects and key issues being addressed are:

- Modelling and analysis of data on HIV/TB interaction and development of a comprehensive TB/HIV database.
- Modelling of the impact of male circumcision on HIV transmission.
- Modelling of the dynamics of HIV virus on the cellular level.
- Estimation of HIV incidence from cohort studies and cross-sectional analysis.
- Vaccine modelling and effect of rolling-out ARV therapy.
- Mathematical modelling of epidemics in populations and modelling of malaria control.

5.4 Programmes funded by the other government departments

5.4.1 South African AIDS Vaccine Initiative

The South African AIDS Vaccine Initiative (SAAVI) was established in 1999 and has become a lead programme of the Medical Research Council (MRC). The main funding contributions are from the Department of Science and Technology, Department of Health, Eskom, and the Impala Platinum. SAAVI was established to co-ordinate the research, development and testing of AIDS vaccines in South Africa. SAAVI is based at the MRC and is working with key national and international partners to produce an affordable, effective and locally relevant AIDS vaccine in as short a time as possible.

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The SAAVI immunology laboratory infrastructure operates according to the highest international standards and is an endpoint laboratory for both SAAVI and other international agencies.

International collaboration is essential to fast track the development of an HIV/AIDS vaccine for South Africa and the rest of the world, and SAAVI values these collaborative ventures. Although closely collaborating with these and other organisations, SAAVI operates independently allowing it to pursue its own specific goals and maintain its focus on the needs of the southern African region.

5.4.2 Medical Research Council

The Medical Research Council (MRC) of South Africa is responsible for medical research.

MRC research priorities

The MRC's research prioritisation, research portfolio, and resource allocation are based on three major inputs:

- The burden of disease and health profile of South Africa as outlined by the Combined Approach of the Ad Hoc Committee on Health Research for Development
- Strategic priorities in health and development in South Africa as identified by such initiatives as South Africa's Foresight Exercise, South African Government programmes and the NEPAD Secretariat
- The need for the training and capacity building in health research.

The MRC’s high-level research strategy is based on the above three key drivers for health research priorities in South Africa and the region. The MRC Research Units, Groups and Lead Programmes have been listed according to the health priorities of South Africa.

National collaborative research programmes (NCRPs) and collaborative research groups (CRGs) are under development, selected from topics within these areas:

- HIV and AIDS (including SAAVI)
- Tuberculosis
- Malaria
- Cancer
- African Traditional Medicine and Drug Discovery
- Genomics, proteomics and computational biology
- Nutrition
- Crime, violence and injury
- Women, maternal and child health
- Cardiovascular and metabolic diseases
- Mental health and functional disorders

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- Policy and implementation

5.4.3 Technology and Human Resources for Industry Programme

The Technology and Human Resources for Industry Programme (THRIP) is funded by the South African department of Trade and Industry (**the dti**)**.** Its aim is to boost South African industry by supporting research and technology development, and by enhancing the quality and quantity of appropriately skilled people.

THRIP brings together the best of South Africa's researchers, academics and industry players in funding partnerships that enable participants to improve the quality of their products, services and people. In 12 years, it has become a powerful formula for stimulating innovation in South Africa and innovation that leads to competitiveness and competitiveness that leads to growth and development.

The objectives of THRIP are as follows:

- To increase the number and quality of people with appropriate skills in the development and management of technology for industry.
- To promote increased interaction among researchers and technology managers in industry, higher education and science, engineering, technology, and innovation (SETI), with the aim of developing skills for the commercial exploitation of Science and Technology promoting the mobility of trained people among these factors.
- To stimulate industry and government to increase their investment in research and technology development, technology diffusion and the promotion of innovation.

5.4.4 Technology for Women in Business

Technology for Women in Business (TWIB) is an initiative funded by **the dti** aimed at enhancing the accessibility of science and technology to women in business and in particular in small, medium and macro enterprises (SMMEs). It is a national programme under the auspices of the Department of Trade and Industry. TWIB is aimed at the following:

- Facilitating focused action by women entrepreneurs at all levels
- Creating successful role models
- Unlocking solutions to progressive approaches to doing business in a global economy
- Exploiting partnerships with government, corporate entities and woman focused organisations.

The activities of TWIB include the following:

- Identification of technological needs of women in business in the identified market sectors, these being:

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- Information and Communications Technology
- Textile, Clothing and Crafts
- Agriculture, Food and Agro-Processing
- Construction and Infrastructure
- Tourism
- Mining and energy

- Addressing the identified needs through technological interventions in a project specific way;
- Facilitation of linkages between women in business and technology service providers;
- Identification and creation of market and business opportunities for the beneficiaries of the TWIB programme;
- Recognition and celebration of the success of women in the various business sectors;
- Identification and provision of support to learners in the science and technology field;
- Establishment and maintenance of a database which contains relevant information on TWIB activities;
- Establishment and maintenance of a TWIB website;
- Exposing south African women to international trends in science and technology;
- Demonstration and diffusion of technology; and
- Incubation of start up businesses.

5.4.5 Support Programme for Industrial Innovation

The programme is managed by the Industrial Development Corporation of South Africa Limited (IDC), on behalf of the Department of Trade and Industry (the dti). The Support Programme for Industrial Innovation (SPII) is designed to promote and assist technology development in South African industry through the provision of financial assistance for projects that develop innovative products and/or processes. The SPII is focused specifically on the phase that begins at the conclusion of basic research (at the stage of proof of concept) and ends at the point where a pre-production prototype has been produced.

The SPII currently consists of three schemes: the Product Process Development, Matching and Partnership Schemes.

<u>The Product Process Development Scheme</u>

Financial assistance is provided for small, very small and micro enterprises (employees <50; turnover <R13 million; assets <R5 million) in the form of a grant of between 50% and 85% of the qualifying cost incurred during the technical development stage with a maximum grant amount of half a million Rand (R500 000) per project. For enterprises with <25% black shareholding - the grant is 50%, for enterprises with>25% ≤50% women/physically challenged shareholding - the grant amount is 50% for enterprises with>25% ≤50% black shareholding or >50%

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women/physically challenged shareholding - the grant amount is 75%, and for enterprises with black shareholding >50% - the grant amount is 85%.

The Matching Scheme

Financial assistance under the Matching Scheme is provided to SMEs (employees <200; turnover <R51 million; assets <R19 million) in the form of a grant of up to between 50% to 75% of the qualifying cost incurred during the technical development stage - up to a maximum grant amount of one and a half million Rand (R1 500 000) per project. For enterprises with <25% black shareholding - the grant is 50%, for enterprises with>25% ≤50% black shareholding or >50% women/physically challenged shareholding - the grant amount is 65%, and for enterprises with black shareholding >50% - the grant amount is 75%.

The Partnership Scheme

Financial assistance under the Partnership Scheme is provided in the form of a condition of repayable grant of 50% of the qualifying cost incurred during development activity with a minimum grant amount of one and a half million Rand (R1 500 000) per project, repayable on successful commercialisation of the project. In considering support for a project under PII, there should be a clear indication of the causality (additionality) that will follow from the support

5.4.6 South African National Energy Research Institute

South Africa's National Energy Research Institute (SANERI) is the public entity entrusted with the coordination and undertaking of public interest energy research, development and demonstration. SANERI is a relatively new body, established by the then Minister of Minerals and Energy in October 2004, as a subsidiary of CEF (Pty) Ltd, the state energy company in South Africa. The Department of Science and Technology, together with the Department of Minerals and Energy, are joint custodians of SANERI and assist in providing political and strategic focus for the company.

The purpose of SANERI is to undertake original research in the energy field that will advance South Africa's development, increase human capacity and eventually lead to commercialisable intellectual property.

SANERI's research areas include advanced fossil fuel use, socio-economic development, environment, energy efficiency & demand side management, energy policy & planning, energy infra-structure, renewable & alternative energy.

5.4.7 Water Research Commission

The Water Research Commission (WRC) was established in terms of the Water Research Act of 1971, following a period of serious water shortage. It was deemed to be of national importance to generate new knowledge and to promote the country's water research purposefully, owing to the view held that water would be one of South Africa's most limiting factors in the 21st century. When the WRC was founded, water

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research and development (R&D) in South Africa was limited to a few institutions and the funding level inadequate. There was no research co-ordination and an apparent neglect of some key research fields. In addition, there was little strategic direction or leadership that would provide for the identification of priority areas or appropriate technology transfer. It was to address these issues, that the WRC was established.

Currently, South Africa is still under threat of a lack of sufficient water, while water quality and availability issues are becoming more acute. However, the country is much better prepared to deal with this problem owing to the WRC's meaningful contribution to the development of the capacity of the water sector, the broadening of the country's water-centred R&D base, and the WRC's continued commitment to direct and fund research on critical issues.

In the future (short- to long-term), it is envisaged that South Africa's water problems may intensify. Issues such as water for all, quality of life, and a sustainable environment are an essential part of the country's national priorities and require considerable attention. In addition, implementation of the National Water Act of 1998 and the related national water strategy places considerable demand on water management and calls for research support. The role of South Africa in SADC and NEPAD (New Partnership for Africa's Development), especially with regard to water resource and water supply and sanitation issues, poses new challenges and requires new initiatives which are within the mandate of WRC.

Hence, the mandate which has been entrusted to the WRC includes:

- Promoting co-ordination, co-operation and communication in the area of water research and development
- Establishing water research needs and priorities
- Stimulating and funding water research according to priority
- Promoting effective transfer of information and technology
- Enhancing knowledge and capacity-building within the water sector.

Key Research Areas

The WRC's key focus areas are:

- Water Resource Management
- Water-Linked Ecosystems
- Water Use and Waste Management
- Water Utilisation in Agriculture
- Water-Centred Knowledge

Funding Sources

The Water Research Act makes provision for a Water Research Fund, which derives its income mainly from levies on water made available for various uses. Diversification of income sources is gaining momentum, with the main other source being income derived from research fund management on behalf of specific sponsors and donors.

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Funding Streams

The WRC's research portfolio has funds allocated to research in the following categories:

- Solicited research
- Non-solicited research

The WRC's investment in research and development (R&D) is mainly through research projects and programmes in the solicited and non-solicited categories. Research proposals are invited on an annual basis in these two categories only, in accordance with the WRC's annual funding cycle.

The annual ratio of solicited to non-solicited research funds may differ between KSAs and also within each KSA according to the changing strategic needs of the KSA and the WRC's overall objectives.

Consultancy research agreements are usually initiated from within the WRC. There is no formal call for proposals in this category.

(a) Solicited Research

The purpose of soliciting research is to proactively and strategically direct research and development into areas of greatest need or greatest potential impact. Solicited research mainly takes the form of relatively large projects or programmes which address medium to long-term needs. In the case of such large projects or programmes, which may extend over a period of several years, there is a preference for the research to be undertaken by consortia rather than individual organisations. Solicited research projects are mostly non-targeted, i.e. any organisation or consortium of organisations, which considers itself qualified, has an equal opportunity to put in a bid to undertake the research. It is conceivable, however, that some solicited research projects may, in exceptional circumstances, be targeted, i.e. assigned to specific research providers who may have exclusive skills to do the necessary research.

Calls for proposals for solicited research are issued annually for a given annual funding cycle and are accompanied by Terms of Reference (ToRs) to which proposers of research are required to adhere closely. The ToRs align the research with the strategic objectives of a particular Key Strategic Area (KSA) and are intended to be clear and specific.

(b) Non-solicited Research

Non-solicited research proposals provide the opportunity of accommodating, within the KSA thrust or preferred programme areas, promising and relevant research based on innovative thinking and with the potential to yield applicable and beneficial results. Proposed projects in this category are typically smaller than those in the category for solicited research; they extend over a period of one to three years and

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may be undertaken by a single organisation or by a number of collaborating organisations.

Calls for proposals for non-solicited research are issued annually for a given annual funding cycle. They are accompanied by clear guidelines for preparation of proposals. All proposals must adhere closely to the guidelines and should be submitted, via the internet, after completing a prescribed electronic submission form.

5.4.8 The South African National Biodiversity Institute

The South African National Biodiversity Institute (SANBI) is responsible for exploring, revealing, celebrating and championing biodiversity for the benefit and enjoyment of all of South Africa's people.

Although SANBI is perhaps best known for being the custodian of the nine National Botanical Gardens in South Africa, the Institute is also a respected authority in research, boasting an unmatched research record in the indigenous, naturalised and alien flora of South and southern Africa, and beyond.

The Institute's knowledge management and planning branch, strives to make biodiversity science more available and accessible through various 'mainstreaming' projects and initiatives. SANBI is also responsible for ensuring that biodiversity knowledge influences policy, management and decision-making.

SANBI also enables a host of biome programmes which focus on South Africa's biodiversity hotspots, and aim to ensure that the country's most important biodiversity regions, such as the Grasslands, Wetlands, Succulent Karoo etc., are protected in a sustainable and beneficial way.

SANBI's biodiversity research comprises collaborative programmes set up to promote and catalyse knowledge about biodiversity. This is an essential part of SANBI's aim to develop the knowledge base and information products that can inform decision making. The broad scope of research includes the origins, composition, and functioning of biodiversity, its conservation and sustainable use, ecosystem services, and biodiversity responses to major drivers such as climate change. The research is organised into three focus areas:

- Applied Biodiversity Research
- Biosystematics Research & Biodiversity Collections
- Climate Change & Bio-adaptation

<u>Biosystematics Research & Biodiversity Collections</u>

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The Biosystematics Research & Biodiversity Collections Division provides a foundation for SANBI's other activities in research, conservation planning, and policy support. The Division is responsible for leading and co-ordinating taxonomic and systematics research on southern Africa's biodiversity. This includes discovering, documenting, classifying, and naming the organisms that make up South Africa's biodiversity. It is also within this Division that fundamental biodiversity information is generated and made available to other units of SANBI, conservation authorities, decision makers, the general public, and a host of other stakeholders.

Applied Biodiversity Research

The Applied Biodiversity Research Division manages a diverse portfolio of research projects dealing with contemporary issues relating to the conservation and sustainable use of biodiversity and the contribution of biodiversity to sustainable development. There is a strong focus on meeting the research needs of the National Biodiversity Strategy and Action Plan (NBSAP) and the implementation of the National Environmental Management-Biodiversity Act (NEMBA).

Climate Change & Bio-adaptation

The Climate Change & Bio-adaptation Division was established to enable SANBI to lead and co-ordinate research and communication regarding South Africa's response to the bio-impacts of climate change. Division activities are grouped into five main clusters that range from "basic" to "applied". These are: monitoring and understanding ecosystem processes; understanding carbon dynamics; climate change impacts and vulnerability; adaptation to climate change; and a synthesis activity that informs policy and communicates to a range of stakeholders. Currently, this work is focused variously on the mega-diverse biomes of the winter rainfall region of South Africa (Fynbos and Succulent Karoo Biomes) and on the important Nama Karoo and Savanna Biomes in the summer rainfall region.

5.5 Research infrastructure access programmes administrated by South Africa's national research facilities

Below are programmes in which South African researchers currently collaborate with international partners.

5.5.1 South African Biodiversity Information Facility

The SABIF aims to contribute to South Africa's sustainable development by facilitating access to biodiversity and related information on the Internet. In doing this, the SABIF will contribute to a co-ordinated international scientific effort to enable users throughout the world to discover and put to use vast quantities of global biodiversity data. South Africa, as a voting member of the Global Biodiversity Information Facility (GBIF), has established SABIF as a national node to the GBIF. The SABIF Portal will therefore serve as the country's national gateway to open and free scientific biodiversity information on the Internet.

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5.5.2 South Africa's bid to host the Square Kilometre Array

South Africa is short-listed to host the Square Kilometre Array (SKA), the most powerful radio telescope ever. If successful, the SKA will be the world's largest radio telescope to be hosted by South Africa. At about 50 – 100 times more sensitive than any other radio telescope on Earth, the SKA will be able to probe the edges of our Universe. It will help us to answer fundamental questions in astronomy, physics and cosmology, including the nature of dark energy and dark matter. It will be a powerful time machine that scientists will use to go back in time to explore the origins of the first galaxies, stars and planets. If there is life somewhere else in the Universe, the SKA will help us find it.

The construction of the SKA is expected to cost about 1.5 billion Euro. The operations and maintenance of a large telescope normally cost about 10% of the capital costs per year. That means the international SKA consortium would be spending approximately 100 to 150 million Euro per year on the telescope. At least 24 organisations from 12 countries, including Australia, Canada, India, China, France, Germany, Italy, Portugal, Spain, South Africa, Sweden, the Netherlands, the UK and the USA, are involved. Europe is expected to fund 40% of the project, with a comparable amount from the USA. The balance will be funded by the other countries involved in the project. It is expected that a significant portion of the capital, operations and maintenance costs would be spent in the host country. South Africa offers a competitive and affordable solution for constructing, operating and maintaining the SKA.

South Africa's bid to host the SKA

Southern Africa has become a hub of activities in the field of astronomy and related technologies. We have the infrastructure and expertise in place to make the SKA project a success. Winning the SKA bid will be a major step forward for the government's Astronomy Geographical Advantage Programme (AGAP), building on the Southern African Large Telescope (SALT), the Hartebeesthoek Radio Astronomy Observatory (HartRAO) and the HESS gamma ray telescope in Namibia. The Karoo Array Telescope (known as MeerKAT) is being built on the site proposed for the SKA. South Africa's new Astronomy Geographic Advantage Act ensures the future of radio astronomy in South Africa by protecting an area of about 12.5 million hectares around the proposed SKA core area against future radio frequency interference.

The SKA project will have substantial long term benefits for South Africa and Africa, corroborating our position as a hub for technological investment, creating local job opportunities, investment in human capital and directly increasing the uptake of science amongst young people.

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5.5.3 Southern African Large Telescope

The Southern African Large Telescope (SALT) is the largest optical telescope in the southern hemisphere, and equal to the largest in the world. The telescope is able to gather more than 25 times as much light as any existing African telescope, and it can detect objects a billion times too faint to be seen by the naked eye. The Southern African Large Telescope (SALT) is now being used to answer numerous questions in hundreds of research studies. Now a question such as how old is the universe, and how does our galaxy to compare to other galaxies.

With projects like this coming into being and further development and research in astronomy coming about, the Southern Africa government has started to promote technology like never before, and are now encouraging people to make investments in these endeavours in order to make further advancements in astronomy in southern Africa.

5.5.4 The South African Astronomical Observatory (SAAO)

The South African Astronomical Observatory (SAAO) is the national centre for optical and infrared astronomy in South Africa. It is a facility of the National Research Foundation under the DST. Its prime function is to conduct fundamental research in astronomy and astrophysics by providing a world-class facility and by promoting astronomy and astrophysics in Southern Africa. SAAO headquarters are in the suburb of Observatory in Cape Town.

The main telescopes used for research are located at the SAAO observing station near Sutherland in the Northern Cape, a 4 hour drive from Cape Town. The SAAO functions as a national South African centre for optical and infrared astronomy, carrying out its own research programmes and providing observing facilities for astronomers from many other countries and from within South Africa. The main observing site is in the dry Karoo near the village of Sutherland, at an altitude of 1798 m. The administrative headquarters, main computer facilities, engineering workshops, and library are located in the Cape Town suburb of Observatory on the site of the former Royal Observatory, where many of the historic buildings are still in use. A small museum in the McClean telescope building displays various instruments once used at the Royal Observatory and at SAAO.

5.5.5 Hartebeesthoek Radio Astronomy Observatory

The Hartebeesthoek Radio Astronomy Observatory (HartRAO) operates as a national research facility under the auspices of the National Research Foundation (NRF). HartRAO is mainly used for continuum radiometry, spectroscopy, pulsar timing and interferometry but also works together with radio telescopes on other continents as well as the orbiting radio telescope HALCA in order to perform Very Long Baseline Interferometry (VLBI).

HartRAO is an associate member of the European VLBI Network, but also operates with the Australia Telescope Long Baseline Array, the Asia-Pacific Telescope, the United States Very Long Baseline Array and the Global Array.

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HartRAO also runs a Space Geodesy programme using VLBI, Satellite laser ranging and the Global Positioning System. The observatory also provides students and lecturers from South African universities the facilities and opportunities to perform research.

5.5.6 MeerKAT

MeerKAT, South Africa's precursor to the SKA, is a radio telescope under construction in the Northern Cape of South Africa. The telescope will be used for research into cosmic magnetism, galactic evolution, the large-scale structure of the cosmos, dark matter and the nature of transient radio sources. It will also serve as a technology demonstrator for South Africa's bid to host the Square Kilometer Array.

The telescope is envisaged to consist of 80 12 metres (39 ft) parabolic antennas. To build experience in the construction of interferometric telescopes, members of the Karoo Array Telescope constructed the Phased Experimental Demonstrator (PED) at the South African Astronomical Observatory in Cape Town between 2005 and 2007.

During 2007 the 15 metres (49 ft) eXperimental Development Model Telescope (XDM) was build at the Hartebeesthoek Radio Astronomy Observatory to serve as a testbed for MeerKAT. Construction of KAT-7, the first 7 dishes on the Northern Cape site started in August 2009. KAT-7 has since been renamed to the more descriptive *MeerKAT Precursor Array (MPA)*, five dishes have been erected and the first interferometry fringes have been detected on 3 December 2009.

MeerKAT will provide an array in the southern hemisphere that complements the eVLA from L-band to X-band. The array will be optimized for deep and high fidelity imaging of extended low-brightness emissions, the detection of nano-jansky radio sources, the measurement of polarization, and the monitoring of radio transient sources. The MeerKAT reference design is an array of 80 12-metre dishes fitted with wideband single-pixel cryogenic receivers.View MeerKAT specifications

MeerKAT science

MeerKAT will be the most sensitive centimetre- wavelength radio telescope in the southern hemisphere, and will make significant contributions to both galactic and extragalactic astronomical research. MeerKAT will explore phenomena such as cosmic magnetism, the evolution of individual galaxies and clusters of galaxies, the influence of dark matter on galaxies and clusters, and the nature of transient radio sources.

The scientific programme will be a mixture of blind and directed surveys conducted by large project teams, and smaller experiments designed by individual principal investigators or small teams.

These teams and principal investigators will be international in their composition, and will include participants from Africa. The scientific productivity of MeerKAT will be enhanced by combining its results with those obtained by instruments operating at other wavelengths, for instance infrared and X-ray satellite data.

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The longer baselines of the MeerKAT will allow it to make full use of its superior sensitivity, providing detailed images of objects discovered by other instruments at different wavelengths, or indeed of objects discovered by the MeerKAT itself. The longer baselines will also allow accurate astrometry of objects discovered by the MeerKAT, which will aid the cross-identification of these objects in surveys at other wavelengths, for instance surveys conducted by infrared and X-ray satellites.

5.5.7 Hermanus Magnetic Observatory

The Hermanus Magnetic Observatory (HMO) is a research facility of the NRF, which is an autonomous science council responsible for research and human resources development in South Africa.

It functions as an active participant in the worldwide network of magnetic observatories (INTERMAGNET), which monitor and model variations of the Earth's magnetic field. The HMO is also one of twelve global Regional Warning Centres which form part of the ISES (International Space Environment Service) Regional Warning Centre network. Specifically, the HMO is appointed as the Regional Warning Centre for Africa.

The HMO is divided into three operational groups:

- Earth Space Research
- Technology
- Science Advancement

5.5.8 South African Environmental Observation Network

The South African Environmental Observation Network (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 our understanding of ecosystems and our ability to detect, predict and react to environmental change. The core research programme will strive to distinguish between anthropogenic and natural change as well as to unravel the relations between social change and ecosystem change.

One of the primary features of the Long Term Ecological Research (LTER) approach is that it overcomes the deficiencies associated with postgraduate research projects. Typically those cannot interpret the ever-present temporal and spatial environmental variability because of the pressure to produce a thesis within two to three years. SAEON will bring better cohesion between research programmes nationally and internationally and will ensure that LTER data is archived and accessible as a national asset for generations to come.

SAEON links existing and new environmental research and monitoring programmes. This is achieved through its research and monitoring platforms and programmes.

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According to the SAEON mandate, its responsibilities rest on three mandates: observation, information and education.

5.5.9 South African Institute for Aquatic Biodiversity

Situated in Grahamstown in the Eastern Cape, the South African Institute for Aquatic Biodiversity (SAIAB) is an internationally recognised centre for the study of aquatic biodiversity. SAIAB runs a number of large, interdisciplinary and multi-institutional programmes, such as the African Coelacanth Ecosystem Programme (ACEP), as well as internal programmes in the fields of freshwater, marine and coastal systems, ranging from South African coastal, estuarine and freshwater systems, to exploration of central African river systems and the Western Indian Ocean islands. Research in these areas is directed at fish taxonomy, systematics, genetics, phylogeography, biology, ecology, ethology, conservation, and fisheries management.

SAIAB hosts the Elwandle Node (coastal and inshore areas) of the South African Environmental Observation Network (SAEON) as well as the management office of the United Nations Development Programme (UNDP) funded GEF project, the Agulhas and Somali Current Large Marine Ecosystem Programme (ASCLME).

Research

The Institute's research strengths are in the biosystematics, taxonomy, phylogeography and conservation of aquatic biodiversity. While the emphasis has historically been on freshwater, estuarine and marine fishes, an increasing amount of research involves invertebrates and amphibians. The Institute continues to engage in long-standing, collaborative research programmes in estuarine ecology, fish telemetry and the management of coastal fishery resources. New areas of research include biomaterial banking, molecular systematics and biodiversity informatics.

5.5.10 National Zoological Gardens

The National Zoological Gardens of South Africa (NZG), situated in the centre of Pretoria, is a veritable oasis of wildlife that beats with an international heart in an African home. The NZG is a declared National Research Facility of the National Research Foundation.

Responsibilities of the NZG as a National Research Facility:

- Generate projects on fundamental and applied research, data gathering through information analysis and technology development
- Provide access for researchers to its facility
- Assist innovative utilization by researchers or research institutions of the platforms and capacities
- Be open to the entire research community across the national science system
- Provide appropriate resourcing of research platforms
- Maximize targeted international linkages and networks

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The NZG has identified three programmes and two knowledge hubs to further their research agenda.

Programmes

Ex situ in situ interface
Sustainable population management
Research education & Training

Knowledge hubs

Cooperative Species Management (Zoo based)

Disease Surveillance / Monitoring

5.5.11 iThemba LABS

iThemba LABS (laboratory for accelerator based sciences) is a multidisciplinary facility aiming to become the leading African organisation for research, training and expertise in accelerator based science and technologies.

The infrastructure is based at two sites, namely in the Western Cape, on Old Faure Road, and in Gauteng, on the campus of the University of the Witwatersrand.

The research activities are overseen by the Director of research and comprise experimental nuclear physics, materials research, radiation biophysics, and research and development pertaining to particle accelerators.

iThemba LABS is the only producer of accelerator-based radionuclides in South Africa. Some of the products (so-called short-lived isotopes) are produced to address the needs of the local medical fraternity, whilst the longer-lived isotopes are exported, thereby generating valuable income.

The radiopharmaceuticals produced at iThemba LABS provide roughly 25 000 nuclear medicine diagnostic applications per year.

Training is an integral part of the activities at iThemba LABS as all researchers are expected to participate in the growth and development of skills for the nuclear sector through lecturing and supervision of postgraduate students.

Opportunities are made available to in-service trainees, apprentices and interns to gain hands-on experience on a yearly basis. iThemba LABS also interacts with learners, teachers, undergraduate students and the general public through interventions aimed at promoting an awareness and appreciation of science.

6. South African - European Bilateral Cooperation

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6.1 Introduction

The DST periodically forges bilateral agreement with international partners and this is concretised through the signing of Bilateral Agreements. The Agreements are intended to provide a framework in which science and technology cooperation is promoted by way of facilitating a set of activities that will include the following:

Joint research projects, normally per submission of joint proposal on the basis of a joint negotiated and agreed on “Call for Proposals”;

- Flagship projects in line with national priorities;
- Joint flagship projects as identified in the signed “Programme of Cooperation” as stated in the Agreement;
- Exchange of scientist as well as mobility grants;
- Support of workshops, seminars and conferences; and
- Support of research training courses.

The DST currently has signed agreements with 12 European countries covering a wide range of scientific areas. Section 4.3 below gives an overview of these agreements. Focus areas are selected and reviewed during annual consultation meetings between the parties.

6.2 Methodology

Updated information about these bilateral agreements was obtained from the Overseas Bilateral Cooperation section of DST, that is responsible for initiating and managing South Africa’s scientific cooperation with these European countries.

6.3 Existing South African bilateral agreements with European States

6.3.1 The Government of Flanders

A 10-year celebration of the SA-Flanders cooperation was held in Cape Town from 13 to 15 March 2006, to reflect on the concluded bilateral S&T projects, representing R8.8 million invested by South Africa, and €5.7 million from Flanders. In addition to the investment, seminars and workshops were held. Ninety-seven projects were supported under the SA-Flanders programme within the following thematic areas: Information and Communication Technology (ICT), Health and Medicine, Economic Sciences, Agriculture and the Environment, and Natural and Social Sciences. This allowed the creation of networks and facilitated the generation of new knowledge as well as its dissemination. The strong partnership that has been built between the research communities of the two countries allowed for the exploration of a new strategy for future cooperation, which placed emphasis on research areas such as Astronomy and Polar Research.

The most recent development in strengthening the partnership has been the hosting of the South African Day in Brussels on 26 April 2007. The event was designed to

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introduce European partners to South Africa's most exciting flagship research and development (R&D) and innovation programmes, across a rich array of disciplines, ranging from Space Sciences to Social Sciences and Nuclear Energy research.

The event also focused on promoting and improving the Seventh Framework Programme instruments (FP7) of the EU. The past instances of cooperation were reviewed, including success stories from more than 120 Sixth Framework Programme projects in which South Africa had participated and the many bilateral cooperation initiatives between South Africa and European countries. The event was a success from the point of view of showcasing South African science, technology and innovation systems and the enhanced cooperative links that were forged between the science communities of both countries.

6.3.2 France

The science and technology cooperation between France and South Africa commenced with the signing of a general agreement on cooperation in the fields of Education, Sport, Culture and Science. A highlight of the ongoing cooperation was the signing of a Science and Technology Agreement on 28 February 2008 during the state visit of the French President, Mr Nicolas Sarkozy, to South Africa.

Both countries agreed that the level of cooperation between them should be elevated through specific projects in national priority areas. The SA-France ICT (SAFeTI) Network and the South African-French Safe Water Programme were identified to serve this purpose. This saw increased research participation by the Department of Science and Technology, the Water Research Commission and the Meraka Institute, as well as French research institutions and the French Embassy in South Africa.

The call for S&T research proposals has resulted in 93 projects being supported, mostly in Natural Resources, Life Sciences, Engineering, New Materials, Health Sciences and Physics. The 2008 call for proposals was extended to the SADC science community, which clearly demonstrates France's commitment to broadening its collaboration in the region.

DST and the French Embassy are discussing new areas for cooperation, for example: Space Technology; Nanotechnology; Synchrotron Facilities; Geosciences; Applied Mathematics; Biodiversity and Sustainable Development; Astrophysics of Very High

Energy; and Rock Art, combined with the usage of the synchrotron facility in France for dating purposes.

Cooperation in Nanotechnology is receiving special attention, including the hosting of workshops, exhibitions and strategic research projects. On 20 May 2008, the French Embassy and the Department of Science and Technology opened an exhibition showcasing Nanotechnology in South Africa. The exhibition was called “Nano Expo: A new dimension to technology” and consisted of posters, objects, experiments, films and interactive programmes integrated on separate terminals.

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(a) The F'SATIE partnership between the Paris Chamber of Commerce and Industry and the Tshwane University of Technology

F'SATIE is a French-South African Graduate School in Electronic and Electrical Engineering, founded by the Paris Chamber of Commerce and Industry, the French Ministry of Foreign Affairs, the South African National Research Foundation (NRF) and the Tshwane University of Technology (TUT). F'SATIE is managed by a management board comprising founding members and representatives of institutions of higher learning and industry. Recently, the Director-General of DST was nominated to serve as board member.

The overriding objective is to promote high-level human resource development in scarce skills areas, especially among previously disadvantaged students, thereby contributing to the national priorities identified in the ASGISA (Accelerated and Shared Growth Initiative for South Africa) and JIPSA (Joint Initiative on Priority Skills Acquisition) programmes.

In recent years F'SATIE has developed, in association with TUT, a skills development programme in electrical and electronic engineering, with a particular focus on advancement at postgraduate level. Students with potential are identified at undergraduate level and are supported throughout their studies. At all levels, a strong emphasis is placed on innovation and entrepreneurship, with students benefiting from strong linkages with industry as well as from international collaboration with partners in France.

The Cape Peninsula University of Technology (CPUT) has been identified by DST and the French Embassy as an ideal institution to implement the extension of

F'SATIE in a dual programme. This programme will attract the best undergraduate students, and is aimed at retaining them and ensuring that they proceed with postgraduate studies.

6.3.3 Germany

On 8 February 2008, the German Minister of Science and Higher Education, Ms Annette Schavan, visited South Africa to conduct high-level discussions with Minister Mangena. She also met with heads of science and technology research institutions and universities in SA. The meetings were aimed at discussing ways of further elevating and strengthening cooperation between SA and Germany within the existing S&T agreement.

The cooperation has grown since the meeting of the two ministers. During the visit, a Memorandum of Understanding was signed, paving the way for the inaugural Workshop on Sustainable Research in June 2008, followed by a Joint Committee Meeting, in Bonn, Germany.

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The Council for Scientific and Industrial Research (CSIR), South Africa and the Fraunhofer institute initiated discussions on innovation cooperation, followed by a delegation visiting South Africa in May 2008. Fraunhofer has also indicated interest in sponsoring the Maths and Science initiatives of the DAAD (the German Academic Exchange Service), to be linked to the JIPSA initiative.

New research areas agreed upon between the two countries are: Sustainable Research, Biocoastal Systems, Energy Systems Analysis, and Indicators Development for Knowledge Economy.

Technical Expert

The successful collaboration between Germany and South Africa since the signing of the Science and Technology Agreement has provided opportunities to elevate the existing cooperation initiatives and to explore new areas of cooperation. The Department of Science and Technology will host a German technical assistant, to work on the OBC Sub-Programme for a period of about two years. The main focus will be on strengthening bilateral cooperation with European countries.

Inkaba yeAfrica (IyA)

The origin of the Inkaba yeAfrica German-SA project goes back to 2001, when discussions about how to better link the earth science communities in South Africa and Germany were initiated. The project is divided into three interlinked categories, namely Heart of Africa, Living Africa and Margins of Africa. The three categories respectively concern energy transfer from core to space; geophysical, geological and geochemical investigation of the oceans, sediments, resources and climate that developed between and around the margins of Southern Africa; and the causes, mechanisms and consequences of continental breakup, and the investigation of the nature of ocean-continent boundary.

An important component of the project is the Capacity Building Initiative for Young Scientists for both countries. The young scientists contributed to the product of this research collaboration in the form of research entries in the South African Journal of Geology, Volume 110 (2007), with over 25 scientific papers. The project's research programme culminated in a conference held at the Wild Coast Sun in the Eastern Cape on 22 and 23 October 2007. The outcome was the recommendation that phase two of the research programme that is being carried out in both countries, should be extended to other universities within and outside South Africa.

6.3.4 Hungary

The bilateral Science and Technology Agreement between South Africa and Hungary was signed on 24 November 1997. Seven Joint Committee Meetings took place to facilitate the bilateral cooperation during the period 1998 to 2007. Key decisions taken at these Joint Committee Meetings included the approval of the joint research projects; an agreement to participate jointly in the European Framework Programme; the establishment of trilateral research cooperation in the area of Biotechnology; and aligning the cooperation with the DST's 10Year Innovation Plan.

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To date, 10 calls for proposals have been launched, with over 100 projects being supported thus far. An amount of more than R10 million was allocated to the research proposals between 1998 and 2008. No fewer than 40 research proposals were received during the 2006 call for proposals, signalling the value that SA researchers attach to cooperation with Hungarian researchers. However, only 26 research grants could be allocated, all of which were in the areas of the "grand challenges".

Former DST Minister Mangena visited Hungary in 2006. During this visit, the need arose to elevate the cooperation from a focus on the mobility of individuals (reciprocal visits) to one from which a number of substantive projects would develop.

It comes at no surprise that South Africa and Hungary have agreed to cooperate in the area of Biotechnology. Interestingly, the term "Biotechnology" was originally coined in 1917 by Károly Ereky, a Hungarian agricultural engineer. In addition, Hungary has 50 core Biotechnology firms, five Biotechnology-related university knowledge centres and three bio-incubators clustered in four academic towns, with 13 institutions dedicated to Biotechnology-related research and development. This makes it logical that the two countries cooperate in this research field, amongst others.

6.3.5 Italy

South Africa and Italy signed a Science and Technology Agreement in 1998, identifying the following scientific research areas: Material, Physical, Medical and Social Sciences; Industrial Research and Technological Innovations; Agricultural Science; and Environmental Protection and Ecology. An executive programme was signed in 2007 and opens the way for further collaborative projects in R&D. A total of 25 projects were awarded under the Executive Programme of Scientific and Technological Cooperation between South Africa and Italy for the period 2008 to 2010. The thematic areas funded are in Agriculture, Energy and the Environment, Biotechnology, Nanosciences, ICT, Medicine and Health and New and Advanced Materials.

Subsequent to the signing of the executive programme, Italy has expressed interest in collaborating with South Africa on initiatives related to the Square Kilometre Array (SKA) telescope and Synchrotron research. These two areas will see growth in the existing collaboration between the two countries. Italy has been instrumental in ensuring that the African component of ICGEB is established in Cape Town.

6.3.6 Norway

The South African-Norway programme on research cooperation supports research projects in thematic areas of mutual interest and relevance. The Business Plan Phase I, where the areas of cooperation were in Health, Information Communication Technology, Environment and Energy, resulted in 40 projects being awarded and

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funded. The success of the Business Plan Phase 1 led to the continuation of Phase II for the period 2007 to 2009.

A total of 25 projects were awarded in Business Plan II for the period 2007 to 2009, and the agreed-upon areas of cooperation were in the fields of ICT, Energy, Environment, Natural and Health Sciences, and Social Sciences. During this event, an officials' meeting was held to discuss the cooperation beyond 2009, and large strategic interventions with regards to new areas of cooperation such as Polar and Antarctic Research were also agreed upon.

6.3.7 Poland

The Scientific and Technological Agreement between the Government of the Republic of Poland and the Government of the Republic of South Africa was signed in November 1999. This has been followed by a series of high-level interactions, including a visit by the Polish Minister of Education and Research, and his deputy, to South Africa in May 2007. The purpose of the visit was to strengthen the S&T cooperation between the two countries and to view the investment that Poland has made in the construction of the Southern African Large Telescope (SALT). Poland is one of the major sponsors of SALT. The research focus areas agreed upon are Animal Sciences, Architecture, Astronomy, Chemistry, Engineering, Mathematical Sciences, Advanced Manufacturing, and Physics.

The South African Square Kilometre Array bid team visited Poland in November 2007, to present the South African bid to the Polish Government and also to establish ways and means of fostering a collaborative effort in this regard. Poland has shown an interest in forging collaboration links with SA in Astronomy, amongst other areas.

A bilateral cooperation/European-South African Science and Technology Advancement Programme (ESASTAP) workshop was held in May 2008 in Poland. The purpose of the workshop was to strengthen South African and Polish scientific and technological participation under bilateral cooperation and to create awareness of ESASTAP.. ESATAP's primary objective is to promote S&T partnership between South Africa and the European Union. This cooperation is showing growth potential beyond the current activities.

6.3.8 Slovakia

The Science and Technology Agreement was signed between DST and the Slovak Ministry of Education on 15 May 2006. A high-level DST delegation visited Slovak science institutions and established linkages in a large number of focus areas, namely: Renewable Energy, Material Science and Solid-State Physics, Laser Science, Accelerator Science, High-Energy Physics, Theoretical Physics, Quantum Computing and Cryptography, and Biotechnology.

A successful call for proposals was launched, covering not only priority areas of the South African national research and development strategy but also projects addressing the grand challenges in the 10-Year Innovation Plan of DST. It is anticipated that the future level of cooperation will be strengthened through

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collaboration in the following areas: Nuclear Physics for application in the medical field, Laser Technology and Quantum Physics.

6.3.9 Sweden

A Science and Technology Agreement was signed between DST and the Swedish Ministry of Education on 23 November 1999. The main focus of the SA-Swedish Research Partnership Programme is to contribute to the socio-economic development of both countries. The cooperation agreement established five objectives for the programme, namely: To produce new knowledge and enhance understanding in fields of mutual concern and relevance in all disciplines;

- To promote research excellence and quality;
- To establish a basis for long-term research cooperation between researchers in South Africa and Sweden;
- To contribute meaningfully to research capacity development; and
- To encourage the internationalisation of South African and Swedish higher education institutions.

One of the key national mechanisms for monitoring the cooperation between South Africa and Sweden is the Bi-National Commission (BNC), established in Stockholm on 4 September 2000. The BNC consists of three committees, i.e. Political Affairs, Economic Affairs, and Social Affairs and Development Cooperation.

In addition, Sweden has indicated that it will be transforming its development cooperation relations with South Africa, with a greater emphasis in future on a regional partnership with South Africa in joint and trilateral projects in Africa.

The current cooperation with Sweden has achieved notable science and technology successes. A total of over R30 million was allocated by the Swiss and DST to the more than 150 research projects that received grants from 2000 to 2008. A special event marking the cooperation was the Carl Linnaeus celebration in Cape Town on 18 September 2007. Linnaeus was a famous scientist who is regarded as “the father of modern taxonomy”, born in 1707 in the southern Swedish province of Småland. His most valuable contribution to botany was the method he developed for identifying and recording flora and fauna. He is best known, however, for the binomial catalogue he introduced, giving all plants and animals two names: a generic (family) name and a name for the species. During his lifetime, he named some 7,700 plants and 4,400 animals.

The Department of Science and Technology is in discussions with the Swedish Minister of Education and Research for the amendment of the Science and Technology Agreement to include innovation policy and cooperation discussions in science and technology.

6.3.10 Switzerland

It was with delight that yet another milestone in the history of South African-Swiss cooperation was reached with the signing of the Science and Technology Agreement

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between South Africa and Switzerland on 7 December 2007. It is expected that the agreement will assist SA in growing its economy and will improve the quality of life of its people in the long term. For its part, Switzerland has a rich culture of scientific and technological achievements, as evidenced by, amongst other things, the many

Nobel Prize winners for science it has produced.

Prior to the signing of the Science and Technology Agreement, collaboration took place between researchers and science and technology institutions in the two countries in the midst of policy discussions and the establishment of instruments for cooperation. For instance, in 2005 alone, seven universities in South Africa cooperated on research with Swiss researchers and institutions, especially in the field of Health, but also in Physics and Astronomy. These informal interactions demonstrated the potential mutual benefits that science and technology cooperation would bring with the signing of the Science and Technology Agreement.

A study on the SA Knowledgebase, a database of South Africa's scientific output (as measured by articles in peer-reviewed journals), indicated that a total of 810 papers have been produced between 1990 and 2007 with at least one South African and one Swiss co-author (WHO addresses included). The graph on the following page distinguishes between papers with an address in Switzerland that includes the World Health Organisation (red line) and those that exclude collaboration with researchers at the WHO (blue line).

There has been a significant increase in SA-Swiss co-authored papers over the past 18 years. The ISI classification of journals according to scientific field has been used to classify all the papers. The fields in which more than 20 papers have been published over this period are listed in descending order below.

- Health Sciences (and especially infectious diseases, public health, virology, oncology and immunology);
- Nuclear Physics (many of these collaborations are with staff at the European Organisation for Nuclear Research – CERN);
- Astronomy and Astrophysics; Plant Sciences and Zoology; and
- Ecology and Environmental Sciences

Switzerland has identified South Africa as one of its preferred partners for the establishment of formalised ties for cooperation in science and technology. This paved the way for the government-to-government agreement in science and technology, which will provide the mechanisms for formal collaboration, including a joint budget commitment for 2008-2011 of over R80 million. In addition, future SA-Swiss cooperation will, inter alia:

- establish a joint committee for the implementation of the agreement;
- deepen the bilateral relations by providing South African scientists with access to the European Organisation for Nuclear Research (CERN);
- extend the focus of cooperation beyond the current cycle of science and technology projects;
- increase cooperation for projects close to innovation; and

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- enable the training of SA post-doctoral students in Switzerland.

6.3.11 United Kingdom

South Africa Day in the UK

South Africa and the UK have a long period of strong relations in many fields of cooperation. Recent highlights of strategic interaction in S&T with the UK are elaborated on below.

Both Sir David King (the then Chief Scientific Advisor to the UK Prime Minister) and Professor Gordon Conway (the Chief Scientific Advisor to the Department for International Development) visited South Africa in September 2007, for the purpose of strengthening the government-to-government relationship of the two nations.

As a result of the SA Day engagement between South Africa and the United Kingdom in 2006, DST supported four research proposals that were received through a call for proposals directly linked to this event. Currently DST considering appropriate funding instruments for the joint funding of specific research areas identified by the two countries.

6.3.12 Finland

Finland's support to the South African anti-apartheid movement was transformed into development cooperation in 1995. The objective was to assist South Africa's efforts in building a socially and economically more inclusive and equal society.

Since then a number of bilateral development cooperation programmes have been carried out. The priorities and objectives for the cooperation are set jointly. The responsibility for, and ownership of, the programmes lie with the South African partner organisations and institutions, with Finnish support adding value to the implementation of the programmes by building capacity, increasing efficiency and making use of Finnish experiences, best practices and new technologies.

Currently a wide range of development cooperation instruments are used: grant-based bilateral cooperation, trilateral cooperation, support to civil society organisations, as well as partnerships between Finnish and South African businesses, universities, institutions, municipalities and other organisations. The creation of synergies between instruments is encouraged.

Knowledge Economy and Knowledge Society: ICT4D and Science and Technology Collaboration

South Africa and Finland are collaborating in Information and Communication Technology for Development ICT4D and science and technology. Particularly Finland is focusing in building Knowledge Economy and Inclusive Knowledge Society through

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a cluster of programs with South Africa. Finland has currently four bilateral cooperation programmes that are active or close to be launched.

Knowledge Economy is focusing on building partnerships between Finland and South Africa to support capacity building in this area. These bilateral programmes are focusing on innovation system (COFISA), ICT applications and capacity building (SAFIPA), provincial information society (INSPIRE) and building biosciences research network in Southern Africa (BioFISA). A regional programme in Open and Distance Learning with SADC will be launched in the near future. Other regional programmes in building knowledge economy are in the planning phase.

6.4 Analysis of how level of implementation or bilateral programmes provides for reciprocal access to South African programmes.

Currently, the funding arrangements for bilateral cooperation imply that each bilateral partner pays for their researchers to participate in the agreed areas of cooperation. Trilateral partnerships have also been identified as key in facilitating strong scientific relations.

7. Analytical findings of the report

The information presented in this report gives an overview of the science technology and innovation including as well as national research facilities programmes that are funded by DST and could be accessed by European researchers. Most of these programmes are not easily accessible to the public however it does not mean that the South African organisations are reluctant to provide information on opportunities available in their organisations. Some organisations have undertaken to improve their website in order for the European researches to be aware of the programmes that they could apply for in South Africa.

Some programmes that discussed in the report are open to European researchers provided their institutions will be willing to fund their participation as the contribution of South Africa is mostly limited to e.g. office space, daily allowance and accommodation. The South African contribution stated above applies to short term exchange programmes i.e. 3 to 6 months stay. It must be noted that it been a challenge to get information from managers of some of the existing the programmes as there is currently no single point where all the information is archived. It is hoped that more information will be made available as the project progresses.

Most, if not all, of the programmes discussed in the report only fund South African researchers, and European researchers typically pay for their participation in these cooperation programmes. Currently funding for European researchers participation in SA programmes is through the bilateral agreement funds.

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