

THE SOUTH AFRICAN SPACE INDUSTRY

September 2011



The South African Space Industry



Introduction

South Africa's space history reaches back to 1820, when the first permanent astronomical observatory (and scientific institution) in the southern hemisphere was completed at the Cape of Good Hope.¹ In recent years, South Africa has made the development and cultivation of a domestic space industry a priority, citing the critical roles science, technology, and innovation play in economic growth and socio-economic development.² South Africa established a civil space agency, the South African National Space Agency, or SANSA, by act in 2008; the agency is now fully operational. South Africa has separately invested heavily in a bid to host the Square Kilometer Array, a proposed massive radio telescope that would revolutionize astronomy, and also create growth opportunities for South Africa's high tech workforce.

History of the South African Space Industry

DATE	EVENTS
1820	The Royal Observatory at the Cape of Good Hope opens, as the first scientific institute in South Africa. The original intention was accurate measurement of the stars to aid navigation
1961	Deep Space Station 51 built by NASA in Hartebeesthoek to track deep space probes
1950s-1970s	Satellites tracked by South African scientists to determine upper atmosphere effects on orbits
1965	First images of another planet (Mars) received on Earth in Hartebeesthoek from the Mariner IV Spacecraft
1968	South Africa ratifies the Outer Space Treaty on 30 September
1969	South Africa signs the Agreement on the Rescue of Astronauts, the Return of Astronauts, and the Return of Objects Launched into Outer Space on June 10
1972	South Africa signs the Convention on International Liability for Damage Caused by Space Objects
1975	Deep Space Station 51 converted into the Hartebeesthoek Radio Astronomy Observatory, the only major radio astronomy observatory in Africa
1981	South Africa signs Convention on Registration of Objects Launched into Outer Space on October 14
Late 1980s-1994	Program to build and launch reconnaissance satellites initiated, with satellite integration and testing facilities built in Grabouw, and a launch facility at Arniston (both west of Cape Town). The program was canceled in 1994 before reaching operational status
1993-1994	Passage (July 1993) and amendment to (1995) the Space Affairs Act, the primary South African legislative instrument governing the regulation of both governmental and non-governmental space-related activities
1999	South Africa orbits its first satellite, Sunsat, built at the University of Stellenbosch. It was launched on a Delta II rocket from Vandenberg AFB
2008	Passage of act creating the South African National Space Agency (SANSA)
2009	The University of Stellenbosch and Sunspace, a university spin-off, successfully completes the SumbandilaSat satellite. South Africa's second satellite (and first government-owned and operated satellite), it was launched from Balkonur via Soyuz launch vehicle on September 17 th .
2011	Launch of Intelsat's New Dawn communications satellite in April. Built by Orbital Sciences, with primary financing from a South African consortium

Department of Trade and Industry

In South Africa, the overarching responsibility for space affairs falls under the Department of Trade and Industry (DTI). The department is mandated in terms of the Space Affairs Act (No 84 of 1993) to oversee and regulate the industry.

DTI, whose role is to promote industrial development, investment, competitiveness and employment creation, has helped to shape space policy in South Africa over the past decade.³

The South African Council for Space Affairs (SACSA) is a statutory regulatory and advisory council within DTI.⁴ It was established in 1993, as South Africa was transitioning its military space capabilities to civil programs.⁵ The council licenses all space activities, and ensures compliance with international treaty obligations and domestic legislation. In July, the Minister of Trade and Industry officially launched South Africa's national register of space objects, which is maintained by SACSA.⁶ The council released South Africa's National Space Policy Document in March 2009.⁷ SACSA is in the process of reviewing South Africa's domestic space legislation to bring it into alignment with developments in the South African space arena since the Space Affairs Act was passed in 1993.

A number of sub-agencies comprise DTI, all of whom work towards the following goals: economic empowerment; Small, Medium and Micro-size Enterprise (SMME) development; industrial development; trade; export and investment financial assistance; and legislation and business regulation.⁸ As of April 2011 the DTI has raised a total of ZAR 28 billion in investments in the South African economy and aims to help facilitate ZAR 115 billion in investments in the next few years.⁹

Department of Science and Technology

The Department of Science and Technology (DST) plays a leading role in the implementation of a space science and technology activities.

DST's mission is:

To develop, coordinate and manage a National System of Innovation that will bring about maximum human capital, sustainable economic growth, and improved quality of life for all.¹⁰

DST is aiming to develop South Africa's system of innovation through:

- Human capital development
- Large-scale innovation projects
- Science and technology (S&T) infrastructure and research
- Research and development (R&D)
- International relations and technology transfer

Space science and technology is a priority among R&D focus areas, along with pharmaceuticals, energy security, and human and social dynamics.¹¹ Expenditures on space science constitute nearly half of DST's research, development, and innovation budget, surpassing other focus areas.¹²

The department's investment in space is organized among two main initiatives; the South African National Space Agency (SANSA) and the Square Kilometer Array (SKA) program, which includes the Karoo Array Telescope (MeerKAT).

DST Expenditure Estimates by Research, Development, and Innovation Programme, Detail by Subprogramme

	2006/207	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013
ZAR (thousands)	Outcome			Adjusted Appropriation	Medium-term Estimates, MTEF Baseline		
Space Science	202,315	296,157	344,206	574,427	611,547	659,342	113,613
Hydrogen and Energy	9,587	33,830	139,650	149,985	134,178	142,780	148,919
Biotechnology and Health	178,114	194,164	228,098	259,344	310,019	298,447	321,768
Innovation Planning and Instruments	4,031	5,705	43,878	159,637	228,296	240,605	241,900
Total of Subprogrammes	394,047	529,846	855,832	1,143,393	1,284,040	1,341,174	826,200

South African National Space Agency (SANSA)



SANSA's mission is to use space science and technology to:

Enable the delivery of space-related services research, support, guide and utilise space science and engineering

Develop human capacity in space science and technology

Nurture space-related partnerships

Grow South Africa's contribution to the global space value chain

The South African National Space Agency Act of 2008 created SANSA to consolidate on-going space activities and research under one agency by 2012 - 2013. The agency budget in 2011 is ZAR 93.6 m (13.4 m USD, 9.3 EUR).

Three strategic goals are set out for SANSA, as laid out in the National Space Science and Technology Strategy Document:

Environment and resource management: A space program that aids in understanding and protecting the environment, and developing and maintaining its resources in a sustainable manner

Health, safety and security: A space program that strengthens development efforts, through ensuring the health, safety and security of society

Innovation, economic growth and social development: A space program that stimulates innovation, while leading to increased productivity and economic growth and at the same time assist in responding to the social needs.¹³

SANSA supports initiatives in research and development, advanced manufacturing, and industrial development. The agency is also taking the lead in South Africa's Earth observation strategy, a priority for South Africa, as it addresses important resource management and environmental concerns.

SANSA's six thematic focus areas address the development of life-improving technologies, and economic and industrial development. The six areas are:

Earth Observation: Collect, assimilate and disseminate earth observation data to support South Africa's policy-making, decision-making, economic growth and sustainable development initiatives.

Space Operations: Providing state-of-the-art ground station facilities and services, including satellite tracking, telemetry and command as well as launch support, in-orbit testing, mission control and space navigation.

Space Science: Creating and utilizing knowledge, developing human capital and advancing science by studying everything above the surface of the Earth, from the planet's atmosphere to the edges of the universe.

Space Engineering: Leading the technical development of space systems and sub-systems by operating a national assembly, integration and test (AIT) facility and supplying related services locally and internationally.

Space Advancement and Public Engagement: Increasing the uptake and appreciation of science among our youth and improving the overall scientific literacy and engagement of the general public.

Human Capital Development: Training South Africans in key areas of national importance, developing scarce and transferable skills and contributing to transforming the country into a knowledge-based economy.¹⁴

The agency offices are in Silverton, a suburb of Pretoria.

South African National Space Agency (SANSA)

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Square Kilometer Array (SKA) and Karoo Array Telescope (MeerKAT)

The Square Kilometer Array (SKA) is a radio telescope in development by a consortium of 20 countries that will provide an order-of-magnitude increase in the global capability for radio astronomy. The name refers to the combined surface area (one square kilometer) of the approximately 3,000 antennas that will comprise the system. South Africa is one of two finalists

(along with Australia) to host the core capabilities of the system. The choice will be announced in 2012. South Africa's proposed site is in the Karoo area of the Northern Cape Province. This area is very dry, with few clouds, and its remote location and surrounding hills minimize signal interference. The location allows a fiber optic connection to a control center in Cape Town.

South Africa has invested in bringing the Square Kilometer Array (SKA) project to the country for over ten years. SKA aligns with South Africa's desirable location for astronomy, and its strategic policy goals of developing an innovative economy

SKA (artist's rendition)
Credit: Peter Macfarlane

and workforce. South Africa has spent over ZAR 1.2 b (175 m USD, 125 m EUR) on the SKA project to date, including a precursor telescope, the Karoo Array Telescope (MeerKAT). Funding in 2011 is ZAR 500 m (69.7 m USD, 49.65 m EUR), more than five times the funding for SANSA.¹⁵

MeerKAT will be one of the world's largest radio telescopes in its own right, and is designed to be most sensitive in the southern hemisphere when complete. (Australia is also developing a precursor system, the Australian SKA Pathfinder.) Like SKA, MeerKAT is an array of antennas (each 12-meters in diameter), totaling 80 in full configuration. This does not include a 7-antenna prototype interferometer array. MeerKAT is scheduled to be commissioned in 2013. The MeerKAT program will develop and test many of the technologies required of the SKA, including one-piece reflectors, single pixel wideband receivers, and cryogenic systems. The total cost of MeerKAT will be just over ZAR 1.5 b (210 m USD, 149 m EUR).

While SKA would ultimately be based in Karoo, the same region as MeerKAT, the full SKA array would be distributed over 3000 kilometers. About half of the antennas would be localized in Karoo, and locations of 30 antennas would be located in 8 other countries, as far away as Ghana and Madagascar.

The project is attractive to South Africa because of the revolutionary advances it is anticipated to bring to astronomy, the innovative IT and technology activities required of the workforce, and the external funding that will support the project. When operational in 2022-2024, SKA will be 50 to 100 times more sensitive than any other radio telescope on Earth, capable of detecting the equivalent of an airport radar on a planet 50 light years away. It will download data at 10 times the global internet traffic rate, have a central processing power of more than 1 billion PCs, and will generate more data in the first year of operation than has been generated in the course of human history to that point.¹⁶ The construction is estimated to cost 1.5 b EUR, with recurring costs at about 100 to 150 m EUR annually.



MeerKAT
Credit: SKA South Africa

Department of Communications

The Department of Communication (DOC) in South Africa is mandated with ensuring affordable and accessible information and communication technology to drive economic and social growth in the country.¹⁷ DOC develops policy and legislation, invests to ensure infrastructure development, and regulates the communications industry.¹⁸ The budget in 2010 is ZAR 2.4075 b (336 m USD, 239 m EUR). The department made significant investments in infrastructure in preparation for the 2010 World Cup. This included funding to Sentech, a South African network business, for a satellite backup system used for broadcasting both the World Cup and the 2009 Confederations Cup. DOC paid Sentech ZAR 200 m (27.9 m USD, 19.9 m EUR) in 2008/2009, and ZAR 100 m (13.9 m USD, 9.9 m EUR) in 2009/2010.¹⁹

South African National Defence Force

The South African military, the South African National Defence Force, has existed in its current state since 1994, following the post-apartheid national elections. Branches include the Army, Air Force, Navy, and the Military Health Services. The Special Forces Brigade is a separate unit under the command of Joint Operations Division. According to the most recently available annual report (2009/2010), the overall budget is ZAR 32 b (4.47 b USD, 3.18 b EUR).²⁰

An industrial base for solid rocket motors supports an indigenous capability for tactical missiles, used by the military and exported. These are produced by the state-owned company Denel Dynamics.

The Denel Overberg Test Range (OTR) provides infrastructure for the testing of aerial weapons systems. The facility, based at Arniston, about 180 km east of Cape Town, features integration facilities, missile launch pads, radar and optical tracking systems, and a multitude of other equipment and instrumentation for testing and evaluating guided and unguided aviation systems.²¹ The test range markets its services internationally, and is well established in Europe and the Far East.²² The country conducted two suborbital launches in the late 80s from this range.²³

While the South African military does not own or operate satellites, it procures communications services and images on the commercial market, and makes extensive use of GPS technologies.²⁴ South African officials have spoken publicly about reducing reliance on assets owned by other nations, particularly imaging satellites.²⁵

South Africa Missile Capability			
Platform	Mission	Range	Producer
Umkhonto	Air defense	12,000m	Denel Dynamics
Ingwe	Anti-tank	250m to 5,000m	Denel Dynamics
Umbani	Long-range surface-to-surface	120km to 200km	Denel Dynamics
Raptor (bomb)	Precision bombing	130km	Denel Dynamics
A-Darter	Air-to-air	10km	Denel Dynamics, with Brazil

Workforce Development

The Human Resource Development Strategy for South Africa says that the strategy is grounded in the language and spirit of the 1996 South African constitution, which states:

Everyone has the right to a basic education, including adult basic education; and to further education, which the state, through reasonable measures, must make progressively available and accessible.²⁶

The overall strategy is concerned with insuring a match between the labor demands of a growing economy and the supply of available labor.²⁷ This is defined for this purpose as not only as existing skills, but an ability to adapt to changing economic conditions.²⁸ Technological and innovation outcomes are one of six major commitments by the government, with associated goals for education in high school through post-graduate research.²⁹ The development of skills also fosters economic growth, and it is a priority in the Department of Science and Technology programs to adapt the workforce to a knowledge-based economy. Goals include:

- Develop high- level human capital through improvements in secondary, undergraduate and graduate level education
- Enhance youth access to science, technology, engineering and mathematics through special programs to engage youth
- Promote and enhance indigenous research productivity through increased funding for university research chairs³⁰

South Africa Employment Statistics

Industry	Number of employees	Annual Change	Monthly Wage (ZAR)	Monthly Wage (USD)	Monthly Wage (EUR)	Growth
Electricity, gas, and water supply	59,000	5.40%	R23,988	\$3,345	€2,382	4.20%
Mining and quarrying	510,000	3.9	R12,821	\$1,788	€1,273	9.50%
Construction	412,000	-1.40%	R9,187	\$1,281	€912	12.30%
Transport, Storage and communication	359,000	0%	R15,875	\$2,214	€1,576	13.10%
Manufacturing	1,166,000	-1.8	R10,910	\$1,521	€1,083	11.00%
Wholesale and retail trade; repair of motor vehicles, motor cycles and personal and household goods; hotels and restaurants industry	1,651,000	1.30%	R8,110	\$1,131	€805	10.20%
Financial intermediation, insurance, real estate and business services	1,796,000	3.10%	R14,219	\$1,983	€1,412	14.00%
Community, social, and personal services	2,345,000	6.40%	R13,837	\$1,930	€1,374	2.60%
Total (all formal, non-agricultural industries)	8,298,000	2.60%	R12,244	\$1,708	€1,216	9.30%

Source: S.A. Department of Labor

A number of South African universities offer a specific type of science and technology focus. In addition to formal university education, South Africa has developed two additional training programs; Further Education and Training (FET) programs, and Sector Education and Training Authorities (SETAs). FET's are vocational programs that mix primary, secondary and university level educations in technical areas, and serve as a vocational or technical alternative to higher education.³¹ SETAs, initiated by the Skills Development Act of 1998, are designed to increase competitiveness by expanding the competitiveness of the labor force in 23 sectors of study.³² Two of the SETAs, Manufacturing Engineering and Related Services, and Transport Education and Training, are relevant to the aerospace industry, with curriculum that includes plastics, metal and motor manufacturing.

The largest private training provider in South Africa is the Denel Centre for Learning and Development (DCLD). DCLD provides courses such as Aircraft Mechanics, Aircraft Structural Work, Turner Machinist, Toolmaker, Aircraft Radiotrician, Aircraft Electrician, Aircraft Avionician, and Machine Tool Millwright.

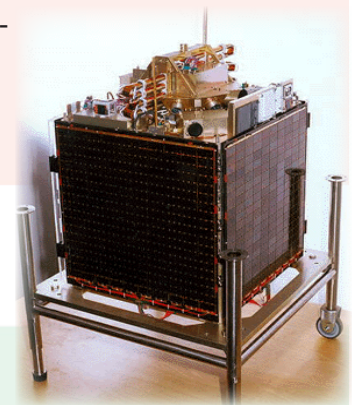
Space Commerce

Space System Manufacturing and Operation

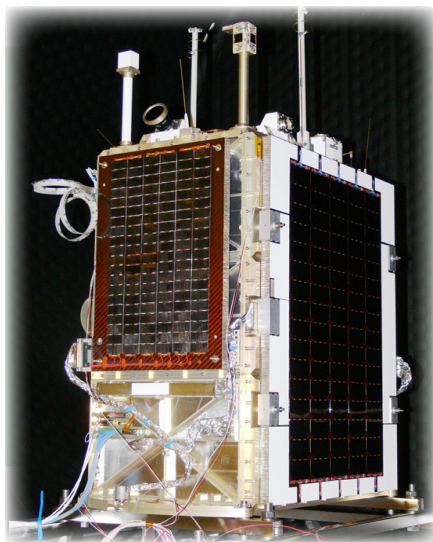
Between 100 and 200 South African organizations are engaged in aerospace activities – including manufacture of aircraft and spacecraft as well as some weapons capability – according to the Department of Labour. The aerospace industry is mainly located in the Geuteng province (especially Pretoria and Johannesburg), with a smaller concentration of more space-focused companies based in the Western Cape.³³

A small number of firms are focused specifically on aspects of manufacturing and/or operating space systems. (Additional firms use or resell space-based capabilities; this is discussed below under ‘Space-based Products and Services.’)

SunSpace is South Africa’s only satellite manufacturer, and the builder of both South Africa’s satellites, SunSat in 1999, and SumbandilaSat in 2009. The company, originally a spin-off of Stellenbosch University, specializes in small and medium sized payloads and related services.³⁴



SunSat
Credit: space.gov.za



SumbandilaSat
Credit: knysnasouthafrica.co.za

The state-owned company Denel Dynamics “is the largest single entity in defence and aerospace in South Africa.”³⁵ Denel was incorporated as a private company (with the state as its sole shareholder) in 1992. As mentioned above, Denel operates the Denel Overberg Test Range and produces tactical missiles for export. The company has capabilities in diverse aerospace and defense areas.

Marcom Aeronautics and Space is a Johannesburg-based company that has reported it will develop a two-stage liquid engine launch vehicle called the CHEETAH-1 CSLV, designed to deliver small payloads into orbit. The company, which also markets engineering services, states that it hopes to reduce the cost of launch and address underserved payload markets.³⁶

Space-Related Products and Services

South Africa is a market for space-related products and services including telecommunications, television, imagery, location-based services, and space tourism.

Demand for remote sensing data is growing rapidly in South Africa, as satellite imagery is viewed as key to sustainable agriculture and natural resource management.³⁷ In addition to being a priority in government policy, the country has had a long-standing relationship with commercial providers of satellite imagery.³⁸ Applications of GPS technologies, as in most markets internationally, are growing at a rapid pace in South Africa, and are expected to total nearly 70 m USD (ZAR 502 m, 49.8 m EUR) in 2014.³⁹

Demand for satellite telecommunications services across Africa has been growing at a sustained and rapid rate, driven by demand for cellular backhaul, VSAT enterprise networks, and direct-to-home television.⁴⁰ Telecommunications in general is one of the fastest growing industries in the country, and South Africa has the most developed telecommunications network in Africa.⁴¹

An innovative partnership between South African commercial entities and Intelsat, designed to increase the available communications infrastructure in Africa, reflects South Africa’s interest in greater participation in the international space

industry. The New Dawn Satellite, launched in April of 2011 aboard an Ariane 5 rocket, was financed by a consortium of African investors, led by Johannesburg-based Convergence Partners. The consortium, which additionally includes Nedbank, the Industrial Development Corporation of South Africa, and the African Development Bank, provided 90 percent of the satellite financing.⁴² New Dawn launched with 28 C- and 26 Ku- band transponders, designed to offer critical communications infrastructure for African customers.

New Dawn's C-band antenna reflector did not properly deploy after launch, reducing the satellites broadcasting payload by half.⁴³ The satellite still has Ku-band broadcasting capability, and supports a new satellite broadband offering, SkyeMax, offering access to the Internet.⁴⁴

Direct-to-home television in South Africa has traditionally been dominated by a single provider, MultiChoice DStv, which began broadcasting in 1995. (Satellite delivery of pay-TV dominates the market, as there is little to no cable TV infrastructure.⁴⁵) The industry is now facing growth in providers and competition.⁴⁶ In 2007, the South African government issued four new licenses for pay-TV, partially motivated by a desire to increase competition and lower prices.⁴⁷ The first of these competitors, On Digital Media's (ODM) TopTV, launched services on May 1, 2010.⁴⁸ Additional services in development include Walking on Water Television (WOWtv), a network devoted to Christian-based programming, and plans by General Satellite Corporation to launch a free-to-air service across Africa.⁴⁹ South Africa's pay-TV household penetration rate, at 12 percent when additional licenses were granted in 2008, is projected to reach 47 percent by 2016.⁵⁰

Two important figures in global commercial space have strong ties to South Africa. SpaceX founder and CEO Elon Musk, who emigrated to the United States at age 17, was born and raised in South Africa. SpaceX, a launch vehicle company based in the United States, is aiming to substantially lower the costs⁵¹ and increase the reliability of

space transportation. South Africa is also the home of a pioneering participant in commercial space tourism. Mark Shuttleworth, an Internet entrepreneur, became the first South African in space in April of 2002.⁵² His trip to the International Space Station, launched via Soyuz and brokered by Space Adventures, cost a reported 20 m USD (ZAR 143.4 m, 14.4 m EUR).⁵³



New Dawn Satellite Launching
Credit: Arianespace

South African Government Entities with Space Missions

Government Organization	Web Address	Mission/Objective	Year Founded	Governing Body	Head of Organization
Aerospace Industry Support Initiative (AISI)	www.aisi.co.za/	The AISI is a government-funded organization that supports the South African aerospace industry. The mission of the AISI is to: <ul style="list-style-type: none"> To enhance the global competitiveness of the South African aerospace industry To provide an institutional platform to facilitate partnerships and innovation between government, industry, and academia To identify, develop, support, and promote the interest and capabilities of the South African aerospace industry To accelerate the achievement of government strategic objectives including growth, employment, and equity. 	2005	Council for Scientific and Industrial Research (CSIR)	Lucas Ndema
Council for Scientific and Industrial Research (CSIR)	www.csir.co.za/	The CSIR is one of the leading scientific and technology research, development and implementation organisations in Africa. Constituted by an Act of Parliament in 1945 as a science council, the CSIR undertakes directed and multidisciplinary research, technological innovation as well as industrial and scientific development to improve the quality of life of the country's people. The CSIR Satellite Applications Centre at Hartebeesthoek provides tracking, telemetry and command (TT&C) services for geo-synchronous and polar orbiting spacecraft to the manufacturers, operators and users of satellites and launch vehicles. It is also delivers earth observation data relayed from satellites to a range of stakeholders.	1945	DST	Dr. Sibusiso Sibisi
Denel Overberg Test Facility (OTB)	www.otb.co.za/	A fully integrated multipurpose test facility near the southernmost tip of Africa, with its core business the in-flight testing of advanced guided and aviation systems for the local and international aerospace industries.	1991	Denel	Abrie van der Walt
Department of Science and Technology (DST)	www.dst.gov.za/	Mission: To develop, coordinate and manage a national system of innovation that will bring about maximum human capital, sustainable economic growth and improved quality of life.		DST	Ms. Naledi Pandor
Department of Trade and Industry (DTI)	www.dti.gov.za/	The DTI's mission is to: <ul style="list-style-type: none"> Promote structural transformation, towards a dynamic industrial and globally competitive economy; Provide a predictable, competitive, equitable and socially responsible environment, conducive to investment, trade and enterprise development Broaden participation in the economy to strengthen economic development Continually improve the skills and capabilities of the dti to effectively deliver on its mandate and respond to the needs of South Africa's economic citizens. 		DTI	Dr. Rob Davies
National Research Foundation (NRF)	www.nrf.ac.za/	The objective of the National Research Foundation (NRF) is to support and promote research through funding, human capacity development and the provision of the necessary research facilities, in order to facilitate the creation of knowledge, innovation and development in all fields of the natural and social sciences, humanities and technology, including indigenous knowledge systems.	1998	Department of Arts, Culture, Science, and Technology	Khotso Mokhele
SANSA Space Science/Hermanus Magnetic Observatory (HMO)	www.hmo.ac.za/	On April 1, 2011 the Hermanus magnetic Observatory (HMO) changed its name to SANSA Space Science and moved from the National Research Foundation (NRF) to SANSA. The facility is located in Hermanus and functions as an active participant in the worldwide network of magnetic observatories, which monitor and model variations of the Earth's magnetic field. SANSA Space Science is also one of thirteen Regional Warning Centers globally that forms part of the ISES (International Space Environment Service).	1932	SANSA	Dr I Lee-Anne McKinnell
South African Agency for Science and Technology Advancement (SAASTA)	www.saasta.org.za/	SAASTA is a business unit of the National Research Foundation with the mandate to advance public awareness, appreciation and engagement of science, engineering and technology in South Africa.	2002	NRF	Beverly Damonse
South African Astronomical Observatory (SAAO)	www.saa.ac.za/	The South African Astronomical Observatory is the national center for optical and infrared astronomy in South Africa. 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.	1972	DST	Dr. Phil Charles
South African Council for Space Affairs (SACSA)	www.sacsa.gov.za/	The South African Council for Space Affairs is established under the authority of the Minister of Trade and Industry to exercise regulatory functions and advise the Minister on all space-related matters. The Space Affairs Act No 84 of 1993 provides the legal framework for matters pertaining to outer space in South Africa.	1993	DTI	Dr. Peter Martinez
South African Large Telescope (SALT)	www.salt.ac.za/	The Southern African Large Telescope (SALT) is the largest single optical telescope in the southern hemisphere with a hexagonal mirror array 11 metres across. Although very similar to the Hobby- Eberly Telescope in Texas, SALT has a redesigned optical system using more of the mirror array. It will be able to record distant stars, galaxies and quasars a billion times too faint to be seen with the unaided eye.	2011	International Consortium	Ted Williams (Chairman of the Board of Directors)
South African National Space Agency (SANSA)	www.sansa.org.za/	Mission is to use space science and technology to: enable the delivery of space-related services; research, support, guide and utilise space science and engineering; develop human capacity in space science and technology; nurture space-related partnerships, and grow South Africa's contribution to the global space value chain.	2008	DST	Dr. Sandile Malinga

South African Space-Related Companies

Name	Location and Web Address	Company Services
Aerosud	Pretoria, Guateng www.aerosud.co.za/	Aerosud is involved in both Civil and Military Aviation Engineering projects. Activities cover design, development, prototyping, manufacture and in service support.
Ansys	Pretoria, Guateng www.ansys.co.za/	Ansys is an integrated firm, specializing in a diverse range of advanced technology systems. Products and services fall in the following economic segments: Rail, Mining, Industrial, Defence.
ATE	Halfway House, Guateng www.atesouthafrica.com/	Advanced Technologies and Engineering Co (ATE) designs, integrates, and tests avionics systems for military aircraft; ballistic algorithms and firing control systems for weapons platforms; and development and production of remote sensing platforms.
Brolaz Projects	Halfway House, Guateng www.brolaz.co.za/	Brolaz Projects is a South African professional service company supporting cellular, telecommunications, broadcast, and electronics industries with products and infrastructure implementation services.
Carl Zeiss Optronics	Irene / Pretoria, Guateng http://www.zeiss.com/optronics	Formerly Denel Optronics, Carl Zeiss Optronics (Pty) Ltd. Is a subsidiary of Carl Zeiss Optronics GmbH in Germany, and a developer and producer of laser rangefinders, thermal imagers, handheld targeting systems, stabilized multi-sensor platforms for use in helicopters, special aircraft and drones, and submarine periscopes.
Cobham	Pretoria, Guateng Cape Town, Western Cape www.cobham.com/	Cobham operates two business units in South Africa: Cobham Advanced Technologies (SA) (Pty) Ltd (Pretoria, RSA) and Omnipless Manufacturing (Pty) Limited (Cape Town, RSA). Cobham Advanced Technologies provides avionics, antennas systems, communications systems, Satellite communications, radio nav systems, installation provisions, and engineering design and certification. Omnipless manufactures airborne satcom antennas, components, and systems.
Convergence Partners	Johannesburg, Guateng www.convergencepartners.com/	Convergence Partners is an investment management and advisory firm, focused on the telecommunications, media and technology sector in emerging markets, with a principal focus on Africa.
Denel	Centurion, Guateng www.denel.co.za/	Denel is state-owned, and the largest manufacturer of defense equipment in South Africa. The company provides defense technology, product and service solutions across a wide range of technology areas for South African defense and security communities, and international customers.
EMSS	Stellenbosch, Western Cape www.emss.co.za/	EMSS specialises in of electro- magnetic simulation software and services, for communications network safety, antenna systems, and EM field simulation.
Marcom	Johannesburg, Guateng www.marcom-as.com/	Marcom is a high technology company developing reliable, cost effective aerospace technologies for the international space industry. The company's current focus is the development of a two stage, liquid fueled, expendable, commercial satellite launch vehicle named the CHEETAH-I CSLV. The vehicle is designed to deliver a 1000 kg payload into low Earth orbit.
New Dawn Technologies	Midrand, Guateng www.ndt.co.za/	New Dawn Technologies provides enterprise architecture and infrastructure, employing a full range of ICT technologies.
Neotel	Johannesburg, Guateng www.neotel.co.za/	Neotel is a telecommunications operator that operates throughout the country, and serves as the primary competitor to Telkom. The company offers the full range of telecommunications services, including satellite communications.
Radio Holland South Africa	Cape Town, Western Cape www.radioholland.co.za/	Supplier of specialized electronic equipment for marine applications, as well as, land based satellite communications systems, avionics and ultra high accuracy GPS positioning fixing systems.
Reutech Radar Systems	Cape Town, Western Cape www.rrs.co.za/	Reutech produces innovative radar and radar-related solutions for National Defence Forces, Parastatals and the Industrial sector.
Reutech Communications	Cape Town, Western Cape www.rdi.co.za/	Reutech Communications specializes in technologically advanced secure V/UHF communication systems for use on airborne-, naval-, and land-based platforms.
Sentech	Johannesburg, Guateng http://sentech.co.za/	Sentech is a state-owned broadband network business that acts as the signal distributor for South Africa. This includes development and operation of infrastructure, and managed services.
Space Advisory Company	Stellenbosch, Western Cape www.scs-space.com/	Space Advisory Company is a space-focused enterprise that provides space-related products and services in mission analysis, design, and optimization studies; program management; systems engineering; functional area engineering; design support; launch support; and deployment support.
Space Commercial Services	Stellenbosch, Western Cape www.comspace.co.za/	Company offers a number of services to establish a space program and manage the development and the operational and commercial deployment of space related services. Current projects include the roll out of community based situational awareness system, support for census projects in Africa, government accessibility studies in South Africa and a programme management project.
SpesCom	Stellenbosch, Western Cape Johannesburg, Guateng Durban, KwaZulu-Natal http://www.spescom.com/	Spescom is an integrated information and communications technology company, founded in South Africa in 1977. The company operates throughout the communications value chain, including infrastructure, services, and consumer applications.
Spectrem Air	Johannesburg, Guateng www.spectrem.co.za/	Operating a proprietary airborne electromagnetic survey system.
SunSpace	Stellenbosch, Western Cape www.sunspace.co.za/	Officially SunSpace and Information Systems Pty Ltd, provider of high-performance small- and medium-sized satellites and related systems and solutions to the local and international aerospace market.
Tellumat	Cape Town, Western Cape www.tellumat.com/	Offers technology solutions, services, and products aimed at the communications, defence and electronic contract manufacturing markets.
Telkom	Pretoria, Guateng	Telkom is Africa's largest integrated communications company, providing integrated communication solutions (including fixed line and wireless) across the spectrum of customers.



South African Universities with Science and Technology Focus

Name	Location and Web Address	High Tech Programs	Year Founded	Students	Graduate School Opportunities/ Professional Education
Cape Peninsula University of Technology (CPUT)	Cape Town, Western Cape www.cput.ac.za	Applied Sciences, Engineering and Informatics and Design Departments	1920	27,691 Undergraduate 1,261 Postgraduate	The Center for Postgraduate Studies
University of Cape Town (UCT)	Cape Town, Western Cape www.uct.ac.za	Engineering and the Built Environment, Health Science, Commerce, Science,	1829	15,800 Undergraduate 6,700 Postgraduate	Continuing Professional Development Program, Executive Education, As well as Postgraduate programs.
University of the Western Cape (UWC)	Tyberg, Western Cape www.uwc.ac.za	Departments Include Physics, Medical Bioscience, Computer Science, Chemistry, Biotechnology,	1960	12,021 Undergraduate 2,821 Postgraduate	Faculty of Science post-graduate educational programs.
University of Stellenbosch	Stellenbosch, Western Cape www.sun.ac.za	Programs in Agriscience, Engineering, Military Science, and Science	1840	16,524 Undergraduate 10,043 Postgraduate	Multiple post-graduate programs in Biochemistry; Botany and Zoology; Chemistry and Polymer Science; Earth Sciences; Mathematical Sciences; Microbiology; Physics; Physiological Sciences.
University of South Africa (UNISA)	Pretoria, Guateng www.unisa.ac.za	Environmental Science, College of Science, Engineering and Technology, Engineering, computing.	2004	203,115 Undergraduate 10,131 Postgraduate	The School of Graduate Studies includes Department of Science and Technology programs as well as the Institute of Science and Technology Education.
University of KwaZulu Natal (UKZN)	Durban www.ukzn.ac.za	College of Agriculture, Engineering and Science	2004	33,600 Undergraduate 8,400 Postgraduate	College of Agriculture, Engineering and Science; College of Health Sciences; and Nelson R. Mandela School of Medicine.
University of the Free State	Bloemfontein www.ufs.ac.za/	Faculties of Health Sciences and Natural and Agricultural Sciences	1904	Over 30,000 students	The Postgraduate School is newly founded.
University of Pretoria	Pretoria, Guateng http://web.up.ac.za/	Faculties of Engineering, Built Environment and Information Technology; Health Sciences; Natural and Agricultural Science; Veterinary Science	1908	37,320 Undergraduate 15,538 Postgraduate	Extensive postgraduate programme.
University of the Witwatersrand (Wits)	Johannesberg, Guateng www.wits.ac.za/	Health Sciences; Science; Engineering and the Built Environment	1922	16,845 Undergraduate 8,256 Postgraduate	Postgraduate studies in Health Sciences; Science; Engineering and the Built Environment.

South African Space-Related NGOs and Non-Profits

Name	Web Address	Objective
South African Space Association (SASA)	www.spacesa.org	SASA is a non-profit that generates awareness, assists, creates, communicates, collaborates and consults to advance the African Space Sector.
Foundation for Space Development (FSDSA)	www.developspacesa.com	The FSDSA is an organization aspiring to the promotion of space awareness, education and research for the benefit of all in our nation.
Space for Development	www.space4dev.com	Space for Development utilises space technology to leapfrog the digital divide. Using space technology, Space for Development accesses and compiles context-sensitive spatially referenced information. This information is prepared and presented in a community development plan. The plan is drawn up at the initiation of a development project, and it is updated on a regular basis throughout the run of the project, providing not only current development targets, but also a report of the successes and impact of the project. Space for Development uses the community development plan to develop and invest in core competencies and personal values in order to increase the economic value-creation of individuals within the community.

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Note:

All currency conversions were calculated on www.xrates.com on September 8, 2011.

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