SOUTH AFRICAN SPACE POLICY

SUPPORTING DOCUMENT 3

PUBLIC AND PRIVATE SECTOR SPACE ACTIVITIES IN SOUTH AFRICA

1. BACKGROUND OF THE DOMESTIC LANDSCAPE FOR SPACE ACTIVITIES

In South Africa, the Department of Communications (DoC), Department of Trade and Industry (the dti), Department of Science and Technology (DST) and the Department of Agriculture (DOA) have been the main role players in overseeing space activities in the country. This however happened with little or no coordination between them as a result of the absence of an over all policy for space.

South Africa has a rich heritage of involvement in space science and technology. The country has been an active participant in the exploration of space since the dawn of the Space Age; there has been an uninterrupted history of scientific endeavours spanning more than 180 years and culminating with the construction of the Southern African Large Telescope (SALT) in Sutherland, Northern Cape in the recent years.

From the 1950's to the 1970's,satellites were tracked to determine the effects of the upper atmosphere on their orbits. Lunar and interplanetary missions were supported from a CSIR tracking station at Hartebeesthoek. This station received the images of the planet Mars taken by the Mariner IV spacecraft - the first images of Mars and of another planet to be received on Earth.

In 1999, South Africa launched its first satellite, Sunsat. Staff and students of the University of Stellenbosch built this 64-kg micro-satellite. Government recently announced the beginnings of a new space programme through the development and planned launch in 2008 of a new South African micro satellite, named SUMBANDILASAT. The team of Sunsat built this second, more capable, South African satellite. The next will detail current roles of various government Departments regarding space activities.

1.1 The Role of the Department of Trade and industry (the dti)

The dti is the custodian of the Space Affairs Act No. 84 of 1993 as amended, which is the primary legislative instrument governing space activities in South Africa. The Minister of the dti appointed the South African Council for Space Affairs to implement and monitor the regulatory and registration functions of the Act as well as to advise the Minister in all space related matters. The dti also hosts the Council's Secretariat which responsible to provide strategic leadership and overall management of the Council.

The very important role is supporting the growth of both the Space and Aerospace industry. South Africa already has capabilities in space and aerospace industry, which can offer great opportunities and benefits to African continent at large.

1.2 The Role of the Department of Science and Technology

The efforts by the Department of Science & Technology to actively support space related sciences and education as defined in the National Research & Development Strategy (NRDS) are well recognised. This ensures that South Africa is home to an internationally recognised and extremely vibrant astronomy community, world class facilities supported through the programmes under the National Research Foundation specifically the Hartebeesthoek Radio Astronomy (HARTRAO) and the South African Astronomical Observatory (SAAO) with the latest addition being the South African Large Telescope (SALT) – and new programmes aimed at continuously challenging the frontiers of astronomy such as the bid for South Africa to host the Square Kilometre Array (SKA) radio telescope.

During July 2006, Cabinet approved the establishment of a National Space Agency (NSA) by the DST in recognition of the requirement for a more coordinated approach to roll out any prospective space programme but also to oversee and support many of the potential activities and facilities referred to in the above and following paragraphs.

1.3 The Role of Department of Communication (DOC)

In 1998, after a Human Sciences Research Council (HSRC) study revealed a huge shortage in high-level ICT skills for the country, the DoC established the Institute for Satellite and Software Applications (ISSA) with the support of the information and communications technology (ICT) sector as a skills development initiative. ISSA's main focus is to develop human capital whose design, analytical, conceptual, development and creative aptitudes are well honed towards the development of software solutions to meet the needs of the South African ICT sector. During the 1999-2004 period *ISSA trained about 105 scientists, in the development of software systems for mobile applications. ISSA also embarked on a business incubation programme.* Through this business incubation venture, ISSA facilitated the development of new Small Medium and Micro Enterprises (SMMEs) by newly graduated trainees.

1.4 Other Government Departments

A number of government departments make use of space-derived geospatial data or other data and services delivered from or via space systems. These include the Department of Agriculture, the Department of Defence, the Department of Land Affairs, the Department of Provincial and Local Government, the Department of Public Enterprises and the Department of Water Affairs and Forestry. Furthermore, it is envisaged that additional departments, such as the Department of Education and the Department of Health, might make use of operational systems to deliver services such as tele-education and tele-medicine or tele-health,

respectively.

1.5 Institutions and other programmes involved in space activities

South Africa has a variety of institutions and programmes that play a significant role in the scientific study, exploration and utilisation of space. These initiatives, situated in academia, the science councils, national facilities, government departments and industry, have broad competencies in satellite applications, satellite engineering and space science, and their supporting technologies. The existing infrastructure and skilled workforce, both inside these facilities and in wider industry supporting them, allow South Africa to position itself as a regional hub of space science and technology. This can be used as a basis for strengthening ties with industry in established space-faring nations, and for developing links with other emerging national space initiatives, particularly in Africa.

South Africa also participates actively in international space activities and fora. Various South African space professionals participate in numerous specialist and political forums, such as the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), Group on Earth Observations, International Telecommunications Union and others. These involvements are discussed in more detail in the document on *The International Space Landscape*.

2. NEW SOUTH AFRICAN LANDSCAPE

Space is increasingly a key element for key SA policies, including transport, agriculture, environment, and security and information society, integrated with terrestrial components in monitoring and communications networks and services.

A new space programme include the need for multi/bi-national agreements on cooperation in outer space, African-centric constellations in support of sustainable environmental management, communication satellite activities, focused earth observation activities, industrial capabilities, and service related activities (including applications development, command and control, tracking, launch, etc). Moreover our lack of launching facilities and equipment makes the country vulnerable and hence it becomes imperative that we develop our potential in this regard and or forge links with our African counterparts.

However the existing infrastructure and skilled workforce inside South Africa allow South Africa to position itself as a regional hub of space science and technology and industry development. This can be used as a basis for strengthening ties with research institutions and industry in established space-faring nations, and for developing links with other emerging national space initiatives, particularly in Africa.

The policy espouses a number of general implementation guidelines, which imply a number of roles for government and its agencies

2.1 The Role of the South African Government

The South African government has an over-arching responsibility to:

- To define the priorities and requirements for space based systems at the service of South Africa's main objectives and policies and public needs;
- To aggregate the political will and user demand in support of these;
- To ensure the availability and continuity of services supporting South Africa's policies by funding relevant up-stream research activities; purchasing services or securing the deployment and operational phases of space systems, as appropriate; and in due course stimulating user funding;
- To create an optimum regulatory environment to facilitate innovation and entrepreneurial talent to promote space industrial development and commercialisation of space based products and services;
- To encourage investment in space science and technology for industrial capability development;
- To promote coordination of the South African position in international cooperation;
- To build capacity within the space arena.

2.2 The role of South Africa's public entities

The roles of the South Africa's public entities are the following:

- To support the technical specification of the space segment of space application programmes, taking particular account of SA requirements;
- To develop and implement space technologies, in particular in access to space, science and exploration;
- To pursue excellence in scientific research in the areas of space science and exploration and also in space applications;
- To advise the government on space segment requirements to support availability and continuity of services;
- To implement international cooperation within the ambit of South African-led programmes or when the country is requested to do so by its African counter-parts.

3. GENERAL OVERVIEW OF SPACE FACILITIES

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Space activities in South Africa are diverse and managed by a number of government departments and their agencies. This diversity in the space sector has evolved over time based on pragmatic and national level requirements. The Space Agency that will be established by DST shall be responsible for the reorganisation of existing programmes and institutions into a coherent space network of research centres. The country has a number of space facilities as mentioned from our rich heritage in the Background information as follows:

3.1 Space Science National facilities

- **The South African Astronomical Observatory (SAAO)**

This is a national facility for optical and infrared astronomy in South Africa. The headquarters are in Observatory, Cape Town, and the various telescopes, including the Southern African Large Telescope (SALT), are at Sutherland in the Northern Cape. The SAAO facilities are the premier facilities for optical astronomy on the continent and are used by scientists from all over the world. The infrastructure of the site also supports scientific installations in space physics and space geodesy. The observatory has a very active public outreach component with national reach.

- **Hermanus Magnetic Observatory**

The HMO is part of an international network of magnetic observatories, which monitor and model changes in the Earth's magnetic field. Researchers at the HMO are also involved in studying the magnetosphere, which is the outermost layer of Earth's atmosphere. The HMO runs science awareness programmes for learners and offers presentations on space physics and guided tours of the HMO's facilities. There is also an interactive science centre and magnetometer museum.

- **The Karoo Array Telescope (KAT) and Square Kilometre Array (SKA) projects**

South Africa is in the SKA programme as part of the country's National Development Strategy. The country is currently bidding to host the Square Kilometre Array (SKA) the next-generation radio telescope being developed by a global consortium of radio astronomers. In support of this bid, South Africa is building an SKA technology demonstrator called the Karoo Array Telescope (KAT), in collaboration with European, Australian and American radio astronomers and with intention of extending it to MeerKAT, which will be a bigger demonstrator telescope than KAT. The KAT prototype dishes have been developed with South African innovative technology in composite materials that will reduce costs and improve the viability of the SKA.

South Africa's bid to host the SKA is currently being reviewed while KAT is expected to be operational by 2009 with full commissioning in 2010 and MeerKAT is expected to be completed in 2011. Fully integrated into the MeerKAT programme is the element of strong human capital development initiative that includes schools programme, undergraduate and

postgraduate programmes, postdoctoral fellowships and international exchanges. The country's involvement in this highly technological programme with human capital development shows that the country is progressively moving from a resource based economy to a knowledge based one.

- **HartRAO**

Radio Astronomy Observatory (HartRAO) operates a 26-metre diameter radio telescope. It is currently the premier radio astronomy facility on the African continent. Because of HartRAO's geographical position, the observatory features strongly in global Very Long Baseline Interferometry (VLBI) campaigns, where the various observatories around the globe cooperate to observe the same targets at the same time. HartRAO conducts a space geodesy programme using the radio telescope, together with global positioning equipment and a satellite laser ranger. The Observatory is one of only four fundamental stations in the world (and the only one in the southern hemisphere) with co-location of three of the four major techniques of space geodesy. This makes the HartRAO station of fundamental importance in the maintenance of terrestrial and celestial reference frames.

- **South African National Antarctic Expedition (SANAE)**

South Africa maintains research bases in Antarctica, as well as on Marion & Gough Islands. These bases are managed and administered by the Department of Environment Affairs & Tourism (DEAT). The scientific component of the Antarctic programme is administered by the National Research Foundation on behalf of the DST. The mission of this program is to increase understanding of the natural environment and life in the Antarctic and Southern Ocean through appropriate research. A significant component of the research conducted at SANAE has space science as its focus. This is because the polar regions are excellent places to study solar-terrestrial phenomena occurring far out in space, which are "mapped" onto the polar regions by the Earth's magnetic field.

Other astronomy facilities used by South African researchers

- **The High Energy Stereoscopic System (HESS)**

It consists of an array of four telescopes, which can detect the light produced by gamma rays entering the atmosphere. HESS is a German-led international collaboration. The HESS telescopes are located on the Khomas Highland, near Windhoek in Namibia. South Africa is a participant in HESS through the North West University.

- **Boyden Observatory**

Boyden Observatory is owned and operated by the University of the Free State. It has the third largest optical telescope in Southern Africa, a 1,5-m reflector and various other telescopes for educational purposes, including an excellent solar telescope. An observation

platform is ideal for looking at satellites, astrophotography and open-air slide/data projector presentations. Boyden hosts open evenings for school groups and adults. A Science Centre is now being established at the site. The observatory is situated about 27 km from Bloemfontein and is therefore easily accessible by the public and school groups.

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3.2 Testing and Integration Facilities

- **The OTB Test Range (formerly Overberg Toetsbaan)**

This is a test facility near Cape Agulhas, specialising in aviation and missile system flight tests for a wide variety of domestic and international clients. The facility has modern instrumentation and a fully controlled range extending some 60 km along the Cape south coast. The facility was originally developed to provide launch support services for the RSA rockets, developed in the previous space programme to launch the low-Earth orbiting satellite Greensat. The facility is no longer performing space launch activities (and is therefore no longer qualified to do so) but it retains infrastructure and expertise that could form the core of a future national space launch initiative. At present, space-related activities at OTB are confined to the operation of a ground station to receive satellite images and to occasional launch support services on a commercial basis with a mobile ground station that can be deployed elsewhere in Africa.

- **Institute For Satellite & Software Applications (formerly Houteq)**

The Institute for Satellite & Software Applications (ISSA) is situated in Grabouw, near Cape Town, and currently falls under the Department of Communications. The facility was established in the late 1980s as a dedicated satellite integration and test facility for the former Greensat programme. ISSA's test facilities include thermal vacuum chambers, anechoic chambers, vibration tables, and rotational tables for measuring inertial properties of satellites. And 3D measurement facilities, all in clean areas. These test facilities have found numerous applications in industry and in some aspects (e.g. electromagnetic compatibility) ISSA offers a unique capability to the industry in terms of the range of testing which can be performed locally. The facility has been used for the integration and testing of both Sunsat and Sumbandila. This facility has the core infrastructure required for a future domestic space programme.

3.3 Satellite Communications Facilities

- **Sentech**

Sentech uses satellites to deliver television and radio programmes to your nearest transmitter station from where it is broadcast to your home TV or radio. If you live in a remote area where there is no land-based television service, you can receive your SABC and e.tv services directly off Sentech's satellite service with a suitable satellite antenna and decoder. Sentech also uses its VSAT system to deliver Internet and other data services via satellite directly to schools and other institutions in remote areas of the country.

- **Telkom**

Through its satellite services (in addition to the undersea cable) Telkom touches the lives of every South African, from connecting us to the world to bringing news and sport to our television screens. Connecting businesses in remote areas, making automatic teller machines work, taking business application into Africa, Europe and the Middle East and fast Internet and telephones to rural South Africa are all part of Telkom Space Stream product range.

3.4 Satellite Applications and Ground Segment Support

- **CSIR Satellite Applications Centre (SAC)**

The CSIR Satellite Applications Centre provides telemetry, tracking and command (TT&C) services, disseminates low and medium-resolution satellite data via various media and ensures the archiving of Earth observation data that are deemed to be in the public domain. Located along the Magaliesberg mountain range, approximately 70 km west of Pretoria, the ground station at Hartebeesthoek is an ideal site for satellite operations, telemetry, tracking and command (TT&C) services, and satellite data acquisition.

4 INDUSTRY

Industry is playing an increasingly important role in the global space arena. For emerging space countries, the question of access to global markets and being part of global supply chains arises. For commercial players in the established space nations, prospects for new partnerships arise, too. It is in this regard that benchmarking South African capabilities against international norms is of particular interest.

Most of the world's space expenditure is concentrated in a few countries. The United States leads with 77% of world spending (civilian and military) on space, valued at an estimated $38.6 billion for 2006. Japan and France have annual expenditures in excess of $2 billion. Italy, Germany, India, Russia and the UK have annual expenditures ranging from $500 million to $1 billion. By contrast, the space budgets of emerging space nations ranges from a few million to a few tens of millions of dollars. The current direct South African expenditure in space-related activities is of order $6 - $10 million per annum. The annual turnover for

industry and public sector institutions is of order $20M. Some 180 – 200 people are currently involved in space-related activities of one sort or another.

A recent audit of the South African aerospace industry conducted by the DST[1] provided unequivocal evidence that South Africa has the necessary industrial and institutional capability to carry out a national space programme. It also suggests that South African industry is well placed to play a significant and leading role in the development of space activities on the African continent. South Africa has important facilities for assembly, integration and testing of satellites, as well as ground station facilities. The country also has significant industrial capabilities in the aeronautics and defence sector that could support future national and regional space programmes.

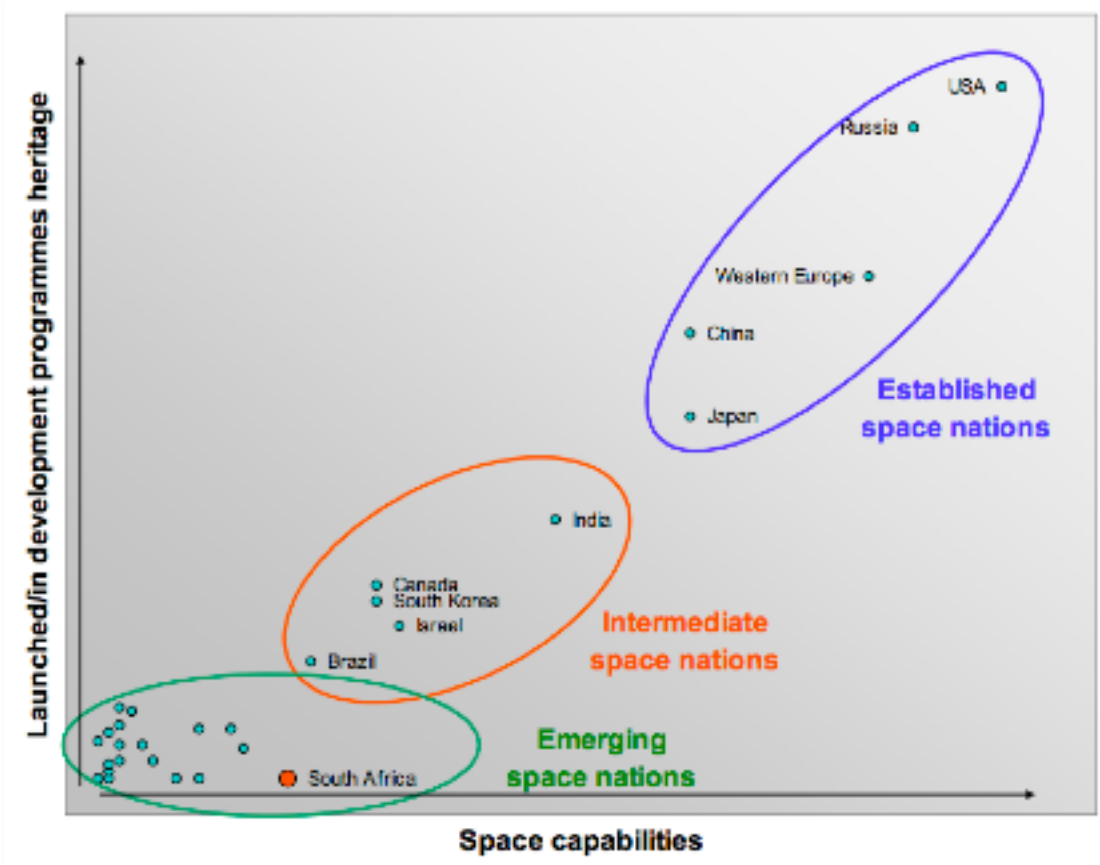

Figure 1: Heritage versus industrial capabilities of various emerging, intermediate and established space nations.

The industry audit shows that among the emerging space nations South Africa is seen to have some of the most significant space capabilities, largely thanks to the former space programme, whereas the low heritage reflects the fact that South Africa is a recent entrant in the space arena. However, it is interesting to note that a significant level of space activity will

[1] Space Audit Summary Report, Department of Science and Technology, 2007

increase the heritage level and propel South Africa into the group of intermediate space countries, such as Korea or Brazil. It is also interesting to note that the most advanced space nations all have full-spectrum capability in space technology in the sense of design, manufacture and launch capability. The intermediate space nations are those nations that have developed or are well on the way to developing their own launch capability.

5 SPACE AWARNESS IN CIVIL SOCIETY

In addition to the very considerable outreach activities of the various national facilities, there are also a number of other organisations contributing to public awareness of astronomy as their main focus.

- **Cape Town Planetarium**
- **Johannesburg Planetarium**
- **Astronomical Society of Southern Africa (ASSA)**
- ***Southern African Amateur Radio Satellite Association (SAAMSAT)***

Various Government Departments and the South African Association for Science and Technology Advancement (SAASTA) run a wide reaching national programme of space awareness activities each year during World Space Week (4 – 10 October). The inter-Departmental National Working Group on Space Science and Technology (NWGSST) operates the South African Space Portal (www.space.gov.za) which is the premier public site for information on space activities in South Africa. The portal also supports the meetings and inter-sessional work of the NWGSST.

3. Future Direction for South African space activities

The global space arena is no longer the preserve of just a few space faring nations. The number of emerging space nations is steadily growing. All the major economic regions of the world now have established or emerging space countries. Cooperation in space activities is also widespread and is driven both on a bilateral basis and through inter-governmental organisations. International cooperation is an important enabler and accelerator of development in the space domain. Many emerging space nations have entered the space arena through cooperation with more established space nations.

A coherent and sustainable national space programme must be based on real user requirements, adequate institutional and industrial organisational arrangements and adequate, sustained funding. The national space agency must be the key driver in terms of

creating the necessary conditions and environment for industry to participate in a national space programme.

The key elements that would be required to carry out a national space programme are distributed across public and private sector institutions, as well in some higher education institutions. The research and academic institutions will have a key role to play in developing the necessary human capital for the future space programme, as well as developing a user community fully conversant with the uses of space-derived data.

In order to do this, it will be important to establish the appropriate roles of the different role-players in technology development activities and in the development of large-scale operational space systems delivering critical services. Hence the importance of a well-developed national space policy that is aligned with other relevant national policies and strategies.

South African industry is well placed to undertake medium-resolution, high-resolution and hyperspectral experimental low Earth orbit (LEO) systems. In the case of large-scale operational medium- and high-resolution systems, or for the development of a synthetic aperture radar (SAR) system, partnerships with more experienced space companies might be more cost effective than attempting to conduct these programmes entirely within South African industry.

As South Africa's national spaced programme unfolds the question of assured access to space will become an important point of debate. In this regard, it is important to acknowledge the nascent launch capability that was developed, though never operationalised, in the previous space programme. Certain elements of that capability are still in place in industry and in flight test ground facilities such as the OTB Test Range, which could provide a basis for future work in this area.

In conclusion, South Africa has accumulated most of the essential elements required to support a national space programme. The next ten years will be a period of consolidation and capacity building to fill the gaps in infrastructure and human capital required for the country to develop a robust and comprehensive set of space capabilities to meet national development needs.