sansa
SOUTH AFRICAN NATIONAL
SPACE AGENCY

science
& technology
Department:
Science and Technology
REPUBLIC OF SOUTH AFRICA

Strategic Plan 2012 - 2017

Foreword

The simultaneous launch of the National Space Strategy (NSS) and the South African National Space Agency (SANSA) in 2010 signalled a giant leap forward for South Africa's endeavours in space science and technology and heralded a new era in utilising the benefits of space exploration in service of humanity.

South Africa's rich space heritage and the merging of key institutions under the SANSA banner have created a solid foundation from which the space agency can coordinate national space activities and create a visible, single point-of-contact for these activities.

In crafting this five year (2012-17) strategic plan and setting the Agency's targets for 2017, the SANSA Board considered and infused various national strategies and plans. Among these are the Ten-Year National Innovation Plan (TYIP), the National Space Strategy, and the South African Earth Observation Strategy (SAEOS). At a broader national level, consideration of the New Growth Path and the National Development Plan: Vision for 2030 finds relevance.

In line with these national imperatives, SANSA has five strategic programmes, namely: Corporate Support, Earth Observation, Space Operations, Space Science and Space Engineering. The Corporate Support Programme will ensure that SANSA functions optimally and there is good corporate governance and operational efficiency within the Agency. The Earth Observation Programme will focus on the utilisation of space to address day-to-day societal needs, including resource and environmental management; disaster management; food security; global change monitoring; health, safety and security; planning, development and service-delivery monitoring.

As the country moves towards a knowledge-based economy, the Space Science Programme will drive scientific enquiry, knowledge creation, technology development and innovation. Building on a very successful heritage, the Space Operations Programme will be the vehicle through which SANSA will interface with space assets and support the international space industry and, by so doing, elevate the country to be part of a community of space faring nations. Lastly, South Africa needs to maintain its satellite manufacturing capability in order to have a level of self-reliance and develop local technologies and skills. This effort will be driven by the Space Engineering Programme. It is the Board's belief that these programmes will enable SANSA to fulfil its mandate and drive the implementation of the National Space Strategy.

On behalf of the Board of the South African National Space Agency, it gives me immense pleasure to present the SANSA 2012-2017 Strategic Plan to the Minister of Science and Technology and the nation. I am confident that SANSA's achievement of its five-year targets will add significant value to the development of science and technology in the country.

Maurice Magugumela
Chairperson of SANSA Board
Accounting Authority

Signature:

Date: March 2013

Message from SANSA CEO

Message from SANSA CEO

The South African National Space Agency has now been operational for a year and we have seen huge strides within the organisation towards satisfying targets in the National Space Strategy and the Grand challenge of Space Science and Technology within the DST's Ten Year Innovation Plan.

SANSA has successfully integrated the former Hermanus Magnetic Observatory and Satellite Application Centre into the SANSA structure and the entire SANSA team comprises competent and passionate employees with the critical skills and experience needed to achieve the deliverables set within the Annual Performance Plan and Strategy for SANSA. Plans are progressing to expand the organisation as required to ensure SANSA contributes to the national objectives of job creation, increased focus on research and development and innovation, as well as contributing toward the National Development Plan: Vision for 2030.

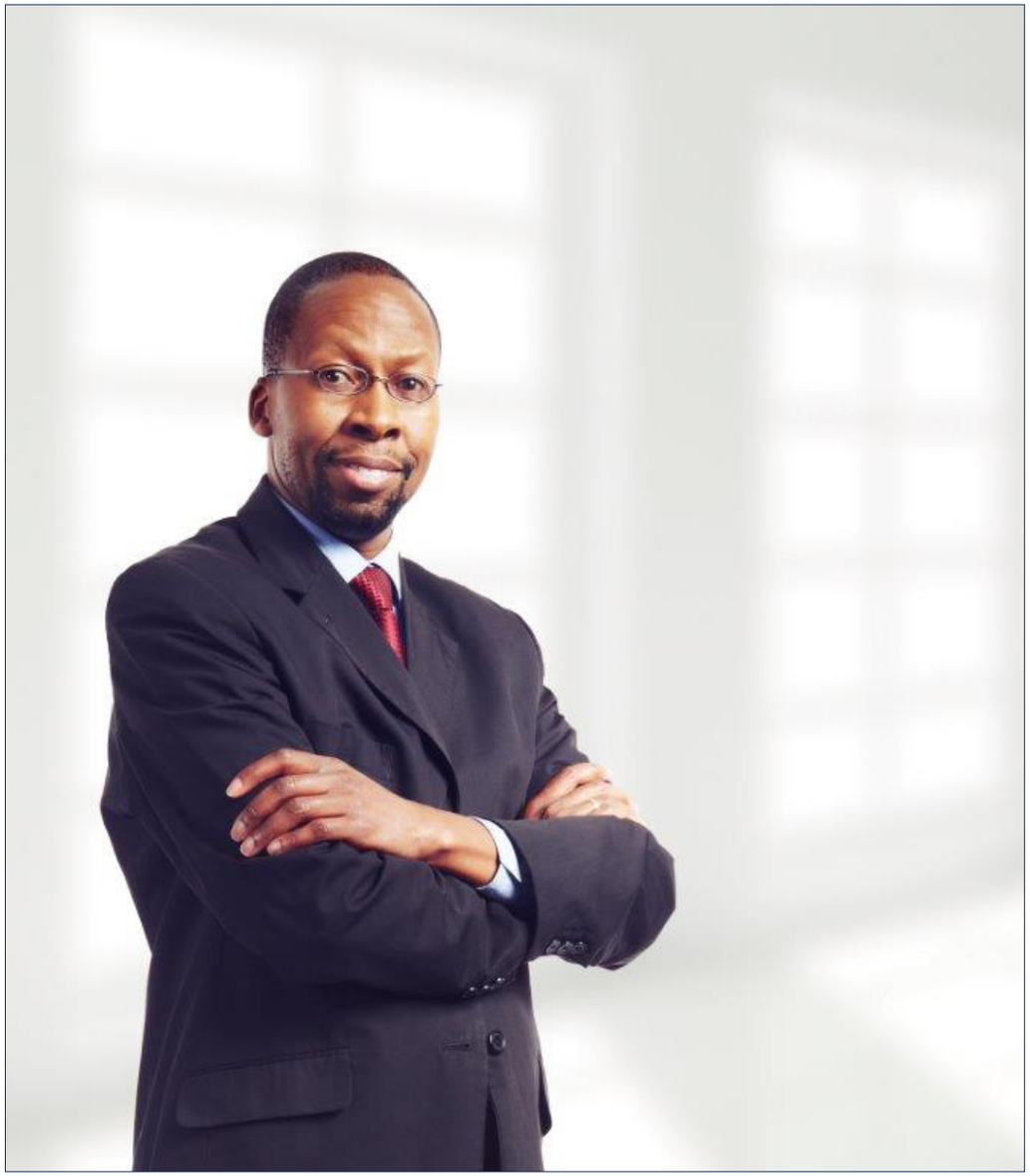
Policies and processes are in place as agreed by the SANSA Board and all employees remain committed to ensuring a fully functional and impactful organisation that lives up to being 'in service of humanity' as we unfold our five year strategic plan.

As we embark on this five year path, we are confident that with the support of the Department of Science and Technology, the dedication of our staff and partnerships with our stakeholders, SANSA will be able to achieve and exceed the targets we have set for 2017.

Dr Sandile Malinga

SANSA Chief Executive Officer

Signature: 



Official endorsement

It is hereby certified that the SANSA Strategy 2012-2017:

- was developed by the management and board of the South African Space Agency (SANSA) in consultation with the Department of Science & Technology;
- takes into account all the relevant policies, legislation and other mandates for which SANSA is responsi ble; and
- accurately reflects the strategic outcome-oriented goals and objectives which SANSA will endeavour to achieve during the period 2012-2017.

Ms Bulelwa Pono
Chief Financial Officer

Signature:

Dr Sandile Malinga
Chief Executive Officer
Head Official Responsible for Planning

Signature:

Mr Maurice Magugumela
Chairperson of SANSA Board
Accounting Authority

Signature:

Approved by:
Mr Derek Hanekom
Minister of Science and Technology
Executive Authority

Signature:

Date: March 2013

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PART A - STRATEGIC OVERVIEW

EXECUTIVE SUMMARY

Legislative Mandate

The South African National Space Agency (SANSA) came into existence on 3 December 2010. Established on the foundation of a rich space heritage, SANSA was established to:

> *"...provide for the promotion and use of space and co-operation in space-related activities, foster research in space science, advance scientific engineering through human capital and support the creation of an environment conducive to industrial development in space technologies within the framework of national government policy..."* [SANSA Act (Act 36 of 2008)]

Vision

Emanating from its statutory mandate, SANSA's vision is:

To be the leader in ensuring that space science and technology benefits society, the environment, research and development, human capital development, the economy and the global community.

Mission

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

- deliver space-related services and products to the citizens of South Africa and the region;
- support, guide and conduct research and development in space science and engineering and the practical application of the innovations they generate;
- stimulate interest in science and develop human capacity in space science and technologies in South Africa;
- create an environment that promotes industrial development; and
- nurture space-related partnerships to enhance South Africa's standing in the community of nations.

Value Proposition

SANSA's five-point value proposition encapsulates:

- **Societal capital,** - use space science and technology to solve day-to-day societal needs and support sustainable development and improved livelihoods.
- **Intellectual and technological capital** - creates new knowledge capital and utilise it for the development of new technologies and innovation.
- **Human capital** - train and develop students and personnel in key areas of national importance; promote the uptake and appreciation of science by the youth; and improve the overall scientific literacy and awareness of the general population.
- **Economic capital** - provide South Africa with the necessary space applications, technologies and industry partnerships to stimulate economic growth.
- **Global capital** – serve as the primary point of contact and face of South Africa in the global space arena and a vehicle for strategically positioning the country amongst the community of space faring nations.

Strategic Goals

SANSA identified five goals that direct delivery against its value proposition:

Goal 1: World-class, efficient services and societal benefits **(societal capital)**
Goal 2: Cutting-edge research, development, innovation, technology and applications **(intellectual capital)**
Goal 3: Effective development of human capital, transformation and science advancement **(human capital)**
Goal 4: Globally competitive national space industry **(economic capital)**
Goal 5: Position South Africa as a recognised global space citizen **(global capital)**

National Strategic Alignment

SANSA's strategy has been formulated within the context of the country's national strategies and outcomes-based planning framework. The strategy is aligned specifically with that of the Department of Science and Technology and contributes to the job creation drivers of the New Growth Plan.

Space science and technology is strongly driven by innovation and technological development. These drivers enable SANSA to contribute to the objectives of a number of national initiatives, including:

- intensifying the country's industrialisation processes and creating a knowledge-based economy in the long-term;
- developing and transferring scarce skills as directed by the National Skills Development Strategy (NSDS III) by offering student, internship and youth volunteer programmes in collaboration with universities and other partners and running staff development and in-service training programmes; and
- aligning its activities with the Space Science and Technology Grand Challenge of the country's Ten-Year Innovation Plan, which informed the development of the National Space Strategy (NSS).

SANSA is mandated to drive the implementation of the NSS and the delivery against its thematic areas of Earth observation, navigation, communications, and space science and exploration. The agency's operating units, each supported by one or more of the following programmes, enable the execution of its mandate.

Strategic Programmes

The SANSA Corporate Office provides executive management and administrative support across all operating units. This facilitates operational efficiency and cost-effective management, aligned with sound governance principles and the seamless integration and collaboration between SANSA directorates.

Earth Observation Programme (EOP)

Earth Observation is recognised world-wide as integral to addressing a wide range of societal needs. These include resource and environmental management; disaster management; food security; global change monitoring; health,

safety and security; and infrastructure planning, development and monitoring. Global initiatives in this regard are coordinated by various international bodies such as the Group on Earth Observations (GEO), Global Earth Observation System of Systems (GEOSS), and Committee on Earth Observation Satellites (CEOS).

SANSA is one of the implementing agencies of the South African Earth Observation Strategy (SAEOS). As such, the **SANSA Earth Observation** directorate strives to maximise societal benefits in this domain. The directorate's activities are focused on six operational themes, each underpinned by research and development and advanced human capital development and implemented in collaboration with external partners.

The goal is to ensure that South Africa and the African region benefit optimally from national and international space assets. This will be achieved by infusing government service delivery initiatives with space-based, data-valued products and services as relevant and necessary tools through a broad network of stakeholders and partners with expertise in their respective fields. Access to a national and international satellite data portfolio that is determined by user needs and well-maintained will create the required interest, impact and uptake. SANSA's inter-agency partnerships and public domain and specialised commercial satellite sensors can be used to optimise the products and services mix in such a portfolio.

Space Operations Programme (SOP)

SANSA operates a satellite ground station to benefit fully from national and international space systems. **SANSA Space Operations** provides clients and government, locally and abroad, with space mission support services, which include launch and early-orbit support, in-orbit testing, satellite life-cycle support and satellite mission control. The directorate's primary focus on ground services and space applications provides South Africa with access to national and international Earth observation and scientific satellites. The opportunities for business growth in satellite mission control include supporting future South African satellites. Within the next five years, SANSA plans to have access to a strategically-selected suite of Earth observation and scientific satellites to help meet the societal and R&D needs of the country.

The directorate's provision of satellite support services to clients on a commercial basis generates a significant income stream for SANSA. Global market surveys predict that satellite activity will increase from around 77 per annum (2000-2009) to approximately 120 per annum (2010-2019). The resultant expectation is an overall increase in SANSA's satellite launch and general orbital support business.

The provision of satellite-based navigation augmentation services is another potential growth area, a third of which will come from satellite-driven communications. Navigation services will be pursued in close cooperation with the Department of Transport and its agencies, while communications will be informed by the satellite communications strategy of the Department of Communications. The commercial nature of navigation and communications services will also require close interaction with private sector role players in the space industry. SANSA envisages having a fully functional, open-service navigation augmentation system at an advanced safety-of-life certification stage within the next five years.

Space Science Programme (SSP)

Space science is an important driver for scientific enquiry, knowledge creation, technology development and innovation. It is also an acknowledged instrument for human capital development and has always been a vehicle for stimulating interest, awareness, understanding and appreciation of science amongst the youth and the general public. The SANSA Space Science directorate leads the space science programme.

SANSA will exploit the advantages of South Africa's geographic position in two areas in particular. Firstly, South Africa is the only African country with a scientific base in Antarctica, a region regarded as the "Window into Geospace" from which deeper space phenomena can be mapped onto the near-Earth space environment. **SANSA Space Science** already operates a significant amount of instrumentation at the South African base in Antarctica, including the SuperDARN radar equipment with global significance.

Secondly, South Africa is ideally located for the study of the South Atlantic Magnetic Anomaly – an area over the South Atlantic where aircraft, ships and satellites experience increased amounts of space-originating radiation that leads to interruptions and damage to communications systems. In partnership with Brazil and India (through the IBSA initiative), specialised satellite and a low-latitude SuperDARN radar are proposed to investigate this phenomenon.

SANSA's multi-disciplinary collaborative approach aims to develop and implement a 'big science' plan to position South Africa as a global authority in the two areas referred to above. This initiative has a strong human capital and science advancement focus with annual student enrolment targets of 64 by 2015 and 85 by 2017.

In addition to creating new knowledge, SANSA applies science to provide operational services such as space weather and geo-spatial data for navigation, communications and mineral exploration, among other areas.

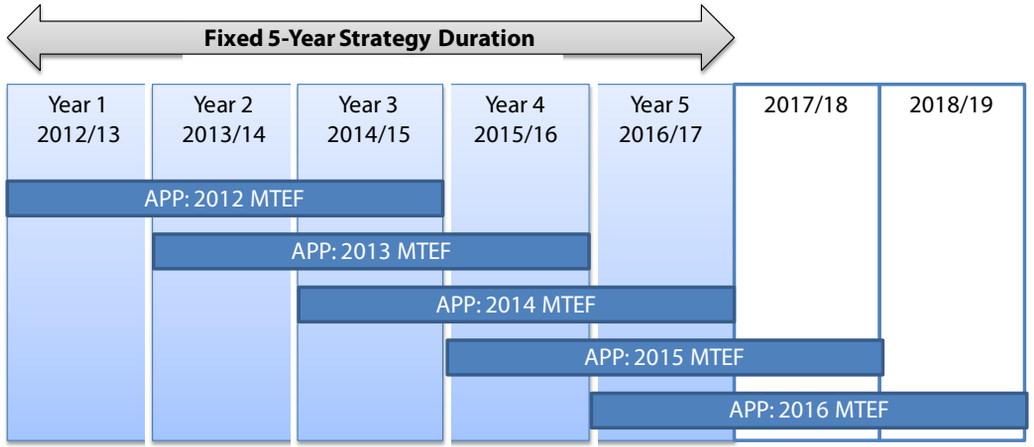
Space Engineering Programme (SEP)

Space science and technology is recognised globally as an essential strategic tool to meet social, economic, technology and foreign policy objectives. Accordingly, many governments around the world are increasing their investments in space activities to advance their space capabilities and optimise the benefit they derive from space operations. **The SANSA Space Engineering** directorate will manage and lead the technical coordination of space systems and sub-system development and provide a facility for space system assembly, integration and testing (AIT) for national, regional and international use. SANSA will work with higher education institutions, R&D institutions and industry partners to develop and implement a 10-20 year satellite roadmap that will encapsulate user needs locally and in the African region. Associated with this will be domain-specific roadmaps for technology, skills, applications, science and engineering.

The immediate focus will be on developing the satellites that will form part of the African Resource Management Constellation (ARMC) project. This is a collaborative project between South Africa, Nigeria, Algeria and Kenya to establish a constellation of African satellites that will provide resource management services to countries throughout Africa. SANSA intends to have launched South Africa's ARMC satellite by 2017, with the second satellite at a fairly advanced stage of development.

In addition to the above programmes, the broader National Space Programme (NSP) has a number of complementary instruments. These include Centres of Competence, Centres of Excellence, research chairs, research grants and open-call bursaries. The successful implementation of the NSP will be determined by the efficiency of the collaboration between SANSA and the broader NSP stakeholder community.

Progress on the 2012-2017 Strategic Plan Implementation



The existing 5-year Strategic Plan of SANSA started in 2012/13 and the Agency is currently in the second year of implementation. The corresponding Annual Performance Plan (APP) covers the detailed implementation over the Medium-Term Expenditure Framework (MTEF) period of 3 years in a forward-looking rolling fashion. The key targets and corresponding high-level achievements to date are outlined in the table.

	Previous Year	Current Year	Upcoming Years		
	Year 1	Year 2	Year 3	Year 4	Year 5
	2012/13	2013/14	2014/15	2015/16	2016/17
Key Targets	Set governance framework Set operational framework Initiate Strategy Implementation	Strengthen governance framework & achieve an unqualified audit opinion Improve operational efficiencies and effectiveness Implement some key elements of the NSP.	Further strengthen governance framework & achieve a clean audit 80% operational efficiencies and effectiveness NSP fully adopted and key programmes clearly defined and initiated	Further strengthen governance framework & achieve a clean audit 80% operational efficiencies and effectiveness Coherent implementation of the NSP at 50% functional level	Further strengthen governance framework & achieve a clean audit 90% operational efficiencies and effectiveness Coherent implementation of the NSP at 70% functional level
Key Achievements	Key policies in place and unqualified audit opinion attained Governance framework in place Foundational operational framework in place Draft National Space Programme (NSP) Plan developed				

Broad National Environment

The National Development Plan has now been finalised. SANSA will play a key role in addressing some of the central challenges identified in the Plan. Areas of contribution include the creation of high-technology jobs; the improvement of geo-spatial patterns to foster the development of marginalised communities; the planning and monitoring of backbone national infrastructure through space systems; health surveillance and intelligence through satellites; space-based service delivery and performance monitoring to assist in the eradication of corruption; and the provision of geo-spatial decision-making tools for decision-makers.

Strategy Modification History

While an institutional strategic plan is meant to be fixed over a set 5-year period, the Framework for Strategic Plans and Annual Performance Plans (FSPAPP) as issued by the National Treasury, allow for some limited modifications to the Strategic Plan in circumstances where these are necessitated by significant policy shifts or changes in the service-delivery environment. Consequently, SANSA has implemented some modifications to the Strategic Plan as follows.

2013/14 Modifications

The modifications implemented in the 2013/14 financial year are not very significant and entail the following:

- Addition of a high-level outline on the progress of the implementation of the strategic plan and the strategy modification history in the executive summary. These were added to clearly contextualise the strategic implementation process and to highlight any adaption of the strategy.
- The strategic objectives of the Corporate Support programme (Section 7.2.1.2) have been reduced from five to three and now concisely focus on (i) leadership excellence, (ii) management excellence, and (iii) operational excellence. These three areas cover all the support functions of the Corporate Support programme in well-defined broad clusters.

1. VISION

The vision of SANSA is:

> To be the leader in ensuring that space science and technology benefits society, the environment, the economy and the global community through products and services; research and development; and human capital development.

2. MISSION

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

- deliver space-related services and products to the citizens of South Africa and the region;
- support, guide and conduct research and development in space science and engineering and the practical application of the innovations they generate;
- stimulate interest in science and develop human capacity in space science and technologies in South Africa;
- create an environment that promotes industrial development; and
- nurture space-related partnerships to enhance South Africa's standing in the community of nations.

The essence of SANSA's mission is reflected in its motto: in service of humanity.

3. VALUES

SANSA values an environment that fosters institutional cohesion, a constructive and fulfilling work environment and an organisation that excels in serving the nation efficiently and effectively and with innovative and relevant services .SANSA's specific values are:

1. Service
2. Teamwork
3. Excellence
4. Integrity
5. Respect
6. Personal growth

4. LEGISLATIVE AND OTHER MANDATES

4.1 Legislative mandate

The South African National Space Agency (SANSA) came into existence through the promulgation of the SANSA Act (Act 36 of 2008) on 3 December 2010. SANSA is a Schedule 3A public entity under the Department of Science and Technology (DST).

The legislative mandate of SANSA is to

"...provide for the promotion and use of space and co-operation in space-related activities, foster research in space science, advance scientific engineering through human capital and support the creation of an

environment conducive to industrial development in space technologies within the framework of national government policy..."

SANSA is broadly required to promote the peaceful use of space; foster international co-operation in space-related activities; and facilitate the creation of an environment conducive to space technology and industrial development. This will be achieved by fostering relevant research and advancing South Africa's scientific and engineering capability through human capital development, outreach programmes and the development of infrastructure.

4.2 Strategic mandates

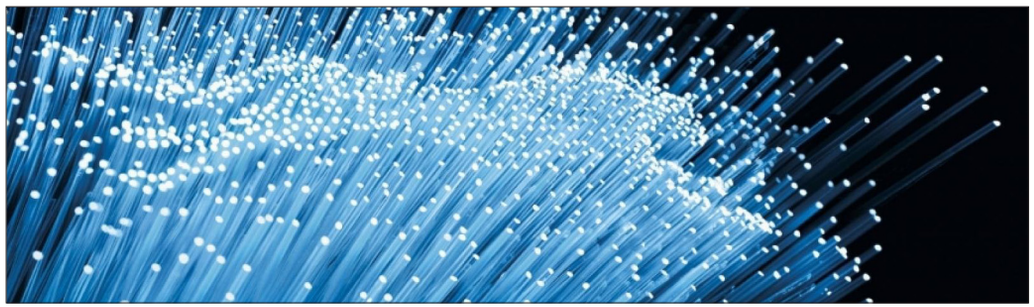
4.2.1 National Development Plan

The National Development Plan has now been finalised. SANSA will play a key role in addressing some of the central challenges identified in the Plan. Areas of contribution include the creation of high-technology jobs; the improvement of geo-spatial patterns to foster the development of marginalised communities; the planning and monitoring of backbone national infrastructure through space systems; health surveillance and intelligence through satellites; space-based service delivery and performance monitoring to assist in the eradication of corruption; and the provision of geo-spatial decision-making tools for decision-makers.

4.2.2 Government's New Growth Path (NGP)

Government's New Growth Path (NGP) identifies South Africa's core challenge as **mass joblessness, poverty and inequality.** Consequently, the NGP identifies four main success indicators to address these challenges, namely (i) job creation (the number and quality of jobs created), (ii) growth (the rate, labour-intensity and composition of economic growth), (iii) equity (lower income inequality and poverty), and (iv) environmental outcomes.

The NGP emphasises the need to improve existing employee skills and aims to provide 1.2 million workers with certified on-the-job skills improvement training by 2013 and create five million new jobs by 2020. SANSA will contribute to these ambitious goals within the ambit of its operational and strategic mandates.



The NGP highlights five job drivers:

Table 1: New Growth Path Job Drivers

	NGP Job Drivers	SANSA's Possible Contribution
1	Delivering infrastructure projects – construction, operation and maintenance and indirectly, efficiency improvement across the economy.	Infrastructure planning; infrastructure monitoring and maintenance (e.g. roads, dams).
2	Targeting more labour-absorbing activities across the main economic sectors – the agricultural and mining value chains, manufacturing and services	Satellite-based agricultural services; satellite-based and mineral exploration.
3	Taking advantage of new opportunities in the knowledge and green economies.	Knowledge creation, technology development and innovation for the knowledge economy; renewable energy planning.
4	Leveraging social capital in the social economy and the public services.	Improved service delivery through satellite-based planning, decision- and policy-making and enforcement.
5	Fostering rural development and regional integration.	Satellite-based rural development planning and monitoring; regional space services.

4.2.3 Industrial Policy Action Plan (IPAP 2)

IPAP2 emphasises the need to continue and increase support for research and development, coupled with the commercialisation of new domestic innovations. As a discipline, space science and technology has strong technology and innovation drivers, which enable SANSA's programmes to contribute to material technology, control technology, solar power technology, optronics and radar technology, and data and signal processing, among others.

SANSA will work with the Technology Innovation Agency (TIA) and the Department of Trade and Industry (DTI) in promoting the advanced materials and aerospace sectors, which fall in the IPAP Cluster 3 (sectors with potential for long-term advanced capabilities). In 2008, the advanced manufacturing sector contributed a significant $17, 7 billion to the South African economy, with about eight per cent coming from the aerospace and defence sector. IPAP identifies the aerospace and defence sectors as critical new technology generators and instruments for enhancing "government engagement across substantial parts of the manufacturing, services and primary sectors of the economy to achieve long-term intensification of the country's industrialisation processes and movement towards a knowledge economy."

4.2.4 National Skills Development Strategy (NSDS III)

The NSDS III highlights the changing nature of work in the context of the shift towards a global knowledge economy in South Africa. The strategy points out that the extent to which employers and employees will benefit from the knowledge economy will be determined by South Africa's capacity to conduct innovative research and apply knowledge in the workplace.

The NSDS III is also aligned with the NGP in highlighting employee training to improve productivity, address race and gender skills imbalances and increase workforce mobility. SANSA's human capital development (HCD) initiatives include presenting student/internship and staff development programmes and in-service training for clients such as the defence force, all of which contribute to the objectives of the NSDS III.

4.2.5 DST Strategic Plan

SANSA's primary objective is to contribute to the realisation of the DST strategic plan.
SANSA will contribute to four DST programmes, namely:

1. Research, Development and Innovation
2. International Cooperation and Resources
3. Human Capital and Knowledge Systems
4. Socio-Economic Partnerships.

4.2.6 Ten Year Innovation Plan (TYIP)

SANSA's strategic mandate is derived from the TYIP, which identifies five Grand Challenges, namely:

1. Farmer to Pharma
2. Space science and technology
3. Energy security
4. Global change science
5. Human and social dynamics.

While SANSA's strategic mandate directs its activities primarily towards giving effect to the Grand Challenge of space science and technology, the agency's activities will also contribute to the TYIP's other Grand Challenges.

4.2.7 National Space Strategy (NSS)

The NSS, as approved by Cabinet in 2008, also informs SANSA's primary strategic mandate.

The goals of the NSS are to:

1. capture a global market share for small to medium-sized space systems in support of the establishment of a knowledge economy through fostering and promoting innovation and industrial competitiveness;
2. empower better decision making through the integration of space-based systems with ground-based systems for providing the correct information products at the right time; and
3. use space science and technology to develop applications for the provision of geo-spatial, telecommunications, timing and positioning products and services.

The NSS identifies three key priority areas, namely environmental and resource management; health, safety and security; and innovation and economic growth, which are underpinned by four thematic areas:

1. Earth observation
2. Navigation
3. Space science and exploration
4. Communications.

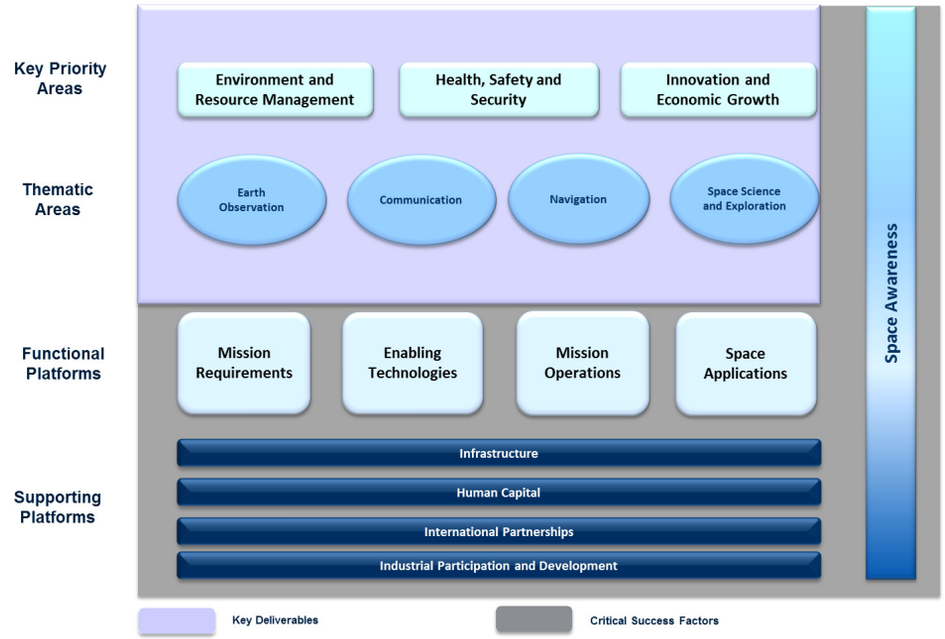


Figure 1: National Space Strategy Themes

4.2.8 South African National Earth Observation Strategy (SAEOS)

SANSA will be a key contributor to the South African Earth Observation Strategy (SAEOS), for which the primary objective is "to coordinate the collection, assimilation and dissemination of Earth observation data, so that their full potential to support policy, decision-making, economic growth and sustainable development in South Africa, can be realised."

SANSA will provide space-based data platforms that focus on in-situ Earth observation measurements in collaboration with entities such as the South African Earth Observation Network (SAEON).

4.2.9 Other strategies

Various other national strategies have a bearing on SANSA. These include the:

- White Paper on Science and Technology
- Youth Into Science Strategy
- National Research and Development Strategy

4.3 Relevant court rulings

There have not been major legal cases that have direct bearing on the SANSA mandate.

5 SITUATIONAL ANALYSIS

5.1 Performance Environment

5.1.1 Global performance environment

The space science and technology sector globally is increasingly finding greater application in environmental monitoring, resource monitoring, safety and security, disaster management, economic growth, planning and development, and technology development and innovation. In 2010, world government expenditure exceeded $71 billion with $37 billion and $34 billion split between civil and defence programmes, respectively. In the same year, about 48 countries invested $5 million or more in space technologies and applications compared to only 24 countries in 2000.

New government entrants are continually entering the space market. A total of 483 satellites were launched in the last decade with the following breakdown: Asia (142); Russia (138); North America (117); Europe (66); Middle East and Africa (16); Latin America (2). The largest expenditure in 2010 was for manned spaceflight ($11.6 billion), followed by satellite communications ($8.4 billion), Earth observation ($8 billion) and space science and exploration ($5.6). Less than $5 billion was expended on access to space, satellite navigation and space security.

A number of forums have been established to leverage an increased focus on Earth observation. These include the Group on Earth Observation (GEO), which is co-chaired by South Africa, the Global Earth Observation System of Systems (GEOSS) and the Committee on Earth Observation Satellites (CEOS). The forums coordinate Earth observation initiatives globally to benefit humanity in a sustained and Earth-friendly manner as the world strives to attain the Millennium Development Goals (MDGs) by 2015.

The primary aim is to ensure that space science and technology is integral to the sustainable development of humanity. There are also new developments in space science as humanity seeks to better understand our universe, starting with the Earth and its near space environment, as well as the deep space environment. Space science missions, which often extend the limits of our current technologies and knowledge, are used to set new technology frontiers. They create new rigours of enquiry, measurement, analysis and interpretation and help develop the associated new knowledge and skills.

As the number of satellites being launched increases, so does the launch support market and the need for low Earth-orbit phase (LEOP), in-orbit testing and satellite life-support services. Satellite navigation is another fast-growing area, with all the major space players implementing satellite navigation systems.

5.1.2 National performance environment

In the South African context, space science and technology is ideally suited to provide services that will advance government's service delivery objectives. SANSA's Service Portfolio covers four classes:

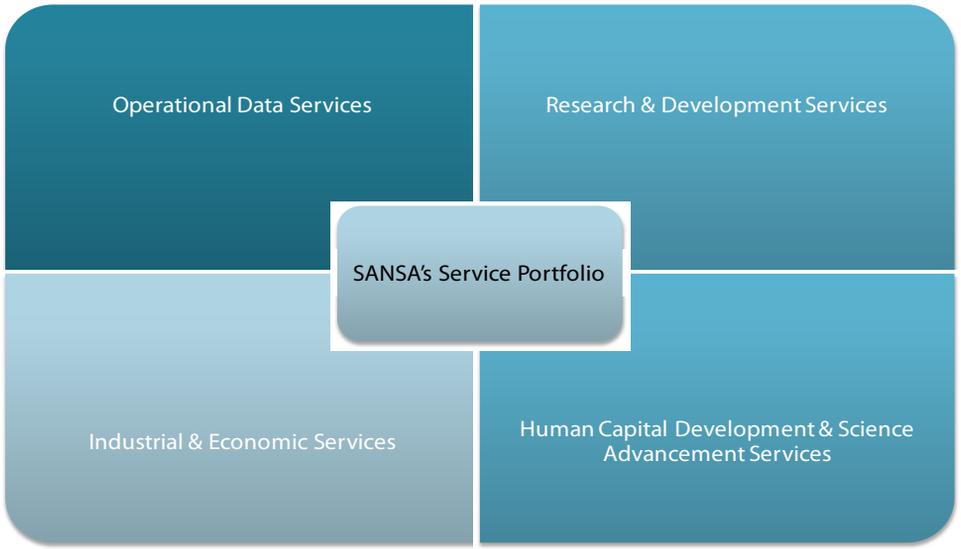


Figure 2: SANSA's Service Portfolio

5.1.3 Operational data services

SANSA provides geo-spatial data, value-added data products, information and services for the operational needs of the country, which include:

I. Decision-making, policy-making and planning instruments
II. Government's service delivery performance monitoring and evaluation
III. Agriculture and food security service
IV. Water resource management
V. Disaster management
VI. Safety and security
VII. Space weather and geo-space services.

5.1.4 Research and development (R&D) services

SANSA also provides R&D institutions and tertiary education institutions with operational data services to serve the intellectual, technological and innovation needs of the country and contribute to the global body of data and knowledge. These services include:

I. Data procurement and acquisition
II. Low-level data processing, archiving and distribution
III. R&D platform provision
IV. Research and development
V. Facilitation of R&D application.

SANSA will stimulate capability development by funding and supporting R&D programmes in partnership with other national institutions.

5.1.5 Human capital development (HCD) services

SANSA provides the HCD services indicated below to address the country's skills needs and increase an awareness and interest in science:

I. Human capital development programmes
II. Science advancement
III. Public engagement.

5.1.6 Industrial and economic services

SANSA undertakes the following services to ensure South Africa's global competiveness:

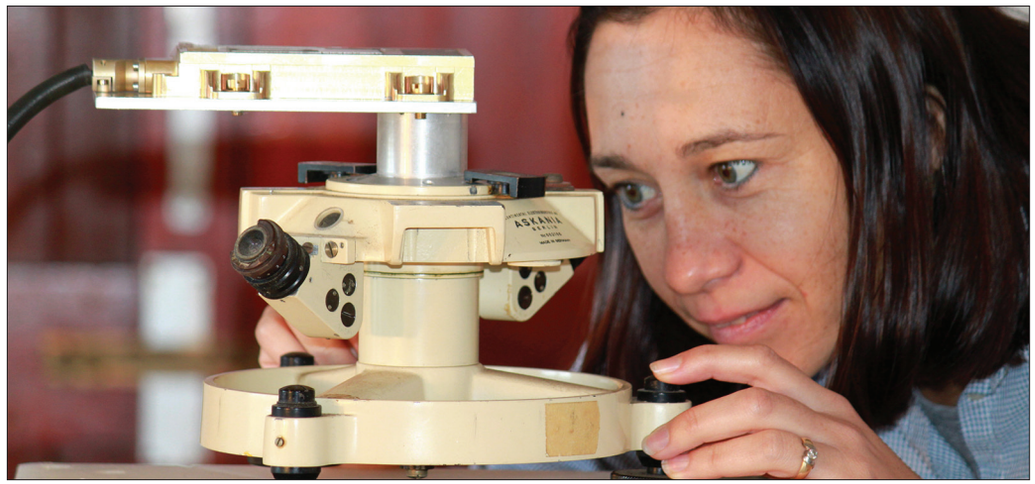
I. Space operations for the space industry
II. Positioning, navigation and timing services
III. Promotion of industry participation in Earth observation, space operations, space science and space engineering programmes
IV. Creation of international opportunities for South African industries through global partnerships.

5.2 Organisational Environment

Structurally, SANSA consists of a Corporate Office and four directorates to give effect to its goals. These are:

- SANSA Corporate Support
- SANSA Earth Observation
- SANSA Space Operations
- SANSA Space Science
- SANSA Space Engineering.

The organogram on the next page reflects the space agency's directorates, programmes and goals



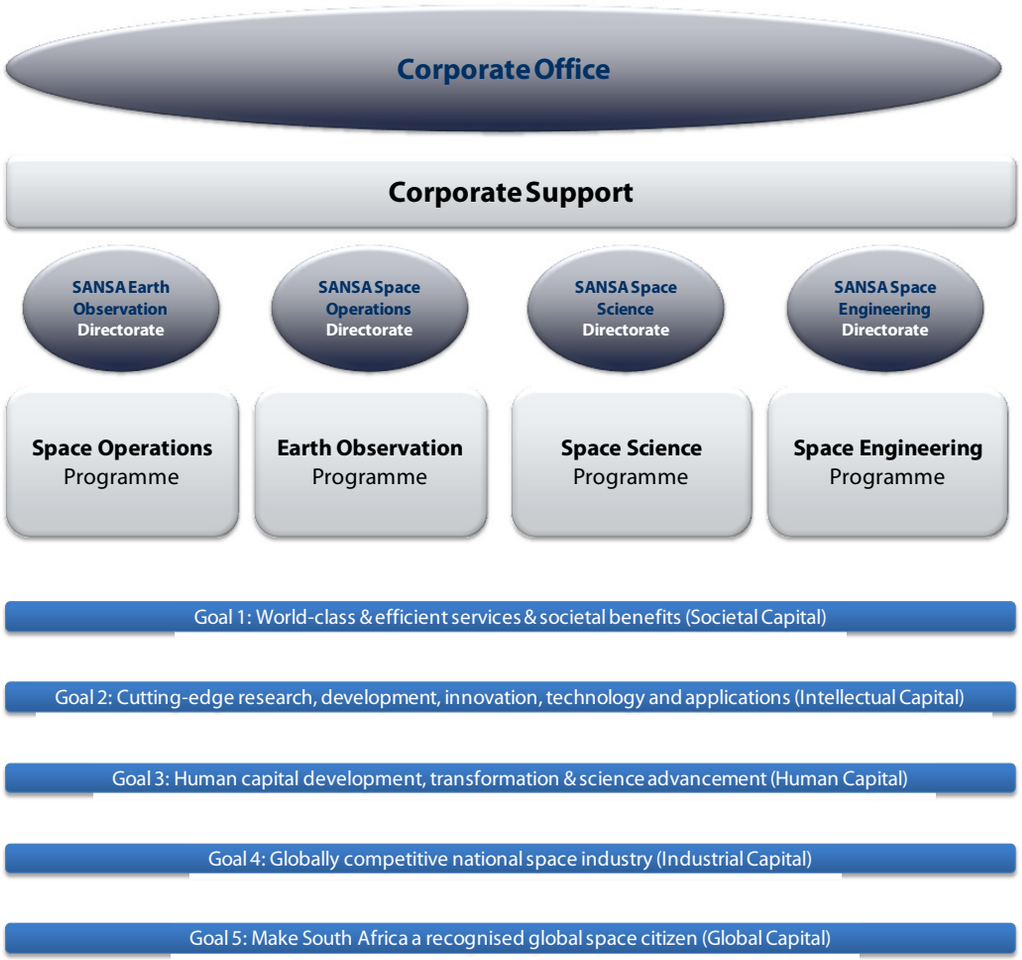


Figure 3: SANSA organisational structure

SANSA's directorates have domain-specific expertise that is more relevant to one specific goal than the others.

Figure 4 indicates the goal focus matrix of the directorates. This matrix depicts the level of focus the directorate devotes to a particular goal in terms of various factors including, the scope of activities, effort, priority programmes, resource allocation, and significance of outputs and anticipated impact.

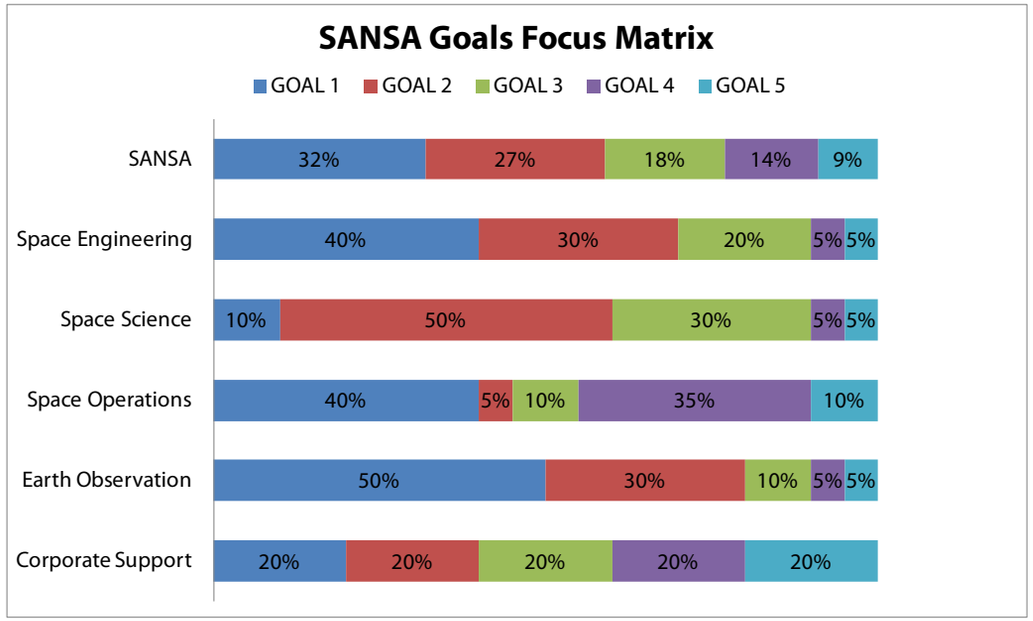


Figure 4: Focus matrix for SANSA goals

5.3 Strategic planning process

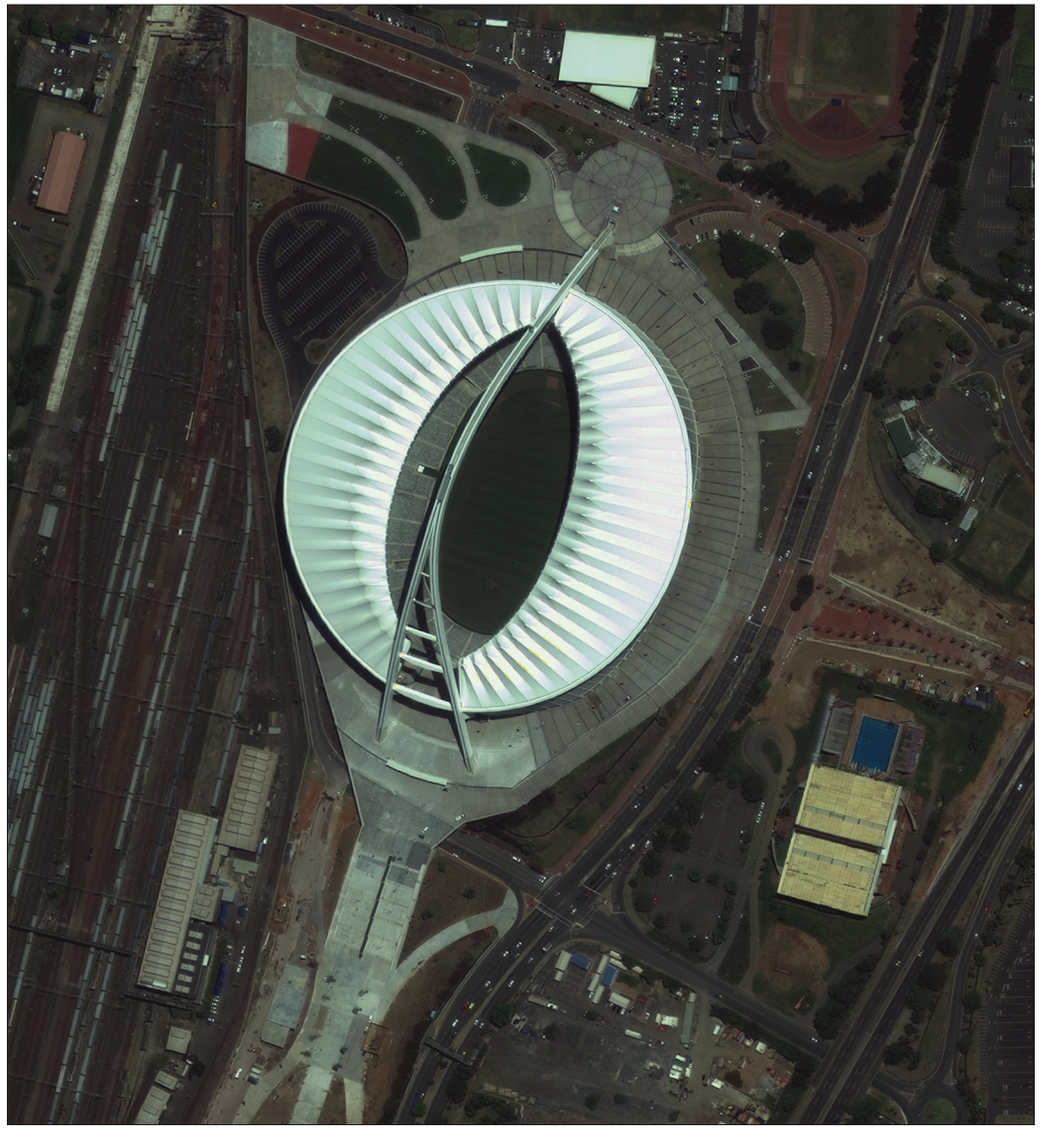
The development of this strategy involved consultation with the Department of Science and Technology and several workshop sessions with the SANSA directorates, as well as a board strategic workshop and several board planning meetings.

6 STRATEGIC OUTCOME-ORIENTED GOALS

6.1 SANSA's value proposition

The raison d'être for the existence of SANSA is encapsulated in the Agency's five point value proposition as outlined below:

Figure 5: SANSA value proposition



6.2 SANSA's strategic goals

SANSA's five strategic goals flow from its value proposition and are reflected in Table 2.

Table 2 SANSA Goals

Strategic Outcome - Oriented Goal 1	World-class and efficient services and societal benefits (Societal Capital)
Goal statement	SANSA contributes to the improvement of the quality of the life of South Africans in a sustained and conserved environment through the use of space science and technology for day-to-day societal benefits and the operational needs of the country. This is achieved through the provisions of geo-spatial data, value-added data products, information and services, including: I. Decision-making, policy-making and planning instruments II. Agriculture and food security services III. Water resource management IV. Disaster management V. Safety and security VI. Space weather and geo-space services.
Strategic Outcome - Oriented Goal 2	**Cutting-edge research, development, innovation, technology and applications (Intellectual Capital)**
Goal statement	SANSA uses space science and technology as a vehicle to increase South Africa's intellectual capital, advanced technological capital and global new knowledge share. This is achieved through the provision of geo-spatial data, value-added data products, information and services to R&D and tertiary education institutions to serve the intellectual, technological and innovation needs of the country and contribute to the global body of data and knowledge through: I. Data procurement and acquisition II. Low-level data processing, archiving and distribution III. R&D platform provision IV. Research and development V. Facilitating the application of R&D VI. Different vehicles including the provision of enabling funding will be instituted to promote this

Strategic Outcome - Oriented Goal 3	Effective development of human capital, transformation and science advancement (Human Capital)
Goal statement	SANSA trains and develops South Africans in key areas of national importance; promotes the uptake and appreciation of science by the youth; and improves the overall scientific literacy and engagement of our populace. This is achieved through the provision of: I. Human capital development programmes II. Science advancement III. Public engagement.
Strategic Outcome - oriented Goal 4	**Globally competitive national space industry (Economic Capital)**
Goal statement	SANSA provides South Africa with the necessary space applications and services that are increasingly permeating and driving successful economies around the world to ensure South Africa's global competitiveness through: I. Space operations for the space industry; II. Positioning, navigation and timing services; III. Promotion of industry participation in Earth observation, space opertions, space science and space engineering programmes; and IV. Creating international opportunities for South African industries through global partnerships.
Strategic Outcome - oriented Goal 5	**Make South Africa a recognised global space citizen (Global Capital)**
Goal statement	SANSA is the primary point of contact and face of South Africa in the global space arena and a vehicle for strategically positioning the country within the community of space faring nations.

6.3 SANSA's stakeholders

SANSA's value proposition and the aligned strategic outcome-oriented goals are targeted at a wide stakeholder community that will benefit from the agency's value creation as mapped in Figure 6.

SANSA aims to ensure that space science and technology is an integral part of all aspects of South Africa's human endeavour and the improvement and sustainability of livelihoods. To this end, SANSA will support and partner with other R&D institutions.

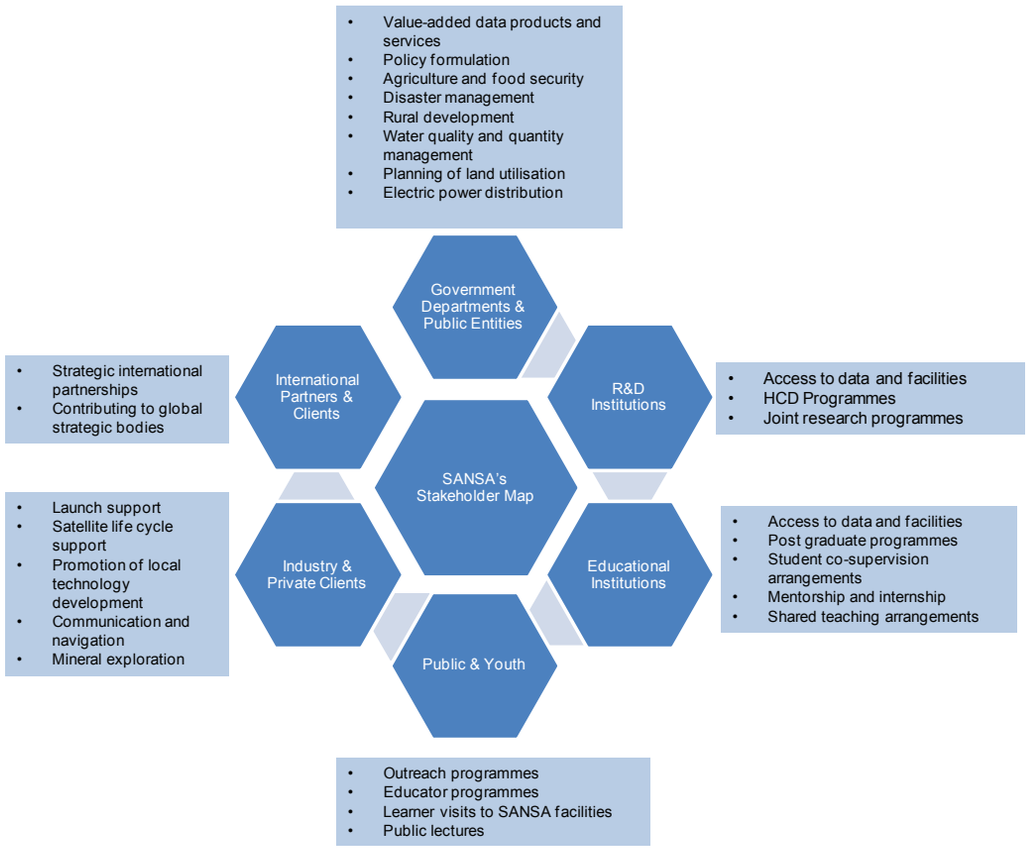


Figure 6: SANSA stakeholder mapping and some typical services and applications.

PART B -
Strategic Programmes, Objectives & Targets for 2017

7 STRATEGIC PROGRAMMES

7.1 Strategic programme context

7.1.1 The national fit of strategic programmes

SANSA is tasked with coordinating and driving the implementation of the National Space Strategy (NSS) and the National Space Programme (NSP). SANSA's strategy is given context by the overarching framework of the NSP, which is outlined in Part C. The NSP consists of two tiers of programmes, namely the Core Functional Programmes (CFP) and Capacity Building Programmes (CBP).

The Core Functional Programmes of the NSP reflect SANSA's five strategic programmes, namely:

I. Corporate support
II. Earth Observations
III. Space Operations
IV. Space Science
V. Space Engineering.

As the nucleus of the NSP, these programmes will complement and interface with the Capacity Building Programmes. The latter will include Centres of Competence, Centres of Excellence, Research Chairs, specialised R&D projects and specialised HCD programmes.

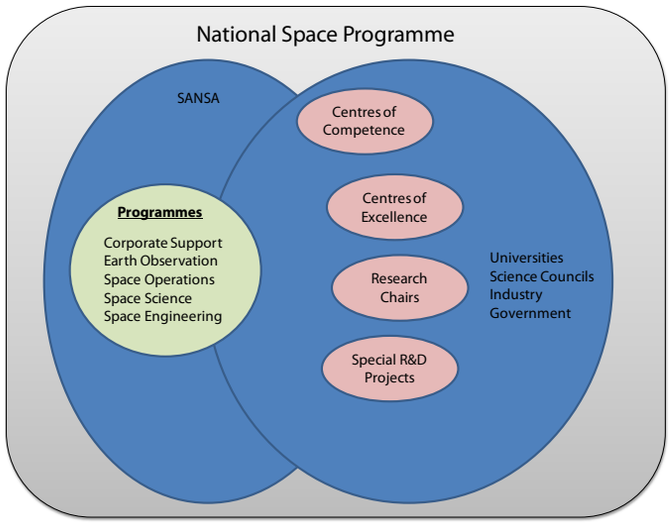


Figure 8: Graduate availability across all fields in 2004 (Source: SA Science and Technology Indicators, 2010)

7.1.2 Cross-cutting priorities

SANSA's Human Capital Development and Science Advancement activities are cross-cutting priorities that support all the agency's programmes.

Human capital development (HCD)

SANSA's HCD goals are articulated in the strategic plan of the Department of Science and Technology and the NSS. These include partnering with local higher education institutes, science and research councils and international organisations to initiate and produce BSc, Honours, MSc and PhD level graduates in space science and technology.

The primary HCD objective is to contribute to equity and transformation. Statistics for 2004 in this regard indicated that only about 48% black graduates became available across all fields, which was disproportionally low in relation to the national demographics. The lack of representation was more pronounced in the engineering sectors, where gender disparity was also a concern, with the availability of female graduates and female engineers at only 48% and 16%, respectively.

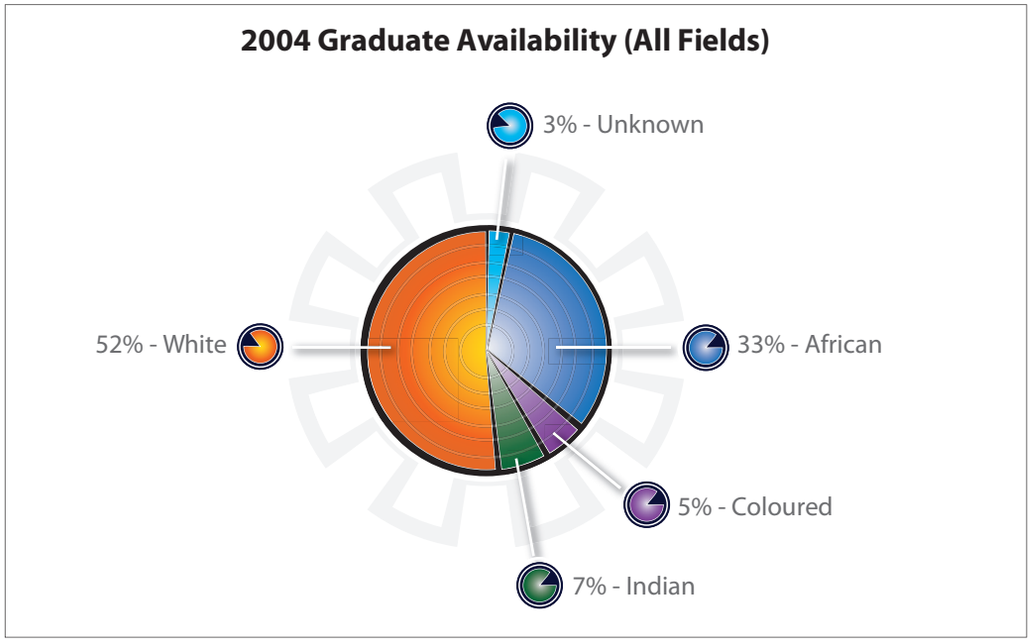


Figure 9: Availability of engineers in 2004 (Source: SA Science and Technology Indicators, 2010)

Government's New Growth Path (NGP) identifies the green economy and the knowledge economy as central to job creation and sets targets of 300 000 new jobs for the green economy and 100 000 for the knowledge intensive sectors by 2020. The NGP also emphasises the need to promote on-the-job training. South Africa's low technology base and unfavourable rating (ranked 54 out of 139 countries in this regard in 2010) are a result of low numbers of knowledge workers.

SANSA's three pronged HCD offering includes formal student programmes, internship and volunteer programmes, and in-service training programmes.

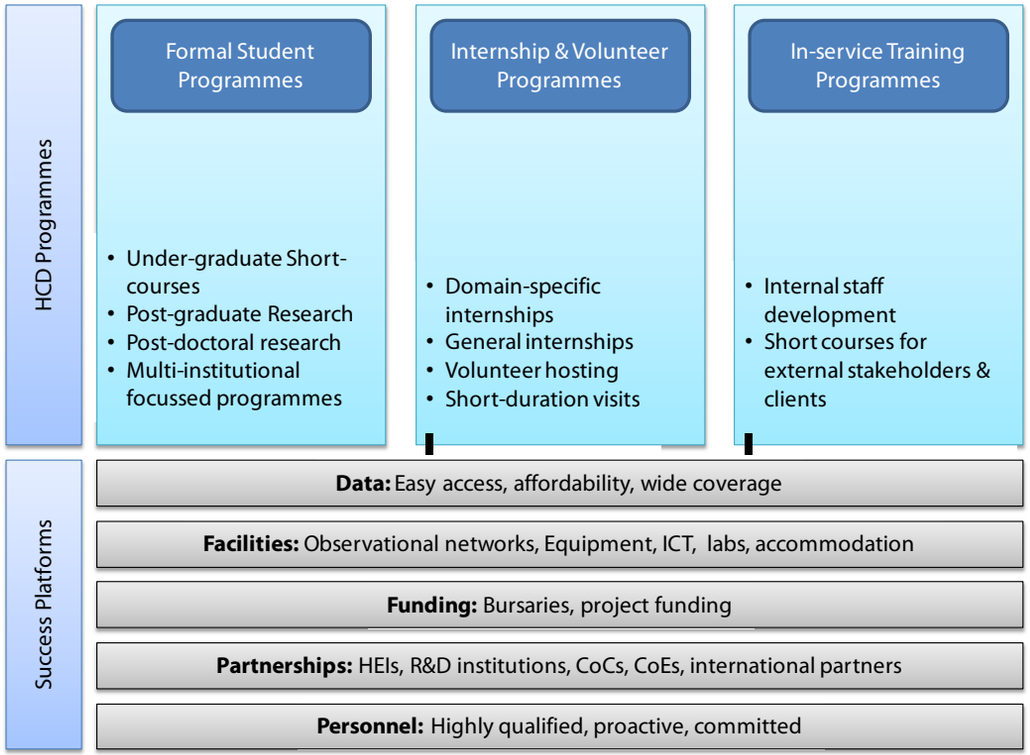


Figure 10: SANSA's HCD offering

Science advancement and public engagement

The most mutually beneficial long-term return on investment in space science and technology is that of instilling the knowledge and motivation in our youth that they, too, can participate in the country's future scientific and technological achievements.

Inspiring the hearts and minds of the youth to pursue science and technology as a career is the single largest sustainable economic multiplier for a country. South Africa needs more learners in the science, engineering and technology (SET) fields. In 2010, only 14% of all learners matriculated with mathematics. The SET at higher education institutions (HEIs) stood at 28.3% in 2009, which was about 1% less than previous year. At the postgraduate level, SET enrolments were even lower with 15% in 2009.

South Africa cannot meet its technology and innovation demands with these low SET numbers. Fundamentally, the mathematics and science student pipeline needs to increase significantly to create a larger SET student pool at HEIs. A system-wide modelling needs to be conducted to ensure adequate numbers throughout the system.

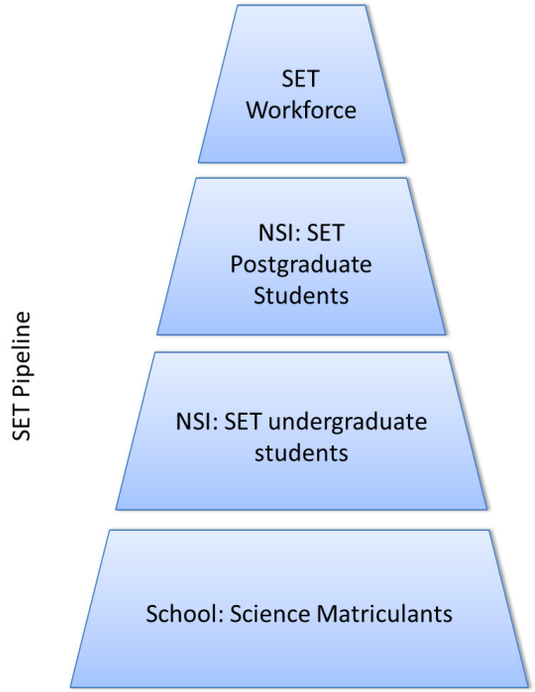


Figure 11: The SET pipeline

SANSA's role in increasing the SET pipeline ranges from stimulating interest in science and infusing space science into the South African curriculum to undergraduate and postgraduate student training, work-force training and employment.

More specifically, the space agency's three themes in science advancement focus on:

- Learner programmes, which consist of science centre activities; learner/school visits; learner lessons; supplementary classes; science exhibits; and science festivals participation.
- Educator programmes, which entail educator workshops; curriculum development; and educator visits.
- Public engagement, which includes public lectures; open days; media liaison; and Space Week.

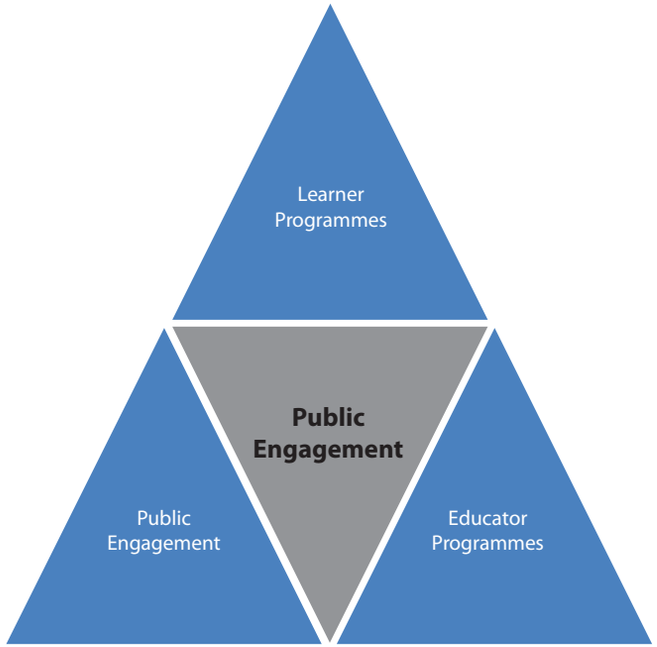


Figure 12: SANSA science advancement

It is important for SANSA to partner with other science advancement entities, such as the South African Agency for Science and Technology Advancement (SAASTA), Science Centres, NGOs and private sector companies with science advancement portfolios.

7.2 SANSA strategic programmes

7.2.1 Programme 1: Corporate Support

7.2.1.1 Programme Overview

The SANSA Corporate Office ensures that the agency is operationally efficient, cost-effective and properly managed, complies with good corporate governance principles and fosters seamless integration and collaboration between all SANSA directorates.

This is achieved through key corporate management functions for the executive and administration; human resources; finance and supply chain; information and communications technology; planning and performance; stakeholder relations; corporate communication and science advancement; audit and risk; and board secretariat and legal management services.

Figure 13: Corporate support structure

7.2.1.2 Strategic Objectives

The Corporate Support programme has three key objectives, namely:

1. Leadership excellence
2. Management excellence
3. Operational excellence

The measure of success for each on these three objectives is through a corresponding Excellence Index. Each index is a weighted composite of the performance in the Key Performance Areas (KPAs) specified in Figure 14.

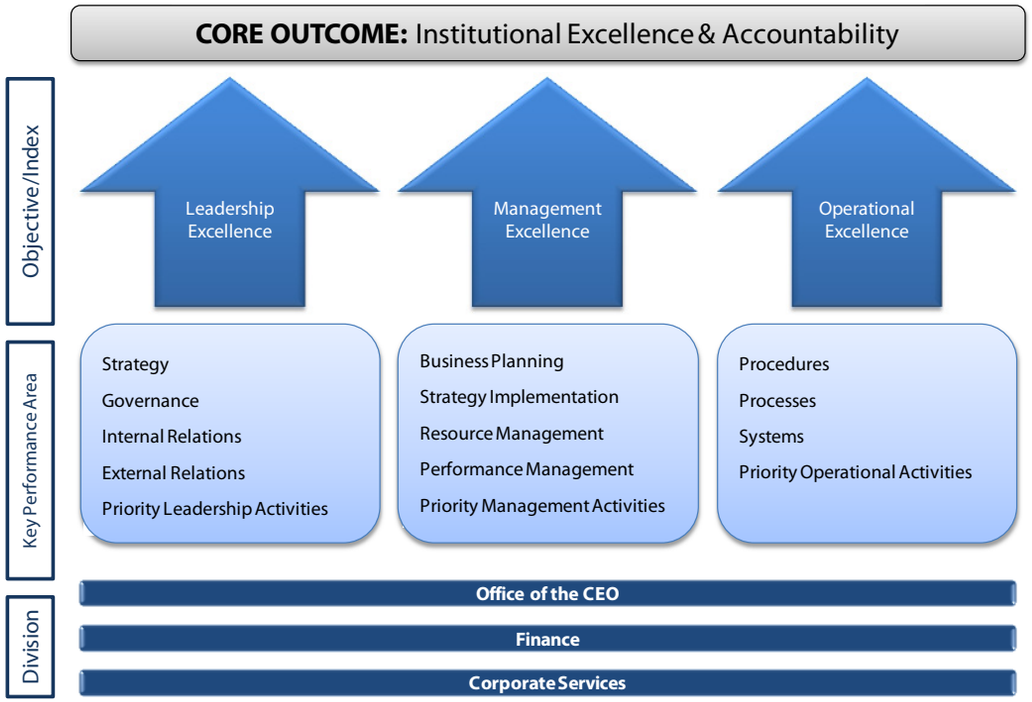


Figure 14: Core outcomes.

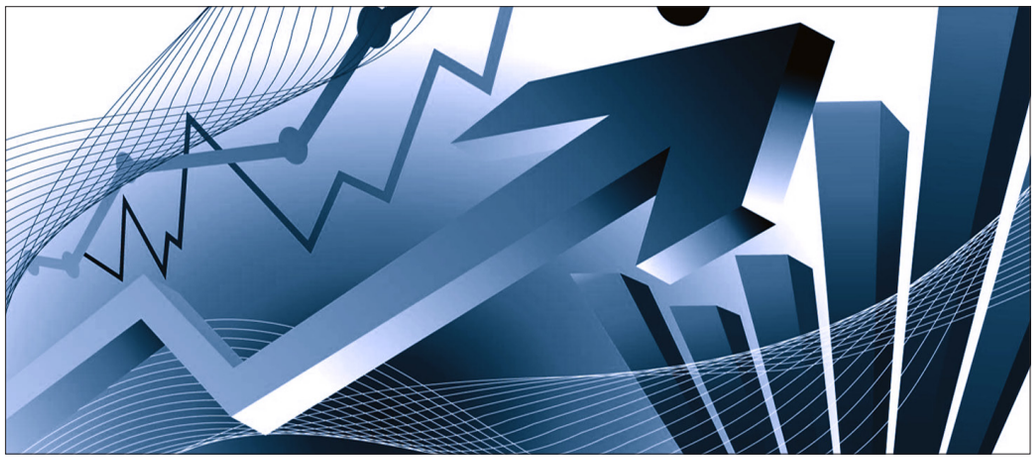
Objective / Index	**Leadership Excellence**
Ensure that SANSA's leadership is excellent	
Baseline	Foundational institutional leadership
Indicator	• Strategic leadership • Good corporate governance • Good internal relations • Good external relations
Five-year target	Fully functional agency with effective leadership. The measure of success for this objective is through an Excellence Index. The index is a weighted composite of the performance in the Key Performance Areas (KPAs) specified in Figure 14.
Justification	Fully functional SANSA with all leadership instruments implemented
Links	Outcome 12: An efficient, effective and development- oriented public service as an empowered, fair and inclusive corporate citizen. This will be achieved through good planning, monitoring, evaluation and reporting..

Objective/ Index	**Management Excellence**
Ensure that SANSA's management is excellent	
Baseline	Foundational institutional management
Indicator	• Good business planning • Efficient and effective strategic implementation • Good resource management • Good performance management
Five-year target	Fully functional agency with effective leadership. The measure of success for this objective is through an Excellence Index. The index is a weighted composite of the performance in the Key Performance Areas (KPAs) specified in Figure 14.
Justification	Fully functional SANSA with all management instruments implemented
Links	Outcome 12: An efficient, effective and development- oriented public service as an empowered, fair and inclusive corporate citizen. This will be achieved through good planning, monitoring, evaluation and reporting..

Objective/ Index	Operational Excellence
Ensure that SANSA's operations are excellent	
Baseline	Foundational institutional operations
Indicator	• Operational efficiency and effectiveness in all key operational areas
Five-year target	Fully functional agency with effective leadership. The measure of success for this objective is through an Excellence Index. The index is a weighted composite of the performance in the Key Performance Areas (KPAs) specified in Figure 14.
Justification	Fully functional SANSA with all operational instruments implemented
Links	Outcome 12: An efficient, effective and development- oriented public service as an empowered, fair and inclusive corporate citizen. This will be achieved through good planning, monitoring, evaluation and reporting..

7.2.1.3 Resource considerations

Based on 2012 MTEF allocation and applying a 5% escalation for the fourth and fifth year of the five year strategic horizon, it is projected that the annual expenditures for the SANSA Corporate Office will range from R32 million to about R39 million over the period. The total expenditure over the five years will be R178 million. The split between the major expenditure classes is presented in Figure 15.



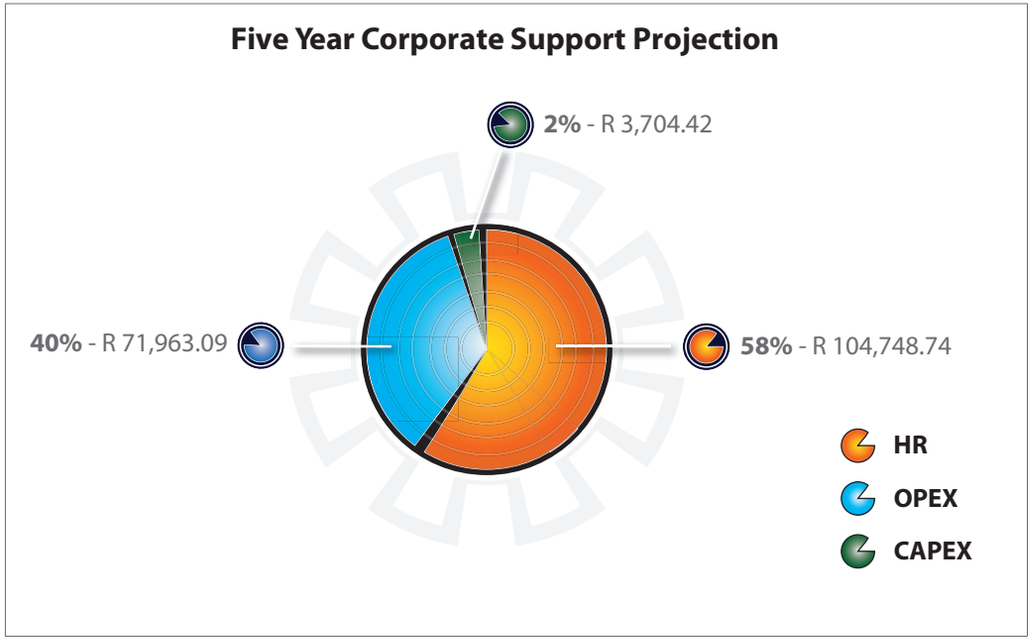


Figure 15: Five-year projected expenditure for corporate support (in R'000).

7.2.1.4 Risk Management

The following risk factors need to be considered in the Corporate Office:

Inability to unlock the value of the Corporate Office to the directorates of SANSA

A risk exists within SANSA that the difficulty in harmonising compliance with performance in the highly specialised space environment will continue into the future. Aligning legislative frameworks compliance with the smooth running of the agency is a challenge that resonates throughout the public sector and is compounded by continual enhancements to the public sector financial and compliance frameworks by the National Treasury.

SANSA's directorates are dependent on the ability of the functions within the Corporate Office to create an enabling business environment through well-developed and need-specific policies and procedures and a proactive and timeous response to the expected and unexpected deviations faced by the directorates. A constructive business relationship between the Corporate Office and directorate management will ensure that the value offered is fully and optimally utilised. Institutional cohesion and an attractive employee value proposition will create an effective organisation that delivers value for the tax-payer.

Lack of visibility of SANSA and creating knowledge of its value to the country

The benefits of space science and technology and SANSA's relevance in this regard must be communicated constantly to mitigate the risk of a divided public opinion about the need for a dedicated space agency in South Africa.

A concerted and coherent effort is required to emphasise the value of space science and technology and the reality of its day-to-day socio-economic application to improve the quality of life of ordinary people. SANSA's ability to source external funding, increase its parliamentary grant income and create human resource capacity within the space industry, will benefit greatly from a well-known, well-positioned public image that gives it stature and prominence throughout the country and the global space community.

Participation in projects such as those that improve government's service delivery, resource and environmental management, disaster management, decision-making and planning, as well as in international and local conferences and media engagements, provide ideal opportunities to achieve greater visibility and highlight SANSA's achievements and value-added service offerings to the African region.

7.2.2 Programme 2: Earth Observation

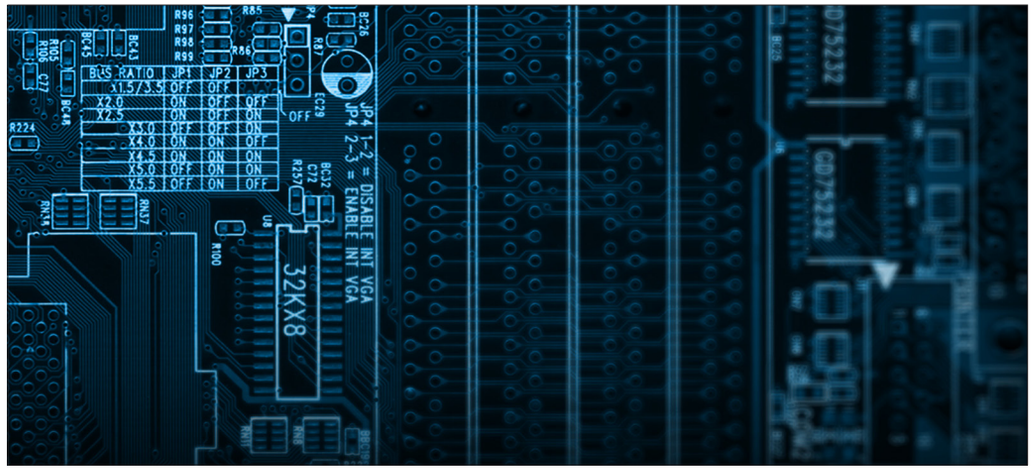
7.2.2.1 Programme overview

Earth observation gets unprecedented importance globally, with an increased focus and expenditure on Earth system monitoring activities.

These efforts are led by various international bodies, including the Group on Earth Observations (GEO), co-chaired by South Africa, Global Earth Observation System of Systems (GEOSS) and Committee on Earth Observation Satellites (CEOS). A common theme is the global coordination of Earth observation initiatives to primarily benefit humanity in a sustained and Earth-friendly manner as the world strives to attain the Millennium Development Goals (MDGs) by 2015.

SANSA, as one of the contributing agencies of the South African Earth Observation Strategy (SAEOS), fulfils this strategic objective through the SANSA Earth Observation directorate. In collaboration with external partners, the directorate will drive six operational themes, as follows:

I. **Environmental management:** With an ever-increasing global population and the associated increase in demand for natural resources and consequent degradation of the environment, satellites are central to ensuring better and sustainable livelihoods. Services include environmental monitoring and assessment; global change monitoring; environmental policy formulation and enforcement
II. **Resource and asset management:** SANSA uses satellites to monitor various resources, including: water, agricultural produce and livestock, energy, and fish stock, to name a few. Satellites are also used for asset and infrastructure management, including the monitoring of roads, dams, bridges, logistics, fleets, etc.
III. **Planning, service-delivery mtonitoring and development:** Rapid satellite imaging of large areas creates a bird's eye view that can improve planning, service delivery monitoring and decision-making. SANSA uses satellite images for rural development, urban planning, informed decision-making and policy-making. Areas of application include human settlement planning and environmental policy formulation and enforcement.
IV. **Health, safety and security:** Satellites provide a broad perspective that is useful for cross-border health, safety and security monitoring. Satellites can, for example, be used to monitor mosquito-borne diseases like malaria; cross-border theft; drug trafficking; African peace-keeping; and crime prevention and monitoring. Satellites are also used for national security and intelligence gathering.
V. **Disaster management:** On an Earth that is so disaster-prone, satellite imagery support disaster forecasting, monitoring, assessment and mitigation. These all contribute to reduced loss of life and disruptions, huge cost savings and the mitigation of even more severe human catastrophes. Recently, South Africa's own satellite, SumbandilaSat, was used to monitor the floods in Namibia and the effects of the tsunami in Japan. Satellite imagery is also used to predict space weather changes that affect communications, electric power distribution and aviation.
VI. **Industrial services:** Different industry-relevant services are available, such as industry-specific geospatial data.



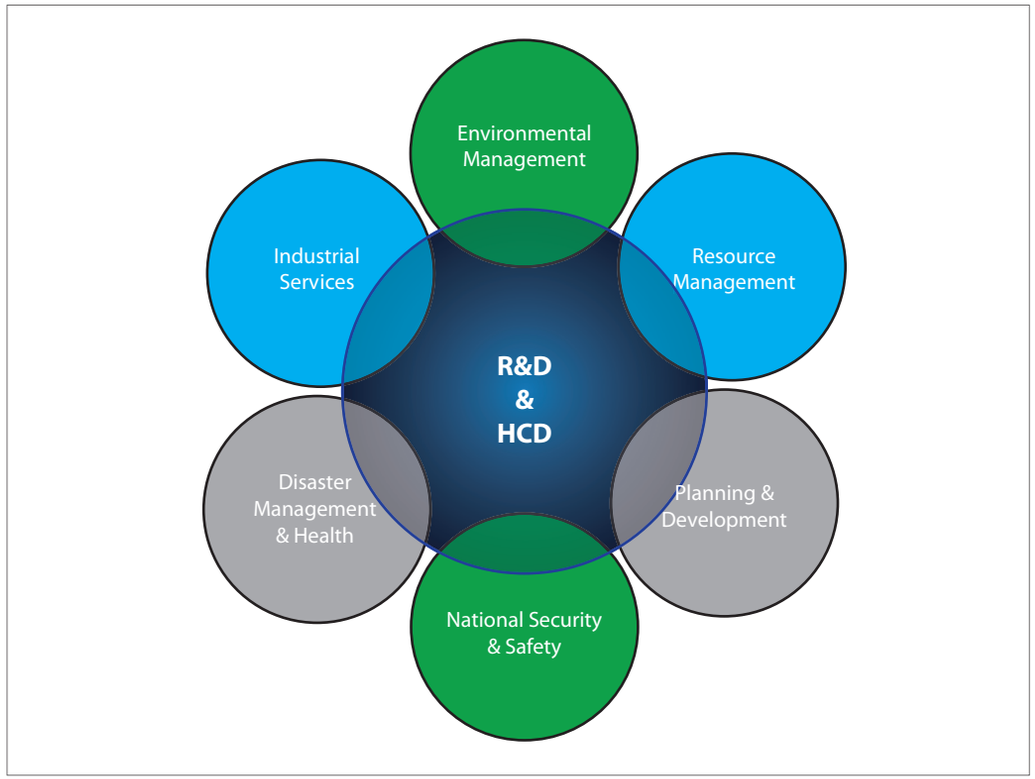


Figure 16: Six operational themes.

The operational themes indicated in Figure 16 above are underpinned by cross-cutting R&D and HCD activities. This will ensure continual improvement in SANSA's services and products and increase its internal skills base and those of its clients.

7.2.2.2 Global trends and SANSA's strategic positioning in Earth observation

The dynamic nature of the global satellite-based Earth observation landscape has seen a significant increase in the number of governments that use EO as an entry point into a space programme. Global EO expenditure peaked at $8 billion in 2010, with a $5.9 billion (74%) spend on civil operations and $2.1 billion (26%) used for non-classified defence operations. There has been an increase in dual-use missions that share data between civilian and defence activities.

During the previous decade (2001-2011), 113 EO satellites were launched, while 202 are planned for launch during the current decade (2011-2020). Asia is the leading country in both instances.

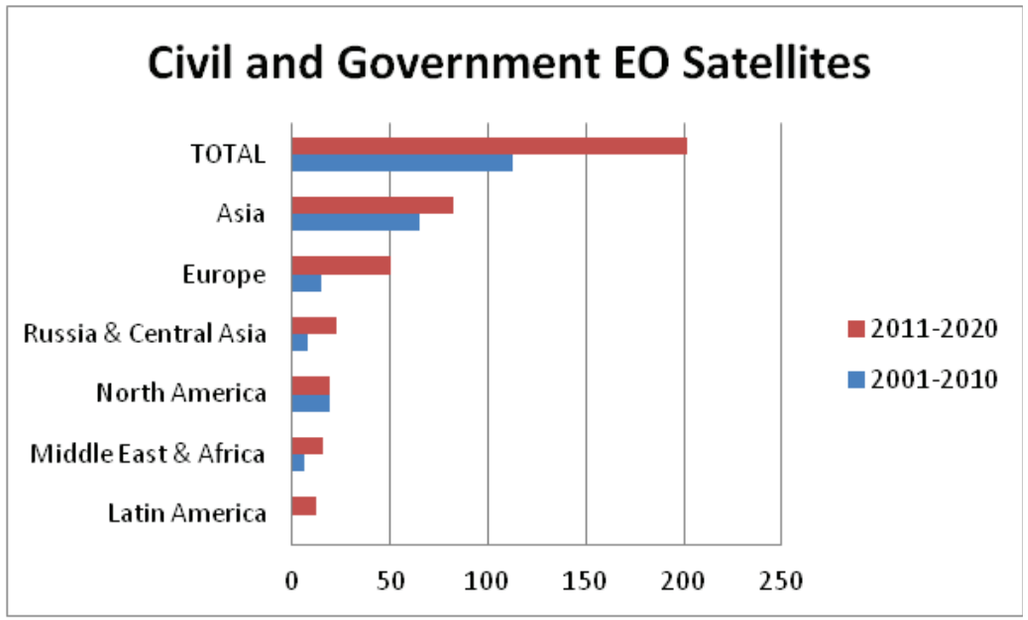


Figure 18: Global 2010 EO civil expenditure.

In the African region, the BRICS partners, including South Africa, have also intensified their EO civil programmes (see Figure 19 below). On the African continent, Algeria launched AlSat 1 in 2002 and contracted EADS Astrium for two satellites: AlSat 2(a) (2.5 m resolution), launched in 2010, and AlSat 2b planned for launch in 2011. AlSat 1b is also planned for 2011 as a successor of AlSat 1 (medium-resolution). Nigeria procured NigeriaSat-2 (2.5 m resolution) for launch in 2010 from SSTL. Both the Algerian and Nigerian contracts had technology transfer obligations. Egypt launched its acquired EO/technology satellite in 2007 which has a high-resolution multispectral imager.

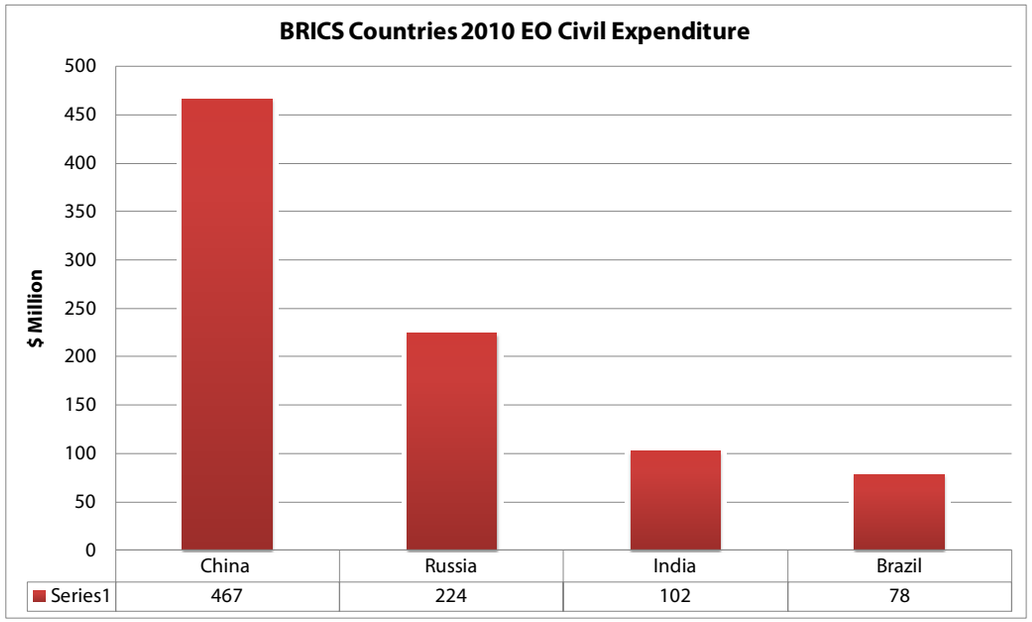


Figure 18: Global 2010 EO civil expenditure.

Strategic partnerships are the cornerstone for any credible space programme. SANSA has Memoranda of Understanding (MoUs) with Russia, Brazil and China on EO programmes and a dialogue with the EU/ESA in this regard. In the African context, an inter-governmental African Resource Management Constellation (ARMC) partnership exists between South Africa, Algeria, Nigeria and Kenya.

Partnerships such as these need to be vigorously pursued as governments are making more and more data freely available, e.g. Russian data, CBERS, data democracy initiatives, ALOS, GMES/Sentinels, GEO/GEOSS programmes and CEOS partnerships.

Recognising that South Africa already has a vibrant and diverse community that delivers a wide spectrum of Earth Observation services and products, it is important that these efforts are better coordinated to ensure better synergy and the minimisation of duplication. SANSA has a role in mobilising this community for better effectiveness and linking it to the Southern African region, the continent and global community. This has to be done in line with SA-GEO efforts as led by the DST. The roll-out of AfriGEOSS will ensure and improve intra-continental partnerships and more coherent global participation by Africa.

SANSA's primary EO strategy
Services and products that create greater value for society

How can this be achieved?
- Increase usage of the services and products
- Undertake projects that have higher societal impact and relevance

Which tactical steps need to be taken?
(a) Infuse space science and technology into government service delivery platforms
(b) Increase the user/stakeholder base through in-service training of government personnel
(c) Improve the availability and affordability of data, value-added data products and services
(d) Understand user/stakeholder needs and align service platforms and product offerings accordingly
(e) Prioritise high-impact projects that benefit society.

7.2.2.3 Strategic Objectives

Table 3 Strategic objectives: SANSA Earth Observation (EO)

Strategic Outcome - Oriented Goal 1	World-class and efficient services and societal benefits (Societal Capital)	
Strategic objective 2.1	Offer efficient EO services and products to benefit national and international societies and sustain the environment.	
Baseline	• 4000 images acquired and archived (EO1) • 40 000 images distributed (EO2)	
Five-year target	• 5000 images acquired and archived (EO1) • 60 000 images distributed (EO2)	
Justification	Geo-spatial information for natural resource management, sustainable environmental management, agricultural food security, rural development and urban planning, disaster management, policy formulation and decision making.	
Links	Outcome 1	Improved quality of basic education This will be achieved through imagery for educational planning.
	Outcome 2	A long and healthy life for all South Africans This will be achieved through health and cross-border health risk surveillance and pollution monitoring.

	Outcome 2	A long and healthy life for all South Africans This will be achieved through health and cross-border health risk surveillance and pollution monitoring.
	Outcome 7	Vibrant, equitable and sustainable rural communities with food security for all This will be achieved through rural development and planning, as well as agricultural monitoring.
	Outcome 8	Sustainable human settlements and improved quality of household life. This will be achieved through human settlement planning.
	Outcome 9	A responsive, accountable, effective and efficient local government system. This will be achieved through municipal and local government planning.
	Outcome 10	Environmental assets and natural resources that are well-protected and continually enhanced. This will be achieved through environmental and resource monitoring.
	Outcome 11	A better South Africa and improved and safer Africa and world. This will be achieved by providing EO services to the continent and the world through global partnerships and data democracy initiatives.
	Outcome 12	An efficient, effective and development-oriented public service and an empowered, fair and inclusive society. This will be achieved through the provision of planning, monitoring, decision-making and enforcement tools to all spheres of government.

Strategic Outcome - Oriented Goal 2	**Cutting-edge research, development, innovation, technology and applications (Intellectual Capital)**
Strategic objective 2.2	Conduct cutting-edge research, development and innovation to continually improve SANSA's EO offering.
Objective statement	Improved data storage, processing techniques and value-added services and products.
Baseline	• 15 000 images distributed for research (EO4) • 10 technical reports and research publications (EO6)
5-Year Target	• 20 000 images distributed for research (EO4) • 10 technical reports and research publications (EO6)
Justification	Data for research, knowledge creation and human capital development
Links	Outcome 4: Decent employment through inclusive economic growth. This will be achieved through R&D programmes that create new knowledge and develop skills.
	Outcome 5: A skilled and capable workforce to support an inclusive growth path. This will be achieved through R&D programmes that create new knowledge and develop skills.

Strategic Outcome-Oriented Goal 3	**Effective development of human capital, transformation and science advancement (Human Capital)**
Strategic objective 2.3.	Development of human capital in EO-related science and engineering, and advanced science, amongst the youth and the public.
Objective statement	Structured and funded HCD programmes to create greater space awareness
Baseline	• 5 students/interns supported/trained (EO7) • 2 short courses conducted (EO9) • 40% of permanent staff from designated groups in the top two management levels (manager, senior manager) (EO12)
Five-year target	• 6 students/interns supported/trained (EO7) • 3 short courses conducted (EO9) • 65% of permanent staff from designated groups in the top two management levels (manager, senior manager) (EO12) • 3000 learners reached through direct and specific engagement (EO15)
Justification	Train students and personnel in remote sensing, image processing, data management, electronics and satellite technology to increase the national skills base in these areas
Links	Outcome 4: Decent employment through inclusive economic growth. This will be achieved through training programmes that create new knowledge and develop skills.
	Outcome 5: Decent employment through inclusive economic growth. This will be achieved through training programmes that create new knowledge and develop skills.

Strategic Outcome-Oriented Goal 4	Globally competitive national space industry (Economic Capital)	
Strategic objective 2.4	Provide services that stimulate industry growth and participation in EO	
Objective statement	Active SANSA EO-industry partnership framework	
Baseline	3 joint or outsourced projects with industry (EO13)	
Five-year target	4 joint or outsourced projects with industry (EO13)	
Links	Outcome 4	Decent employment through inclusive economic growth This will be achieved through R&D programmes that create new knowledge and develop skills.
	Outcome 5	A skilled and capable workforce to support an inclusive growth path This will be achieved through R&D programmes that create new knowledge and develop skills.
	Outcome 6	An efficient, competitive and responsive economic infrastructure network This will be achieved through economic infrastructure monitoring and management, including roads management.

Strategic Outcome-Oriented Goal 4	Make South Africa a recognised global space citizen (Global Capital)	
Strategic objective 2.5	Establish and maintain effective and mutually beneficial international EO partnerships aligned with national strategic priorities.	
Objective statement	Strong and effective EO international partnerships	
Baseline	2 multi-national projects (EO14)	
Five-year target	3 multi-national projects (EO14)	
Justification	Enhance South Africa's global stature and competiveness in space science and technology through effective international partnerships	
Links	Outcome 11	Create a better South Africa and contribute to an improved and safer Africa and world This will be achieved through EO services to the continent and the world through global partnerships and data democracy initiatives.

7.2.2.4 Resource Considerations

Personnel: The SANSA Earth Observation directorate requires a core team of specialists that span a broad EO domain to deliver on SANSA's EO objectives. It must also entrench existing and establish new partnerships within the remote sensing and space Earth observation communities, predominantly located in universities and science councils. Mobilising this resource base will create sufficient capacity to deliver a range of applications within the six identified themes. The EO staff numbers are projected to increase from 20 to about 35 within three years and to about 45 within five years.

The EO directorate will play a leadership role in aligning the EO innovation chain and its participants with a national outcomes solution-focus to improve planning, resource management, disaster management and information-based products for health, safety and security.

Human capital development: SANSA will pursue an aggressive HCD programme to increase the use of EO services and products, as well as the number of geo-informatics practitioners within government and the wider community.

This will also create transferable skills in software development, data and image processing and related areas. The SANSA EO directorate will focus on smart instruments to, among others, establish university programmes, support studentship programmes and conduct training programmes. Resources permitting, the annual trainee/student enrolment numbers within the NSP are projected to increase to 33 (three-year target) and 55 (five-year target) as reflected in Figure 20.

In addition to PhD and Masters training, attention will be given to Honours training to create a larger pool of EO practitioners in the public sector. This need is aligned with initiatives within the broader university education sphere and other public sector training to address skills shortages in specific areas.

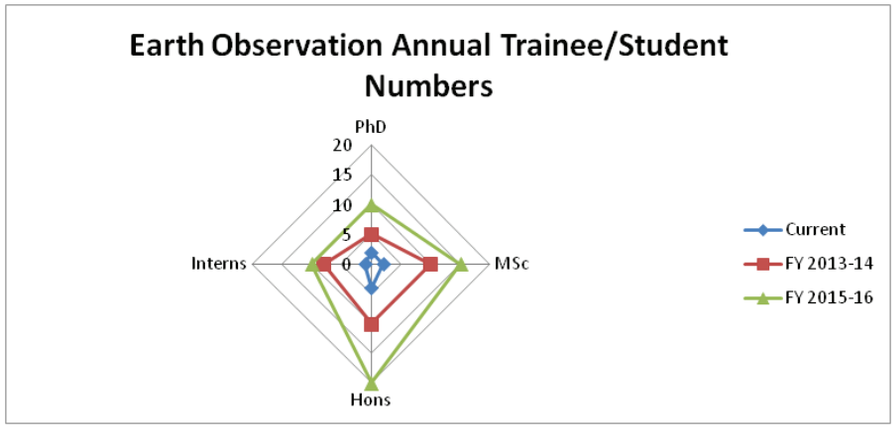
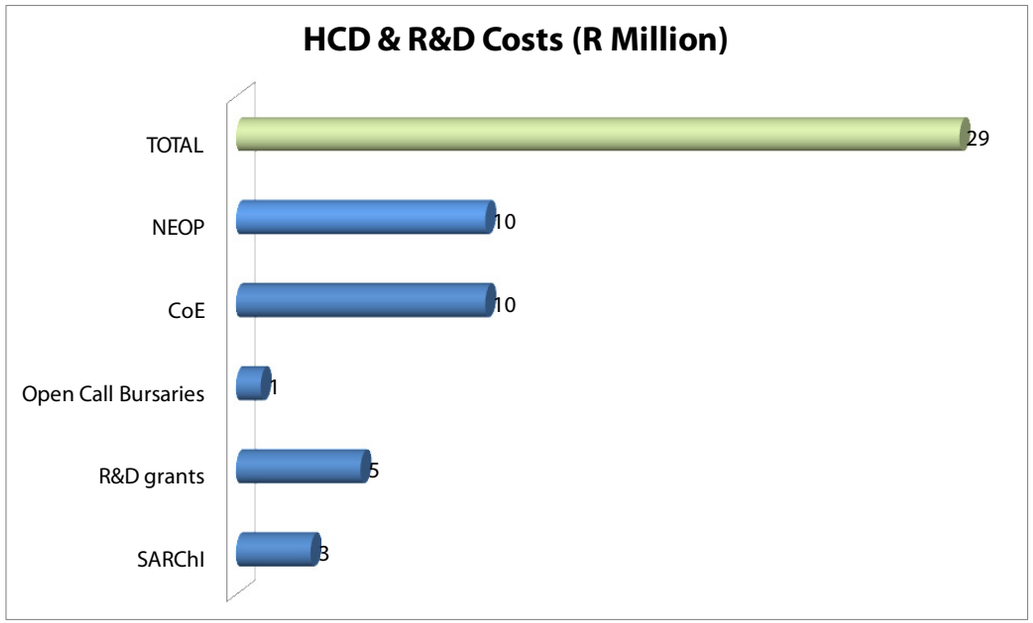


Figure 18: Global 2010 EO civil expenditure.

SANSA will use various HCD and R&D instruments in partnership with other stakeholders to achieve the required number of enrolments. These instruments should include at least a Centre of Excellence, a Research Chair, specific research directed grants and student bursaries in Earth Observation. A dedicated multi-institutional EO degree programme (National Earth Observation Programme - NEOP) should also be established.

The estimated funds that would be required if all the proposed HCD & R&D initiatives were to be implemented in the first year is R29 million (Figure 21), with a total cost of R160 million over five years at a five per cent escalation. Since all the other programmes have embedded bursary allocations, the open-call-bursary allocation is relatively low at R1 million.



Sensor portfolio: SANSA requires a diverse sensor portfolio that covers a wide spectrum of spatial resolution, temporal resolution and radiometric and spectral coverage functionality to meet the needs of the different government departments. The sensor portfolio mix will include commercial sensors, free/low-cost access sensors and South Africa's own sensor, currently SumbandilaSat.

SANSA will, however, always strive to increase its portfolio of free and low-cost sensors through strategic partnerships and participation in multi-national programmes. SANSA Earth Observation currently acquires about one Tb raw data (processed, this increases by 300%) per annum at a cost of about R15 million under a single user-license agreement for South Africa. This data is used by government, R&D institutions and universities.

Data and geo-informatics platform: Data archiving and processing systems are crucial, costly and require constant upgrading to the latest storage and data processing hardware and software. These systems also need excellent distribution channels that include online data access interface mechanisms and broad-band Internet connectivity.

Optimum location: SANSA Earth Observation works closely with government departments, science councils, universities and industry. Relocating this directorate to Pretoria will facilitate such interaction.

Projecting from the 2012 MTEF allocation and applying a five per cent escalation for the fourth and fifth year of the strategic period, expenditure by the SANSA Earth Observation directorate over the next five years is projected at approximately R48 million to R66 million annually with a total expenditure over the period of R277 million. This amount includes R77 million (32%) for servicing a comprehensive sensor portfolio for public good services and advancing SAEOS, as well as R28 million (10%) for capital expenditure, which will primarily be used for data acquisition and distribution platforms (Figure 22).

About two per cent (R5 million) will be spent on HCD to increase the pool of geo-informatics practitioners and experts. This will optimise the derivation of maximum value from space-based geo-spatial products and services within government and the broader community.

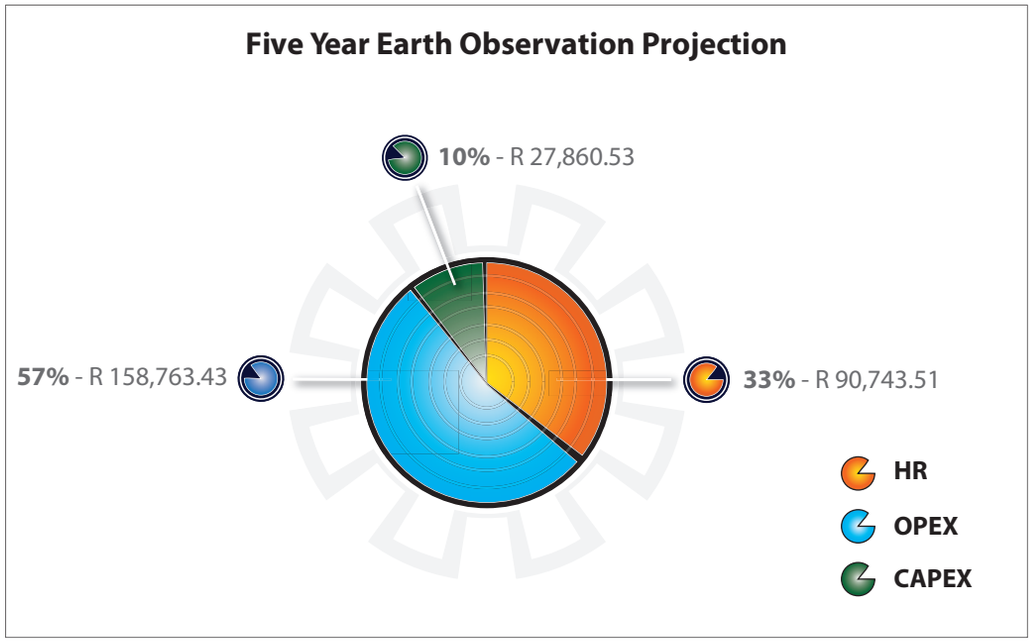


Figure 22: SANSA Earth Observation directorate high-level projections (in R'000).

7.2.2.5 Risk Management

From the perspective of the UNDP's Millennium Development Goals, the SANSA Earth Observation directorate has an ability to make an impact in at least three of the eight goal areas. However, the primary risk facing the directorate is the ability to create sufficient human resource skill to fully exploit these opportunities.

The measure of performance, and continued sustainability for the directorate lies not only in providing imagery for decision making, but assisting in training and interpretation of the imagery for such decision making to enhance benefit to stakeholders. This can be achieved by aggressive human resource drives and training programmes, and the entering of international agreements with the view to transferring knowledge and skill globally. These initiatives will not only enhance the skill base locally, but assist in creating a global footprint for the directorate. Keeping abreast with fast changing techniques, the ability to access and utilise affordable satellite data, and increasing a competent user base will be central for the sustainability of the programme.

7.2.3 Programme 3: Space Operations

7.2.3.1 Programme Overview

SANSA operates a satellite ground station for various space operation activities to benefit fully from national and international space systems. These activities include launch support and early-orbit support, in-orbit testing, satellite life-cycle support and satellite mission control for the local and international space industry and governments. **The SANSA Space Operations** directorate is the primary driver for SANSA's space operations and also pursues other space applications, such as satellite-based navigation augmentation. The directorate's two focal themes are ground services and space applications.

Satellite Ground Services

The satellite ground services include telemetry, tracking and command (TT&C), mission control, in-orbit testing (IOT) and hosting satellite ground infrastructure on behalf of clients for commercial gain.

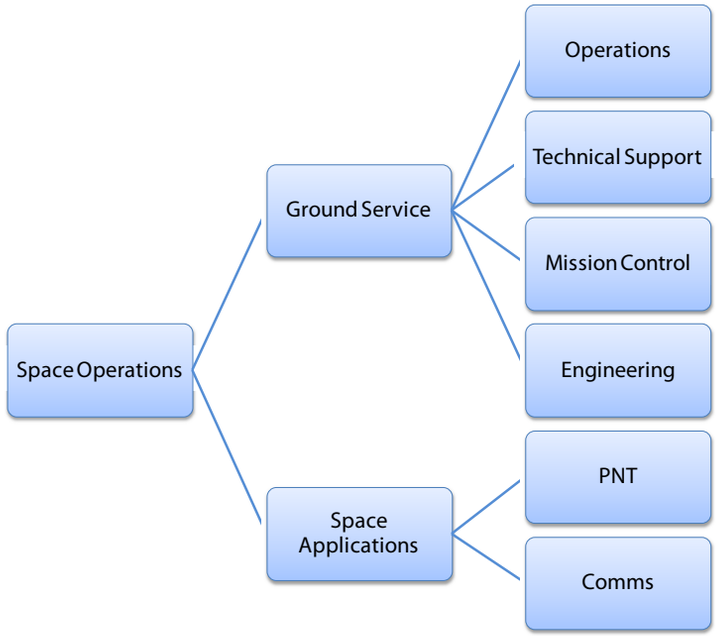


Figure 23: SANSA Space Operations Directorate

Space Applications

Positioning, navigation and timing

Satellite navigation, positioning and timing are integral to creating sustainable and competitive socio-economic development. South Africa needs to reduce its transport-related emissions and fuel consumption and improve its transport logistics; economic competitiveness, productivity and efficiency; asset tracking and routing; agricultural yield through precision farming; and response relevance during emergencies and disasters.

All of the above rely on accurate satellite navigation, positioning and timing necessitating SANSA to intensify its satellite-based augmentation initiatives. South Africa spent approximately R340 billion (about 15% of GDP) on logistics in 2008. Satellites could lower these costs and improve logistics integration and efficiency. Ultimately, this will help to improve South Africa's unsatisfactory 2010 global competitiveness rating of 54th out of 139 countries.

Communications and data transmission

Communications and data transmission is the cornerstone for all economic, social and political activity. Satellites today enable instant communication to virtually any destination across the globe; they provide societies world-wide with TV and radio reception, tele-medicine and tele-education, and Internet and ATM connectivity, among many other applications.

SANSA's future operations will include communications in collaboration with the Department of Communications and private industry.

7.2.3.2 Strategic objectives

Table 4 Strategic objectives: SANSA Space Operations

Strategic Outcome - Oriented Goal 1	World-class and efficient services and societal benefits (Societal Capital)
Strategic objective 3.1	Offer efficient, cost effective and globally competitive space operations and applications for societal benefit and the global market
Strategic objective 3.1 Objective statement	Provide space operations services to meet client needs, as well as national and global priorities.
Baseline	• 95% success rate for EO satellite passes as per service requirement (SO1) • 24 mission launches supported and in-orbit tests undertaken (SO2)
Five-year target	• 95% success rate for EO satellite passes as per service requirement (SO1) • 33 mission launches supported and in-orbit tests undertaken (SO2)
Justification	Data acquisition for South Africa and enabling the global space industry to launch, operate and access data collected by their space systems
	Through data acquisition for EO, the space operations programmes have the following outcomes:
Links	Through data acquisition for EO, the space operations programmes have the following outcomes:
	Outcome 1	Improved quality of basic education This will be achieved through imagery for educational planning.
	Outcome 2	A long and healthy life for all South Africans. This will be achieved through health and cross-border health risk surveillance, as well as pollution monitoring.
	Outcome 7	Vibrant, equitable and sustainable rural communities with food security for all This will be achieved through rural development and planning, as well as agricultural monitoring.
	Outcome 8	Sustainable human settlements and improved quality of household life This will be achieved through human settlements planning.
	Outcome 9	A responsive, accountable, effective and efficient local government system. This will be achieved through municipal and local government planning.
	Outcome 10	Environmental assets and natural resources that is well protected and continually enhanced This will be achieved through environmental and resource monitoring.
	Outcome 11	Create a better South Africa and contribute to an improved and safer Africa and world. This will be achieved by providing EO services to the continent and the world through global partnerships and data democracy initiatives.
	Outcome 12	An efficient, effective and development-oriented public service and an empowered, fair and inclusive society. This will be achieved by providing government with planning, monitoring, decision-making and enforcement tools.

Strategic Outcome - Oriented Goal 2	Cutting-edge research, development, innovation, technology and applications (Intellectual Capital)	
Strategic objective 3.2	Cutting-edge research, development, innovation, technology and applications (Intellectual Capital)	
Objective statement	Create new and innovative space operations techniques and a navigation augmentation network for South Africa.	
Baseline	2 technical reports and research publications (SO4)	
Five-year target	4 technical reports and research publications (SO4)	
Justification	New and innovative space operations techniques	
Links	Outcome 4	Decent employment through inclusive economic growth. This will be achieved through R&D programmes that create new knowledge and develop skills.
	Outcome 5	A skilled and capable workforce to support an inclusive growth path. This will be achieved through R&D programmes that create new knowledge and develop skills.

Strategic Outcome - Oriented Goal 3	Effective development of human capital, transformation and science advancement (Human Capital)	
Strategic objective 3.3	Focused HCD in space operations and space application and active science advancement.	
Objective statement	Funded HCD programme structured towards skilled employees, science advancement programmes and public engagement programmes.	
Baseline	• 6 students/interns supported/trained (SO5) • 40% permanent staff from designated groups in the top two management levels (manager, senior manager) (SO9) • 1000 learners reached through direct & specific engagement) (SO10)	
Five-year target	• 6 students/interns supported/trained (SO5) • 40% permanent staff from designated groups in the top two management levels (manager, senior manager) (SO9) • 1000 learners reached through direct & specific engagement) (SO10)	
Justification	Train students and personnel in satellite telemetry, tracking and control, engineering, remote sensing and microwave technology	
Links	Outcome 4	Decent employment through inclusive economic growth This will be achieved through training programmes that create new knowledge and develop skills.
	Outcome 5	A skilled and capable workforce to support an inclusive growth path. This will be achieved through training programmes that create new knowledge and develop skills.

Strategic Outcome - Oriented Goal 4	Cutting-edge research, development, innovation, technology and applications (Intellectual Capital)	
Strategic objective 3.4	Maintaining a strong commercial service for industry	
Objective statement	Active space operations - industry partnership framework	
Baseline	new	
Five-year target	25% Global launch, spacecraft, IOT support market share (SO12)	
Justification	At least 25% attainment of global launch, spacecraft, IOT support market share	
Links	Outcome 4	Decent employment through inclusive economic growth. This will be achieved through stimulation of space industry.
	Outcome 6	An efficient, competitive and responsive economic infrastructure network. This will be achieved through economic infrastructure, e.g. space navigation and communications.

Strategic Outcome - Oriented Goal 5	Position South Africa as a recognised global space citizen (Global Capital)
Strategic objective 3.5	Establish and maintain effective and mutually-beneficial international partnerships and customer relations aligned with national strategic priorities.
Objective statement	Develop and maintain active global partnerships in space operations to position South Africa as a recognised global space citizen.
Baseline	95% client performance rating rate (SO13)
Five-year -target	95% client performance rating rate (SO13)
Indicator	• Customer satisfaction rate

Justification	Prominent global standing and competiveness of South Africa in space science and technology through effective international partnerships.	
Links	Outcome 11	Create a better South Africa and contribute to an improved and safer Africa and world. This will be achieved through space operations services to the continent and the world through global partnerships and data democracy initiatives.

7.2.3.3 Resource Considerations

Personnel: SANSA Space Operations requires a full staff complement to secure specialised expertise and meet the demand for space operations services. Space operations are capital-intensive and require a high degree of preventative maintenance. The Space Applications group will be fully established in 2012. This will initially consist of the EGNOS extension to South Africa and later extended to include application development. The navigation initiative is only at an early stage and minimum resources will be required to develop the strategy and initial projects. Staff numbers will increase from 46 to about 57 during the five years of the current strategy.

Satellite Ground Services: During recent years, the satellite ground services strategy has developed around a few well-defined service areas, such as launch and early-orbit phase (LEOP), in-orbit testing (IOT), remote sensing data reception and hosting services. The market for these services seems stable, with a possible shift in workload from Ku- to Ka-band in the LEOP and IOT services areas during the next five years. The Ku-band facilities are still operating at capacity and the addition of a dedicated Ku-band IOT facility in 2011 has increased the tracking station's income-earning potential in this area considerably. The addition of hosted X-band facilities has opened a new market segment and requests to host similar facilities on site are expected to increase in future.

SANSA Space Operations will continue to support SANSA Earth Observation and take guidance from the EO strategy to ensure that the correct level of receiving antennas is maintained to fulfil the requirements. Mission control activities will be retained and developed to meet the future needs of the South African satellite programme. In this regard, it is imperative to expedite the finalisation of the new satellite building strategy as soon as possible.

Space Applications: The ESESA FP7 project and EGNOS steering committee (SA and EU representation) have developed a strategy that details all hardware and human resources required to complete the navigation augmentation system by 2015. This system is an integral component of the international FP7 initiative and mission-critical to the aviation community.

HCD: Human capital development in space operations is largely resourced from an internship programme that provides newly qualified technicians with first-time work experience for them to enter the job market as work-ready employees. Suitably qualified personnel and women engineers are scarce and succession planning in this area is critical to address the recruitment challenge.

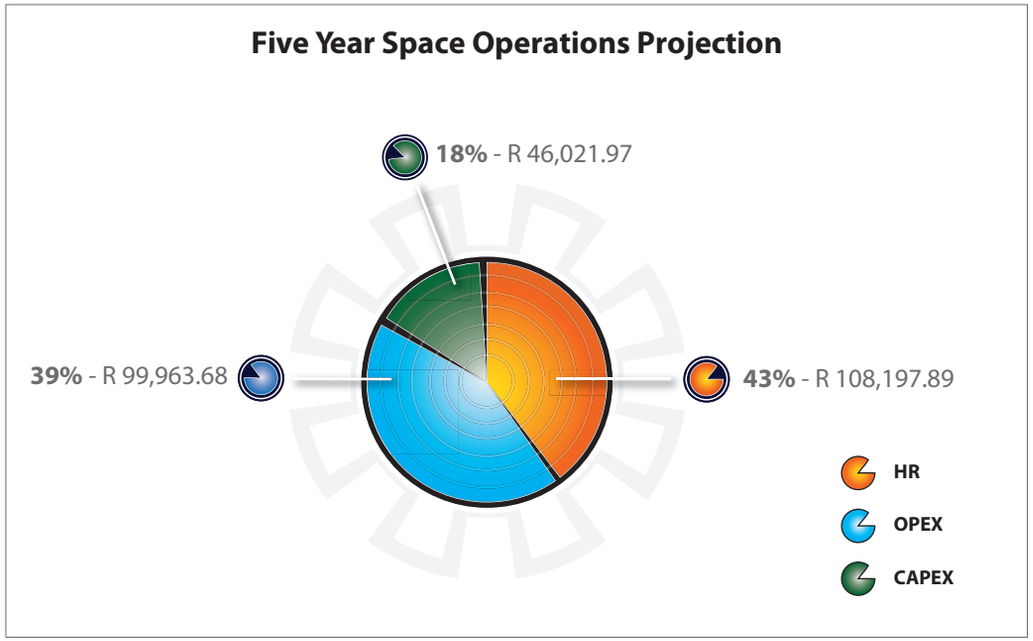


Figure 24: Five-year high-level resource projections for the SANSA Space Operations directorate (in R'000).

Based on the 2012 MTEF allocation and applying a five per cent escalation for the fourth and fifth year of the five year strategic horizon, it is projected that the annual expenditure for the SANSA Space Operations directorate ranges from R44 million to R60 million annually, with a total spend of R254 million over the forthcoming five years. About R46 million (18%) will be spent on infrastructure (refer to Figure 24). The operations nature of this directorate results in an HCD expenditure of about R5 million, which is complemented by an extensive internship programme accounted for under its HR expenditure.

7.2.3.4 Risk management

The success of the directorate is dependent on its ability to maintain exceptionally high service levels in a field with no margin for error and little tolerance from clients for poor performance. Client satisfaction and a high success rate are paramount to retaining clients and attracting new clients, both of which are critical to capturing a greater share of the global market.

Additional challenges include competitively priced services in a market with high capital and maintenance costs, while staying abreast of future satellite technologies to consistently improve the directorate's service offering. Meticulous market analyses and research, staff training and development, well-planned and cost-effective maintenance and equipment upgrades and frequent customer interaction will assist the directorate in managing this risk.

7.2.4 Programme 4: Space Science

7.2.4.1 Programme overview

According to the Science & Technology White Paper:

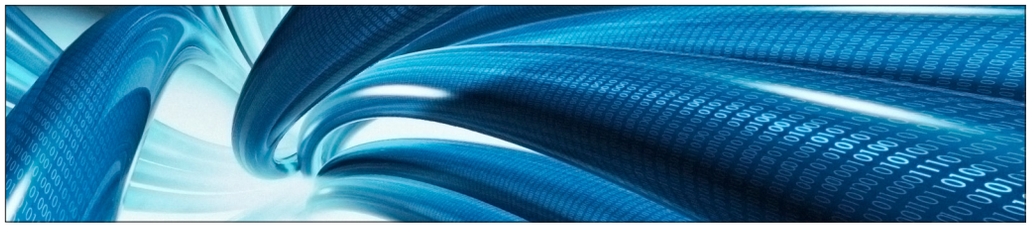
"Human wonder and curiosity and the ability to recognise serendipitous discovery account for much of scientific progress. ... It is important that fundamental research activity not be regarded as impractical, because it is the preserver of standards without which, in the long term, the applied sciences will also die."

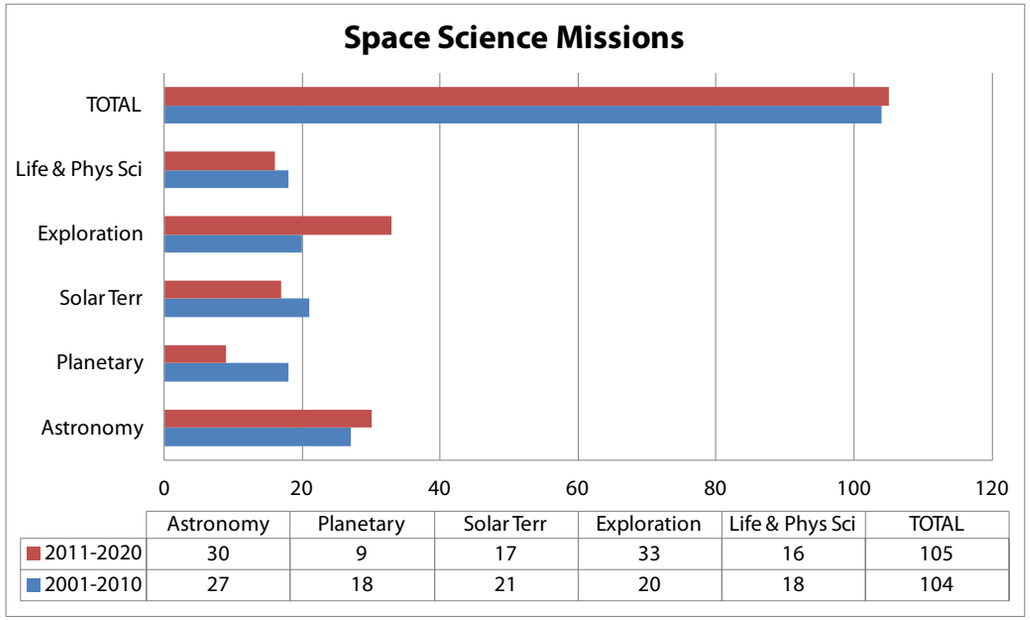
SANSA acknowledges the relevance of this statement and within its context envisages the SANSA Space Science directorate as the central driver of this endeavour within the Agency. The long-term sustainability of the South African space programme and the country's competitiveness and increased market share in the global space industry are strongly dependent on the continued creation of new knowledge as the bedrock for the local development of space science and technology, innovation and related services. Without space science research and knowledge capital available locally, South Africa will continually be an importer of space expertise and will not optimise its innovative potential or competitive capacity, nor will it become self-reliant in this regard.

7.2.4.2 Global trends and SANSA's strategic positioning

While global expenditure for scientific missions has experienced a gradual decline from $7.1 billion in 2005 to $5.6 billion in 2010, there is still a huge interest in space science, with 22 space agencies that have dedicated space missions. During the last decade (2001-2010), a total of 104 science satellites were launched with 84 focusing on space science applications and the rest on space exploration. A total of 105 science missions are planned for the current decade. The breakdown of the missions of the previous and current decade for the different science focus areas are indicated in Figure 25.

A primary focus for SANSA Space Science is on solar terrestrial physics, which with astronomy has a relatively high global profile.





	Astronomy	Planetary	Solar Terr	Exploration	Life & Phys Sci	TOTAL
2011-2020	30	9	17	33	16	105
2001-2010	27	18	21	20	18	104

Figure 25: SANSA Space Science missions

The top five space agencies account for 90% of the world's science expenditure, with the smaller players focusing largely on instrumentation. South Africa's BRICS partners are either expanding or revitalising their science programmes. India almost doubled its science budget to $79 million in 2010; China has increased its budget from $100 million (2006) to $280 million (2010); Russia increased its expenditure from $39 million (2004) to an estimated $196 million (2010); and Brazil spent about $5 million, while its first science satellite, Lattes-1, will be launched in 2013.

In general, the complexities of science missions drive international cooperation. South Africa, through SANSA, must position itself as a strategic partner for the BRICS countries, as well as other global players in space science. In particular, we have to focus on (i) scientific experimentation, design and collaboration, (ii) payload/instrumentation development and (iii) ground station services. This will enable local scientists to participate in expensive scientific missions at a fraction of the associated costs.

7.2.4.3 Strategic themes

The SANSA Space Science directorate will be the primary driver for Space Science under SANSA, and will play a leading role in basic and applied Space Science research and application, human capacity development, science advance ment and public engagement.

Knowledge creation and utilisation

A **better understanding of the universe and knowledge creation** has always been a fundamental quest for humanity. Space science research provides greater clarity about the universe and how, for instance, the near-space environment protects mankind from the sun's harmful energetic particles and radiation or affects and enables ground-based technologies.

Space science research also creates new knowledge, increases the information stock for the knowledge-based economy and serves as a vehicle for student training. The increase in South Africa's knowledge share of ISI journal publications has risen at a slower rate than the global trend, from 0.55% in 2006 to 0.61% in 2009.

Increasing South Africa's global knowledge share to 1.5% by 2018 is outlined as a national objective in the country's Ten-Year Innovation Plan. Space science will contribute to the achievement of this objective. In 2006, South Africa had 1.5 researchers per 1 000 people employed, which was low compared to 7.5 (OECD total), 6.8 (Russian Federation) and 2.0 (Brazil) per every 1 000 people employed.

Space science and technology has a crucial role to play in helping South Africa increase its knowledge workforce to remain competitive in the global space market place.

Applied Science and Technology

The SANSA Space Science directorate is the space weather Regional Warning Centre (RWC) for the African region under the International Space Environment Service (ISES). The directorate uses scientific knowledge to develop applications and technologies that benefit society. Scientific data is collected and processed to provide a variety of geo-space space weather services. The directorate's data products and services are required primarily for communications and navigation and are used by the defence force and those in the aerospace, navigation and communications domains, among others. Additional applications include mineral exploration by mining companies and electric power distribution by power utilities, as well as technology services for aerospace, navigation and electromagnetic signature management.

The unique facility at SANSA Space Science also provides services that rely completely on knowledge about space, such as compass calibrations.

Science Advancement and Public Engagement

Space science and technology is an ideal instrument for science advancement and public engagement. Since the beginning of time, humanity has been fascinated by space. This fact needs to be exploited to increase the youth's interest in science, engineering and technology (SET) and improve the scientific literacy of the general public.

Greater interest among the youth and awareness among the general public will assist SANSA in addressing the current skills shortages in SET and stimulate informed participation in scientifically-linked issues such as global warming and conservation. In 2009, SET student registration at HEIs stood at 28.3% of total student enrolment, which is reflective of South Africa's higher education enrolment ratio of 0.15. This is unacceptably low when compared to about 0.25 for Brazil and about 0.9 for Finland, Korea and the US.

SANSA Space Science is well positioned to play a leading role in science advancement and public engagement through its science centre, exhibitions and mobile learning unit, to mention a few of the initiatives that are already in place.

7.2.4.4 Strategic Objectives

Table 6 Strategic objectives: SANSA Space Science

Strategic Outcome - Oriented Goal 1	World-class and efficient services and societal benefits (Societal Capital)
Strategic objective 4.1	Offer a state-of-the-art research platform and applied science/technology service platforms.
Objective statement	The long-term sustainability of the national space programme and an increase in South Africa's competitiveness and global share of space technology are strongly dependent on the continued creation of knowledge in space technology and innovation and the provision of world-class services.
Baseline	1 Tb of Science data acquired & archived (SS1)
Five-year target	5 Tb of Science data acquired & archived (SS1)
Justification	Socio-economic benefits through applied science and technology
Links	Outcome 6: An efficient, competitive and responsive economic infrastructure network. This will be achieved through economic infrastructure e.g. navigation, communication.

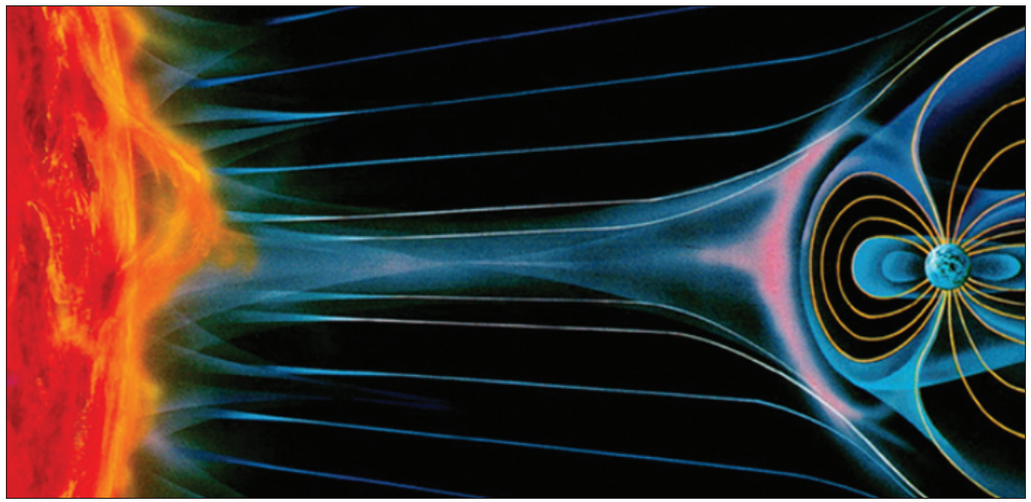
Strategic Outcome - Oriented Goal 2	Cutting-edge research, development, innovation, technology & applications (Intellectual Capital)
Strategic Objective 4.2	Conduct cutting-edge research, development and innovation.
Objective statement	Create effective R&D framework producing high impact research for societal benefits.
Baseline	2 ISI publications per researcher (SS4)
5-Year Target	4 ISI publications per researcher (SS4)

Links	Outcome 4: Decent employment through inclusive economic growth. This will be achieved through R&D programmes that create new knowledge and develop skills. Outcome 5: A skilled and capable workforce to support an inclusive growth path. This will be achieved through R&D programmes that create new knowledge and develop skills.

Strategic Outcome - Oriented Goal 3	**Effective development of human capital, transformation and science advancement (Human Capital)**
Strategic Objective4.3	Development of human capital in space science and science advancement.
Objective statement	Drive human capacity development, science advancement and public engagement in space science and technology.
Baseline	• 15 students/interns supported/trained (SS6) • 4 short courses conducted (SS9) • 40% permanent staff from designated groups in the top two management levels (manager, senior manager) (SS12) • 3000 learners reached through direct and specific engagement (SS13)
Five-Year Target	• 30 students/interns supported/trained (SS6) • 8 short courses conducted (SS9) • 60% permanent staff from designated groups in the top two management levels (manager, senior manager) (SS12) • 7000 learners reached through direct and specific engagement (SS13)
Justification	Increased SET workforce as well as increased SET student participation.
Links	Outcome 4: Decent employment through inclusive economic growth. This will be achieved through training programmes that create nevw knowledge and develop skills. Outcome 5: A skilled and capable workforce to support an inclusive growth path. This will be achieved through training programmes that create new knowledge and develop skills.

Strategic Outcome - Oriented Goal 4	**Globally competitive national aerospace industry (Economic Capital)**
Strategic Objective 4.4	Active role in South African contribution of SANSA Space Science to the South African aerospace industry.
Objective statement	Contribute towards skills development and the stimulation of the space industry.
Baseline	• new
5-Year Target	• 10 industrial/commercial sector services/products (SS15)
Justification	Greater application of science and new technologies in the aerospace and defence industries.
Links	Outcome 4: Decent employment through inclusive economic growth. This will be achieved through stimulation of aerospace industry. Outcome 6: An efficient, competitive and responsive economic infrastructure network. This will be achieved through increased knowledge utilisation in SA's knowledge economy.

Strategic Outcome - Oriented Goal 5	**Make South Africa a recognised global space citizen (Global Capital**
Strategic Objective4.5	Establish and maintain effective and mutually beneficial international partnerships in line with national strategic alignment.
Objective statement	Strong and effective international partnerships & collaborations in Space Science.
Baseline	5 active multi-national projects (SS16)
5-Year Target	8 active multi-national projects (SS16)
Justification	Prominent global standing and competiveness of SA in space science and technology through effective international partnerships.
Links	Outcome 11: Create a better South Africa and contribute to a better and safer Africa and World. This will be achieved through strong and effective international partnerships & collaborations.



7.2.4.5 Resource considerations

Personnel: Optimal personnel resourcing of the SANSA Space Science directorate is crucial for the realisation of the set objectives. The directorate needs a core team of high-profile and productive researchers, technologists/engineers, data and signal processing specialists and data managers. The most important challenges are the lack of a critical mass in the directorate's research focus areas and lack of equity. The projected increase in the current staff complement of 47 will be to about 60 members in the next three to five years.

Human Capital Development: SANSA Space Science has an eminently viable HCD programme and is an active participant in the National Astronomy and Space Science Programme (NASSP). The NASSP partnership needs to be nurtured and the space science component increased. Additional HCD programmes are planned, including the marketing of opportunities for student projects, earmarked space science bursaries, exchange programmes, mentorships and internships.

These efforts are all aimed at attracting and retaining the personnel needed for a vibrant space programme. Annual trainee/student numbers for the next three to five years are indicated in Figure 12, which translates to an increase in annual enrolment numbers within the broader national space science system to 64 (three-year target) and 85 (five-year target).

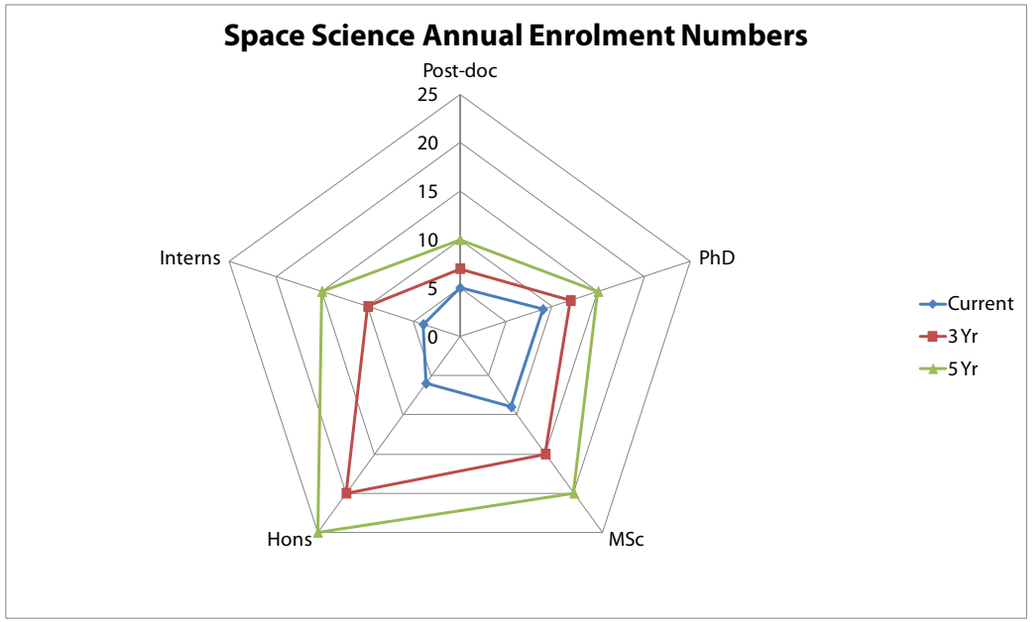


Figure 26: NSP: Projected annual enrolment numbers in space science.

These enrolments will require the collaborative utilisation of various system-wide HCD and R&D instruments. As a basic minimum success factor, these should at least include a Centre of Excellence, a Research Chair, focussed research grants and student bursaries in space science. The estimated costs if these proposed NSP programmes were implemented in the first year is R21 million (refer to Figure 26), with a total cost of R116 million over five years at a five per cent escalation.

Once more, it should be borne in mind that since all the other programmes (refer to Figure 27) have embedded bursary allocations, the open-call-bursary allocation is relatively low at R1 million.

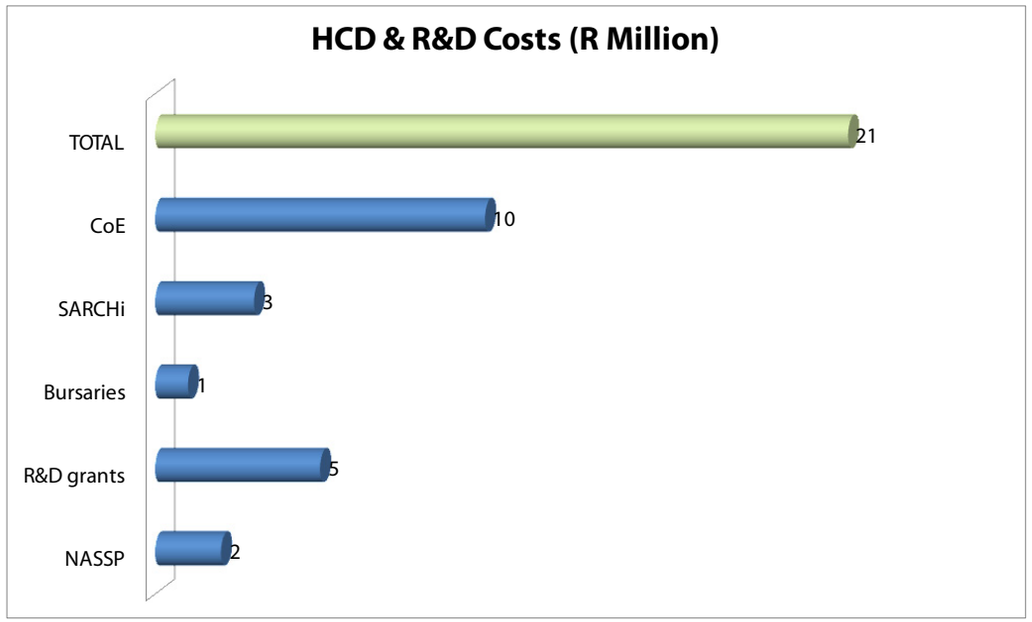


Figure 27: NSP estimated costs for HCD and R&D in space science.

R&D Platforms: The R&D platforms (observational network, data hardware and software and student facilities) have to be constantly maintained and upgraded to remain at the cutting-edge of research. Capital expenditure will be set at 20% of the directorate's budget to accomplish this. The overall projected directorate expenditure breakdown is as shown.

Strategic science programmes: SANSA Space Science will lead a number of collaborative multi-disciplinary big science programmes, including:

- **Antarctic Programme:** Antarctica is considered to be the "Window into Geospace" from where deeper space phenomena can be mapped onto the near-Earth space environment. South Africa is the only African country with a science research base in Antarctica, giving SANSA a geographic advantage that needs to be exploited to increase access for its African partners to Antarctic science research. SANSA Space Science already owns a significant amount of instrumentation located at the South African base in Antarctica, including a SuperDARN radar which plays a significant international role.

- **South Atlantic Magnetic Anomaly:** South Africa is ideally situated for the study of the South Atlantic Magnetic Anomaly, which is an area in the South Atlantic with increasing space-originating radiation that adversely affects aircraft, satellites and communications systems, among others. The proposed IBSA satellite and low-latitude SuperDARN radar aim to investigate this phenomenon in partnership with Brazil and India.

Extrapolating from the 2012 MTEF allocation and applying a 5% escalation for the fourth and fifth year of the five year strategic horizon, it is projected that the annual costs for the SANSA Space Science directorate range from R33 million to R39 million during the forthcoming five years, with a total of R200 million over the period. A total of R32 million (17%) will be spent primarily on research infrastructure during the same period. Approximately R13 million (6%) will be spent on HCD and Science Advancement and a further R18 million (8%) is allocated to operational expenses for research.

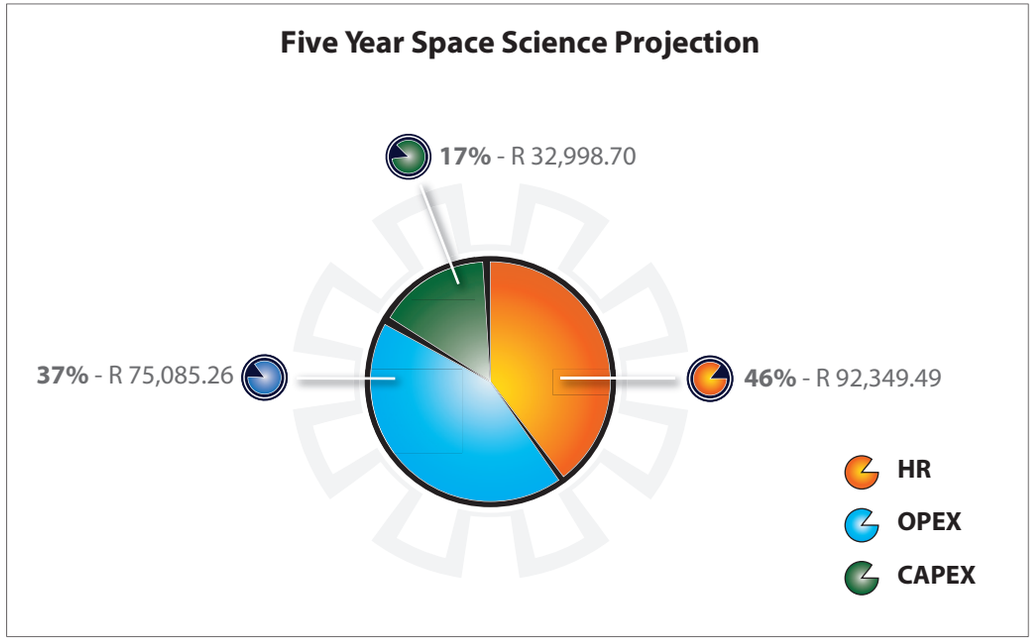


Figure 28: Five year high-level resource projections for the SANSA Space Science directorate (in R'000).

7.2.4.6 Risk management

Inability to create a sustainable science skills pipeline
The greatest challenge facing the Space Science directorate is the ability to create a sustainable knowledge base. Certain key focus areas within the directorate do not have a critical mass and the loss of personnel in these areas could adversely affect the directorate's ability to deliver in certain key areas. This risk is further compounded by the failure to attract high-calibre, demographically representative students to the field of science.

The utilisation of the science advancement centre and initiatives such as winter/summer schools, bursary offerings and aggressive recruitment campaigns are underway to mitigate this risk. The programme needs to identify and pursue one or two high-impact and visible flagship projects that address 'big science' questions to ensure sustainability. These projects should form common threads and foster intra-institutional, national, regional and global collaboration with multi-disciplinary underpinnings.

7.2.5 Programme 5: Space Engineering

7.2.5.1 Programme Overview

Humanity is becoming increasingly reliant on space systems and sub-systems for a wide spectrum of social benefits and economic endeavours. Space is recognised by industrialised nations as an essential and strategic tool to meet social, technology, economic and foreign policy objectives. Accordingly, many governments around the world are increasing their investments in space activities to advance their space capabilities and benefit from space operations.

South Africa has a demonstrated space heritage, with space mission support capacity, assembly, integration and testing (AIT) facilities, two satellites already launched into orbit and EO images delivered for downstream use. The country has established itself as a player in the micro-satellite niche, which is proving to be a competitive advantage as international demand for more cost-effective satellite assets is starting to grow. A number of local universities have also positioned themselves to advance the indigenous knowledge base in satellite engineering.

The SANSA Space Engineering directorate will manage and lead the technical coordination of space system and sub-system development on behalf of SANSA. The directorate will provide a complete functional facility for space system assembly, integration and testing (AIT) for national and regional use. This role will be fulfilled through the upgrade of the current Houwteq facility in Grabouw, Western Cape.

SANSA will further aim to stimulate and increase market opportunities for the local industry to supply the international satellite market. This will be done through strategic relationships with space agencies (especially in developing nations), investing in the upgrade and development of the AIT facilities and generating new intellectual property and technological know-how through R&D investments in satellite systems and satellite payloads. The R&D investments made in the aerospace industry and advanced materials processing can be leveraged to boost the country's domestic satellite engineering capability.

7.2.5.2 Global trends and SANSA's strategic positioning

During the previous decade (2000-2009) a total of 770 satellites were launched of which 513 (67%) were government satellites and the other 33% commercial satellites. The majority of the government satellites, approximately 61%, were low Earth-orbiting (LEO) satellites, while the commercial satellites (77%) were predominantly global Earth observation (GEO) satellites. Close to 54% (277) of the government satellites were for civilian agencies (largely research and EO) and the remaining 238 for military agencies. During the decade, satellite manufacturing and launch services averaged $13 billion per year.

Current market trends suggest that future demand will be largely driven by government satellites. The projected number of satellites to be launched during the 2010-2019 decade will be approximately 59% higher than during the previous decade and generate $195 billion in revenue. Technological innovation has led to the drastic reduction in the average LEO launch mass from 2 000 kg 15 years ago to about 750 kg in 2009. South Africa has to be cognisant of this trend when deciding on its satellite roadmap. In general, these smaller satellites are developed by space agencies that want to maximise the benefit of recurring systems and sub-systems and the use of commercial off-the-shelf (COTS) products.

Developing its own satellite system development capabilities to become self-reliant is strategically important for South Africa and will also create a development platform for unique technologies and related skills.

7.2.5.3 Strategic Themes

Space engineering is a SANSA programme that has not yet been fully mapped out. A consultative process to define a comprehensive 10- to 20-year National Space Programme (NSP) is currently underway and will clarify the content and structure of the space engineering programme. SANSA will drive the programme with participation from the South African space industry, R&D institutions and universities.

The focus will be on both satellite system and sub-system development with a strong human capital development focus. Other HCD and technology development instruments will include two Centres of Competence: one in satellite systems and the other in satellite sub-systems (satellite sensors). The actual satellite development will be undertaken through a prime contracting arrangement for which details are still to be determined. Our focus will be on the micro- and nano-satellite segments.

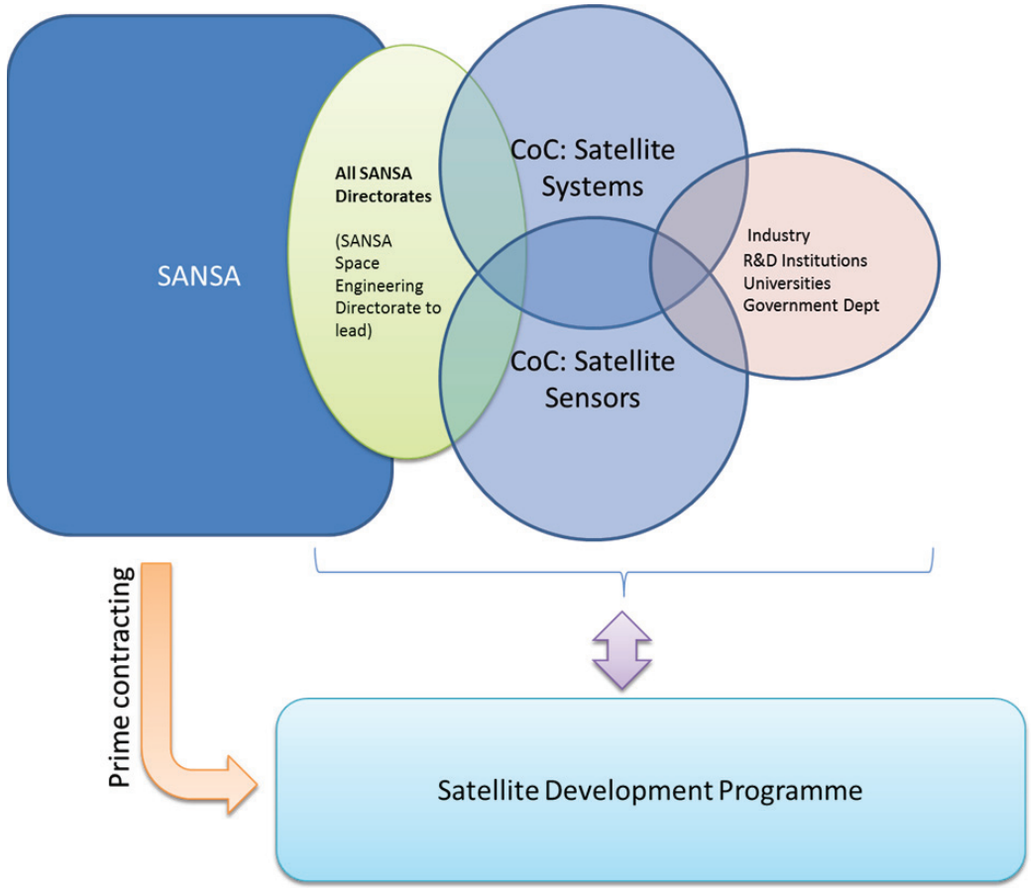


Figure 29: Satellite development programme.

The key strategic objectives

At a strategic level, the satellite development programme aims to achieve the following objectives:
South Africa's indigenous capability and self-reliance.

While no nation can be totally independent of other space nations, complete reliance on foreign nations is problematic in a number of ways, including:

I. Exposing the security of the country to other nations.
II. Limiting access to certain space products, such as access to super-high resolution images.
III. Limiting the control of satellite imaging schedules so that the country is dictated by foreign countries or commercial companies.

South Africa will continue to develop its own capability in strategically chosen satellite segments and build on its current space heritage. Government's strategic decision to renew the country's deteriorating satellite engineering capability has resulted in a significant effort to find an appropriate model to achieve this. SANSA will explore the model and prepare a business case to revitalise this invaluable industrial capacity.

The significance of national pride should not be underestimated in the context of the regional space race currently. Several African countries have operational satellites in space and Nigeria recently launched two satellites. SANSA will work hard to strategically position South Africa as a preferred destination in the region for satellite engineering services (both space and ground segment).

Technology development, innovation and skills development

Technology and innovation are the building blocks of human prosperity. Space science and technology require the development of specialised materials that are energy efficient and can withstand harsh space conditions. In additions, components need to be miniaturised, reliable and with a high precision rating.

These challenges lead to ground-breaking technologies and innovation that find application in medicine, security and many other areas and require scarce and transferrable skills in engineering, electronics, remote sensing, data management, software development and others. Currently South Africa is experiencing a large and growing trade deficit in high-end technologies. The deficit increased from R49 billion in 2002 to R73 billion in 2007.

Importing sophisticated technologies should go hand-in-hand with importing the necessary skills and personnel. In 2009 South Africa's high-technology manufacturing contributed only 5% to total manufacturing exports, while its high-technology imports represented a modest 20% of all manufacturing imports during that year. In 2005 South Africa contributed 6.6% to total manufacturing exports compared to the 28.3% of developing countries. This is indicative of South Africa's high-technology immaturity while the country's global patent share has decreased from a high of 0.121% in 1995 to 0.023% in 2009, which is of even greater concern. Space is an ideal vehicle for developing the technologies and innovative skills that can help address these national challenges.

Industrial stimulation

The development of new technologies and skills, as well as contracting opportunities and an increase in import and export channels through SANSA partnerships will boost the South African aerospace industry. During 2002 to 2006, the aerospace engineering industry sector experience low activity (bottom 25%) and impact (bottom 25%) levels. This situation needs to be improved if South Africa is to be regarded as a reputable space faring nation.

African Resource Management Constellation (ARMC) project

In view of the inter-governmental agreement between South Africa, Nigeria, Algeria and Kenya to establish the African Resource Management Constellation (ARMC) project, SANSA has to initiate the process of developing South Africa's contributory satellite for the ARMC in 2012. The ARMC project will establish a constellation of African satellites to provide Earth observation services across the African continent.

7.2.5.4 Strategic Objectives

Strategic Outcome - Oriented Goal 1	**World-class and efficient services and societal benefits (Societal Capital)**	
Strategic objective 5.1	Offer a state-of-the art satellite assembly, integration and testing (AIT) platform and service	
Objective statement	To have a full assembly, integration and testing (AIT) service platform	
Baseline	None	
Indicator	Completion of assembly, integration and testing (AIT) facility upgrade	
Justification	Socio-economic benefits through indigenous satellite capability	
Links	Outcome 6	An efficient, competitive and responsive economic infrastructure network. This will be achieved through the provision of high-tech facilities and skilled service personnel.

Strategic Outcome-Oriented Goal 2	**Cutting-edge research, development, innovation, technology and applications (Intellectual Capital)**
Strategic objective 5.2	Technical coordination of satellite system and sub-system development on behalf of SANSA.
Objective statement	Effective R&D framework for assembly, integration and testing (AIT)
Baseline	None
	• Number of collaborative R&D projects • Centres of Competence established • Completion rate of Satellite development

Justification	New technologies and innovation contributing to an effective R&D framework for AIT	
Links	Outcome 4	Decent employment through inclusive economic growth. This will be achieved through R&D programmes that create new knowledge and develop new technologies and skills.
	Outcome 5	A skilled and capable workforce to support an inclusive growth path. This will be achieved through R&D programmes that create new knowledge and develop technologies and skills.

Strategic Outcome - Oriented Goal 3	**Effective development of human capital, transformation and science advancement (Human Capital)**
Strategic Objective 5.3	Focused HCD in space engineering in partnership with space systems universities and other partners.
Objective statement	Structured and funded HCD programmes in space engineering
Baseline	None
Indicator	• Number of students/trainees formally trained supervised • Number of short courses conducted • Number of short courses attendees • Proportion of SA students from designated groups that have been trained • Training of parties from African countries • Staff Equity • Staff equity in top three tiers of organogram
Justification	Increased SET workforce as well as increased SET student participation.
Links	Outcome 4: Decent employment through inclusive economic growth. This will be achieved through training programmes that create new knowledge and develop new technologies and skills. Outcome 5: A skilled and capable workforce to support an inclusive growth path. This will be achieved through training programmes that create new knowledge and develop technologies and skills.

Strategic Outcome - Oriented Goal 4	**Globally competitive national space industry (Economic Capital)**
Strategic Objective 5.4	Promotion of a conducive environment for industrial/private involvement in satellite system and sub-system development.
Objective statement	Active SANSA space industry – partnership framework.
Baseline	None
Indicator	• Number of collaborative projects with industry • Number of facilitated local industry to international partners projects/collaboration
Justification	Increased industrial competitiveness in satellite engineering.
Links	Outcome 4: Decent employment through inclusive economic growth. This will be achieved through stimulation of industrial/private involvement in satellite system and sub-system development. Outcome 6: An efficient, competitive and responsive economic infrastructure network. This will be achieved through increased knowledge utilisation in SA's knowledge economy.

Strategic Outcome - Oriented Goal 5	**Globally competitive national space industry (Economic Capital)**
Strategic Objective 5.5	Establish and maintain effective and mutually beneficial international partnerships and customer relations in line with national strategic alignment
Objective statement	Strong and effective international client base and partnerships in space engineering
Baseline	None
Indicator	• Number of signed/formal and active international partnerships • Number of signed/formal and active African partnerships
Justification	Greater global satellite market share and high national profile in the space scientific arena.
Links	Outcome 11: Create a better South Africa and contribute to a better and safer Africa and World. This will be achieved through strong and effective international client-base, partnerships.

7.2.5.5 Resource Considerations

Personnel: To deliver on the set objectives SANSA will need to have a core team of high-profile engineers and technicians who will work closely with prime contractors and other stakeholders. Emigrated South African space engineers have to be attracted back to South Africa. Retired/near-retirement space engineers and technicians who were involved in the pre-1994 space programme have to be brought back or be kept longer in the system post-retirement as mentors and trainers. Attracting retired space engineers and technicians who want to relocate to South Africa will be explored.

Human Capital Development: Aggressive student programmes have to be pursued. To fast-track the development process and attainment of numerical targets in the shortest possible time, a dedicated overseas student training programme has to be implemented. Annual trainee/student numbers in the next three to five years are indicated below. This translates to about 70 students/trainees annually (three-year target) and 105 (five-year target). About 25-30% of these should be in overseas training programmes.

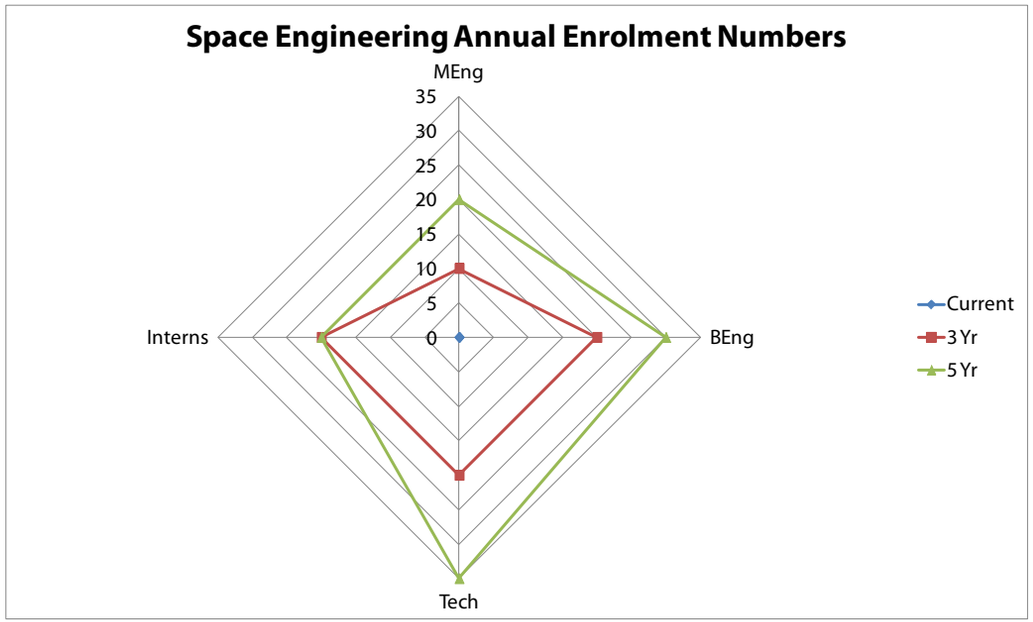


Figure 30: NSP Space Engineering Annual Enrolment Numbers

The accomplishment of these enrolment targets will require the collaborative utilisation of various system-wide HCD and R&D instruments. As a basic minimum success factor, these should include, at least, a Centre of Competence, and focussed research grants and student bursaries in Space Engineering.

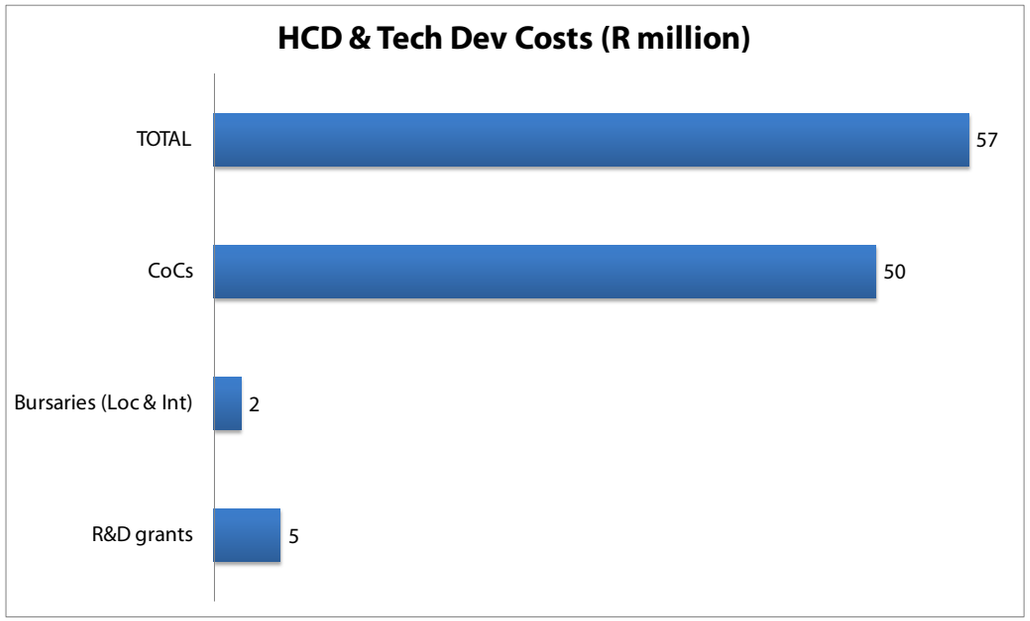


Figure 31: NSP estimated costs for HCD and Technology Development in Space Engineering

R&D Platforms: The satellite Assembly, Integration and Testing (AIT) facility at Houwteq is a key infrastructure for satellite engineering. Annually, the projected expenditure by the SANSA Space Engineering directorate ranges from R41 million to R76 million with a total of R298 million over the five years. The AIT facility has to be upgraded at a cost of R 15-20 million per year over a two to three year period. To progressively upgrade the facility to global standards, 35% (R103 million) of the directorate's budget will be used for capital expenditure (see Figure 32).

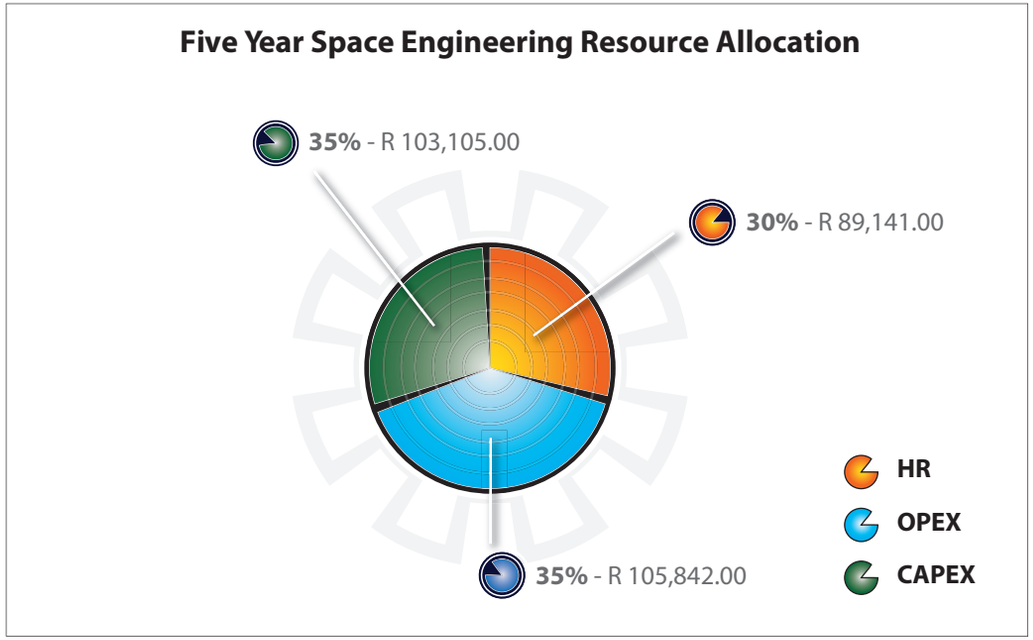


Figure 32: SANSA Space Engineering high-level resource allocation (in R'000).

7.2.5.6 Risk Management

The following five risk factors need to be considered.

Inability to operate efficiently due to lack of adequate funding:

The ability of the directorate to deliver its strategy is reliant upon creating an enhanced facility and attracting suitably qualified engineers. The financial investment required in funding a complete upgrade of the Houwteq facility and an aggressive recruitment campaign will be large, and require long-term commitment. The risk exists that the ability to attract such funding will be extremely difficult. To be able to offer the services envisaged, the facility needs to align with international standards. Training and development will need to be provided on an on-going basis for staff members.

PART C - Links to other Plans

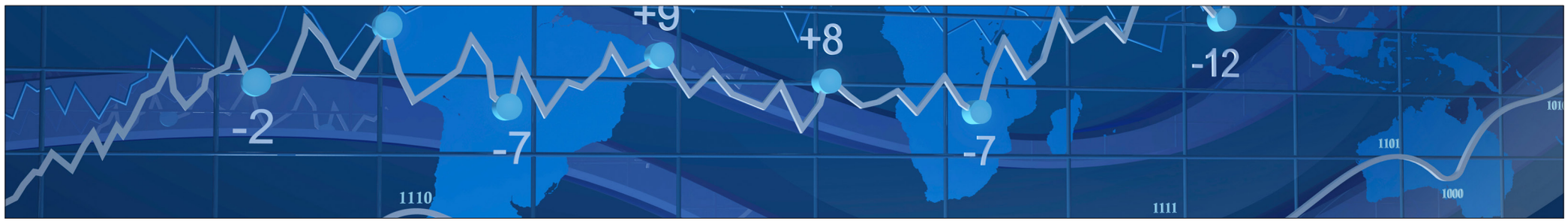
8. LINKS TO OTHER PLANS

8.1 Capital Plan

SANSA - Five year Capital Projects and Infrastructure Plan												
Project name	**Programme**	**Output**	**2010/11**	**2011/12**			**Medium Term Estimates**			**Outer years**		
R thousands			**Audited Outcome**	**2011/12**	**Adjusted Appropriation**	**Revised**	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**Total**
New and replacement assets												
Powerstation	Space Operations		-	7,000	-	7,000	-	-	3,000	3,000	-	6,000
Community Science Center	Space Science		-	-	-	-	-	-	10,000	-	-	10,000
Data Storage Device	Earth Observation		-	-	-	-	7,000	2,000	2,000	2,000	8,000	21,000
Earth Observation Archive Mirror	Earth Observation		-	-	-	-	6,000	-	2,000	-	8,000	16,000
X-Band 7.3m	Earth Observation		-	-	-	-	-	-	-	25,000	-	25,000
Saterlite-Based Navigation Augmentation System	Space Operations		-	-	-	-	5,000	15,000	10,000	15,000	10,000	55,000
Antenna C -Band	Space Operations		-	-	-	-	-	-	22,000	-	-	22,000
UPS System	Space Operations		-	-	-	-	-	-	4,000	-	-	4,000
Low Lattitude Radar	Space Science		-	-	-	-	11,000	-	-	-	-	11,000
Geophysical Infrastructure Network Upgrade	Space Science		-	-	-	-	-	-	-	12,000	-	12,000
Scientific Mission Antenna / Science Tracking Mission	Space Science		-	-	-	-	-	22,000	-	-	-	22,000
Satellite Development	Space Engineering		-	-	-	-	80,000	97,000	145,000	100,200	106,212	528,412
Ku Band Antenna	Space Operations		-	3,000	-	3,000	-	-	-	-	-	-
Share Radar	Space Science		-	3,720	-	3,720	-	-	-	-	-	-
Total New and replacement assetsz			**-**	**13,720**	**-**	**13,720**	**109,000**	**136,000**	**198,000**	**157,200**	**132,212**	**732,412**
Maintenance and repairs												-
Specialised Vehicles	Space Operations		-	-	-	-	1,800	500	-	-	-	2,300
Servers replacement	Earth Observation		-	-	-	-	-	1,500	1,500	-	1,500	4,500

8.1 Capital Plan - Continue

Project name	Programme	Output	2010/11	2011/12			Medium Term Estimates			Outer years		
Total Maintenance and repairs			**-**	**-**	**-**	**-**	**1,800**	**2,000**	**1,500**	**-**	**1,500**	**6,800**
Upgrades and additions												-
New office space	Space Operations		-	-	-	-	-	3,000	-	-	-	3,000
Additional Space Weather Infrastructure	Space Science		-	-	-	-	-	-	-	-	14,000	14,000
Office Space	Earth Observation		-	-	-	-	2,500	-	1,000	-	1,000	4,500
SAEOS Architecture upgrade / maintenance	Earth Observation					-	4,000	4,240	6,000	5,000	6,000	25,240
Earth Observation Sensors / Antennas Upgrades	Earth Observation					-	4,000	10,600	2,000	4,000	4,000	24,600
Servers replacement	Earth Observation					-	-	1,500	1,500	-	1,500	4,500
Specialised Software	Earth Observation					-	-	-	-	8,000	-	8,000
Antenna upgrade	Space Operations					-	-	-	-	4,000	-	4,000
Software	Space Operations					-	-	2,000	-	-	-	2,000
General Capex	All		3,820	4,025		4,025	6,500	7,052	7,476	9,682	10,851	41,561
Total Upgrades and additions			**3,820**	**4,025**	**-**	**4,025**	**17,000**	**28,392**	**17,976**	**30,682**	**37,351**	**131,401**
Rehabilitation, renovations and refurbishments												**-**
Office Space upgrade and renovations	Space Engineering		-	-	-	-	15,000	20,140	21,348	22,629	23,987	103,104
Building renovations	Space Engineering		-	-	-	-	5,000	-	-	-	-	5,000
Total Rehabilitation, renovations and refurbishments			-	-	-	-	20,000	20,140	21,348	22,629	23,987	108,104
Total Capital Programme			**3,820**	**17,745**	**-**	**17,745**	**147,800**	**186,532**	**238,824**	**210,511**	**195,050**	**978,717**



The projected strategic infrastructure expenditure for SANSA is R174 million over the MTEF with R41 million for 2012/13, R64 million for 2013/14 and R69 million for 2014/15. A large proportion (R61 million) of this capital expenditure is for Earth observation infrastructure including satellite sensors, data systems and other ICT infrastructure. SANSA has to maintain a comprehensive sensor portfolio in order to meet national needs. SANSA Space Operations has been collecting and providing SPOT imagery under a multi-government license and this has led to an affordable and easily accessible geo-spatial information layer for public sector use. While the national SPOT programme is important in ensuring an annual national coverage at 2.5 m and should be continued, it is limited in collecting sufficient time series data to monitor specific behavioural change in land use and land cover classes. The monitoring of crops to estimate the crop yield during its phenological curve cannot be fulfilled by the SPOT 5 satellite alone, as an example. In order to solve the remote sensing demand from government the India ResourceSat-2 satellite will be added for direct telemetry. In addition, SANSA Space Operations has very valuable data that has been collected since 1972. There is an urgent need to create mirror storage for this data to reduce the risk of permanent loss. Further, existing storage systems and media (tapes) have to be consistently upgraded to ensure the continued extraction of archived data. All this, together with the continued maintenance of the SAEOS system, will cost about R33 million over the MTEF period.

SANSA plans to spend a total of R46 million on infrastructures for space operations, over the five year period. About R22 million is for a C-band antenna which will largely be funded through external contract income. SANSA proposes to carry forward about R7-11 million per year of its surplus contract/commercial income over the five years for the purpose of accumulating enough reserves to continually upgrade or add/replace a new antenna or other capital intensive system every three years. This is important if SANSA is to sustain the space operation contract income which accounts for about 20% of SANSA's total revenue and 60% of SANSA's contract income. The profit margin for this contract work is estimated at R46 million over the five year period translating to about 5% of SANSA total revenue. Apart from the monetary value of this work, the fact that it largely services the global space industry elevates South Africa's role in the international space arena and leverages the creation of international strategic partnerships. Further, these activities also involve the hosting of sophisticated instrumentation on behalf of international clients. This exposes SANSA staff to cutting-edge technologies and operations ultimately boosting the country's global competitiveness and skills base. A total of R30 million on infrastructure spending would be required over the five year period for navigation. This money will be partly funded by SANSA in partnership with other navigation stakeholders in the Department of Transport.

With regard to space science, SANSA plans to spend a total of R33 million over the MTEF period. About R11 million in 2013/14 is for the low-latitude HF radar to be used to study the South Atlantic Magnetic Anomaly (SAMA). South Africa is ideally positioned for the study of the SAMA—an area over the South Atlantic where increased space-originating radiation is experienced within the path of aircraft, ships and satellites, leading to communication interruptions and damage to systems. In partnership with Brazil and India (through the IBSA initiative), a specialised space weather satellite and a low-latitude SuperDARN radar are proposed to investigate this phenomenon. This research, together with the Antarctic space science research, will form the flagship project of the SANSA Space Science directorate with the aim of exploiting South Africa's geographic advantage. In 2014/15, about R22 million would be required for a science mission tracking station. With the sparse distribution of satellite ground stations in the Southern Hemisphere, SANSA is highly sought after to support scientific missions with three such requests being received recently. Leveraging this geographic advantage and positioning SANSA as a global scientific partner of choice, enables SANSA to access data from a wide range of scientific missions at the fraction of the cost and expand the scientific collaborative networks of our scientists. SANSA Space Science has a Science Centre that successfully services a community in a 200km radius. To increase the effectiveness of the centre an expansion of the current facility is planned at a cost of R10 million in 2014/15.

The satellite development programme capex is classified under the National Space Programme with a total estimate for the MTEF at R322 million and a breakdown of R80 million in 2012/13, R97 million in 2013/14. About R145 million would be required for 2014/15 for both the development and the launch costs later that year. Focus will be on developing the satellites that will form part of the African Resource Management Constellation (ARMC) project. This is a collaborative project between South Africa, Nigeria, Algeria and Kenya as per an inter-governmental agreement signed in 2009. It aims to establish a constellation of African satellites that will be used to provide satellite resource management services on the African continent.

General capex is essentially the normal operations capex, with the major allocation to the Space Engineering's upgrade of premises. The total estimate for general capex over the five year period is R78 million.

8.2 SANSA Strategy and the National Space Strategy

As the primary implementer of the National Space Strategy (NSS), SANSA's Goals are aligned to those of the NSS. This alignment is reflected in Table 7.

		NATIONAL SPACE GOALS		
		Goal 1: To capture a global market share for small to medium-sized space systems in support of the establishment of a knowledge economy through fostering and promoting innovation and industrial competitiveness.	Goal 2: To empower better decision making through the integration of space-based systems with ground-based systems for providing the correct information products at the right time.	Goal 3: To use space science and technology to develop applications for the provision of geo-spatial, telecommunication, timing and positioning products and services.
SANSA GOALS	Goal 1: World-class & efficient services and societal benefits (Societal Capital)	• Societal needs driven space systems and sub-systems	• Timely, accurate, detailed & easily accessible data, value-added data services & products • Space based decision making tools • Observational infrastructure & global networks	• Space operations services • EO applications • R&D in space applications • Applied space science services

SANSA GOALS				
	Goal 2: Cutting-edge research, development, innovation, technology & applications (Intellectual Capital)	• R&D in space systems engineering, space science	• R&D in EO, GIS, geo-informatics, image/ signal processing	• R&D in navigation, space weather, telemetry, tracking & command (TT&C), space operations, tmission control
	Goal 3: Effective development of human capital, transformation and science advancement	• HCD in space engineering and space science	• HCD in EO, GIS, geo-informatics, data/ image processing etc.	• HCD in space science & engineering
	(Human Capital)			
	Goal 4: Globally competitive national space industry (Economic Capital)	• Industrial stimulation through projects • Promotion of local industry through international partnerships	• Industry participation in sensor development and satellite system development	• Creating enabling space application platforms that could benefit industry
	Goal 5: Make South Africa a recognised global space citizen (Global Capital)	• Competitive space systems development • Technology & knowledge transfer partnerships	• Active participant in EO and space science technology forums • Contributing to t	• Part of global space applications networks e.g. EGNOS

Table 6 Alignment of SANSA Strategic Goals with National Space Goals

8.3 SANSA Strategy and the National Space Programme (NSP)

8.3.1 Overview

SANSA is tasked with coordinating and driving the implementation of the National Space Strategy (NSS) and the National Space Programme (NSP). The NSP consists of two tiers of programmes:

1. Core Functional Programmes (CFP): programmes which are largely, but not exclusively, undertaken within SANSA structures

2. Capacity Building Programmes (CBP): programmes which have a broader national participation or are largely driven by external stakeholders in partnership with SANSA.

The Core Functional Programmes within SANSA are:

III. Corporate support
IV. Earth Observations
V. Space Operations
VI. Space Science
VII. Space Engineering

These form the nucleus of the NSP and will be complemented and interfaced with the Capacity Building Programmes. The CBPs will include Centres of Competence, Centres of Excellence, Research Chairs, specialised R&D projects, and specialised HCD programmes.

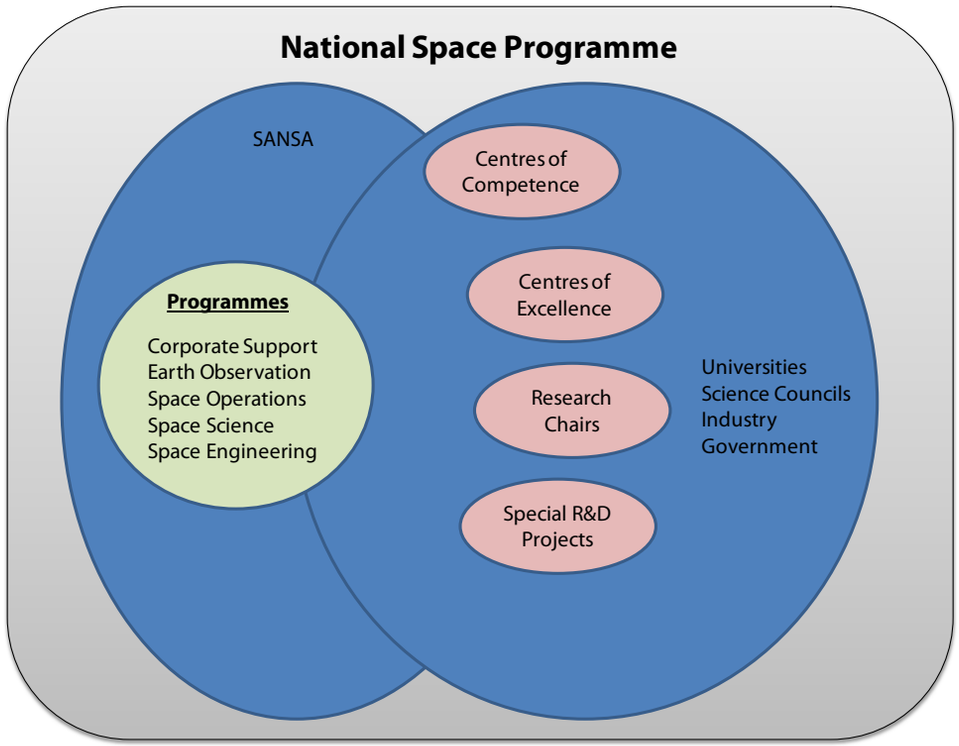


Figure 33: National Space Programme

8.3.2 Capacity Building Programmes

The Capacity Building Programmes will be driven in partnership with the relevant stakeholders. The leadership of these programmes will be in line with set NSI governance structures. The following programmes are identified as the absolute minimum requirement if the National Space Programme is to succeed.

1. **Centre of Competence (CoC) - Satellite Systems:** This CoC will focus on satellite bus R&D both in the micro-segment and nano-segments. Broadly, the CoC partners will include SANSA's directorates, universities, R&D institutions (e.g. Science Councils, other CoCs, CoEs), industry, state-owned entities (SoEs) and government departments, where appropriate. SANSA will play a central administrative and project management role in addition to functional participation by its directorates. The University of Stellenbosch and SunSpace have been very involved in the micro-satellite segment leading to the development and launch of SunSat and SumbandilaSat. Other universities are also involved e.g. the satellite propulsion research between Wits University and SANSA Space Science and the Cape Peninsula University of Technology together with SANSA Space Science have been driving the development of cubesats under the F'SATI programme. Other players include the South Africa Amateur Radio Satellite Association (SA AMSAT) which is involved in cubesat development. This association is an important strategic partner for SANSA in technology development and science advancement.

2. **Centre of Competence (CoC) - Satellite Sensors:** This CoC will focus on satellite sensor R&D. The initial focus would be on optical sensors development which will be then followed by radar sensors. The structure of the CoC will be similar to that above. The CSIR, universities and various industry partners would be instrumental in driving sensor development efforts. The immediate target is to develop a 2.5 resolution imager with development of a sub-meter resolution imager in the future. The defence partners would be a crucial strategic partner in the realisation of sub-metre and radar capabilities. Other sensor integration already in place is that of magnetic sensor integration on satellite subsystems as implemented by SANSA Space Science in previous South African satellites. This is an area of expertise that can be utilised across directorates.

3. **Centre of Excellence (CoE) - Earth Observation:** In order to derive maximum benefit from the data that South Africa acquires and to meet the ever increasing societal needs, a CoE in Earth observations will be set up. The emphasis will be more on the remote sensing and data/image processing side while working closely with more downstream partners like the CSIR, CoE in Applied Centre for Climate and Earth Systems (ACCESS) and other R&D partners. The location of the CoE hub will be optimised to facilitate greater collaboration, large student participation and ease of accessibility to data and infrastructure. Universities could be better suited for hosting the CoE, to enable broader student participation and greater university collaborations. The proposed establishment of the South African Institution for Geomatic Sciences (SAGE) is another determining factor.

4. **Centre of Excellence (CoE) – Space Science:** A dedicated Space Science CoE will be established to
5. re-generate focus on near-Earth and heliospheric science. The push will be for multi-disciplinary research both experimental and theoretical. The expansion of the SANSA Space Science observational network and the continuation of the South African National Antarctic Programme (SANAP) space programme are crucial success factors for the CoE.

6. **Research Chairs:** Two Research Chairs, one in Earth observation and another in space science, will extend the EO and Space Science nodes to other institutions.

7. **Student Bursary Programme:** A well-defined open-call Student Bursary Programme will be established. This will fund both local and international student training.

8. **Focused Student Training Programmes:** The development of multi-institutional, multi-disciplinary degree programmes is important in solving Earth system problems which transcend the classification of scientific and engineering disciplines and require skills and resources that go beyond institutional boundaries. Within space science there is the National Astrophysics and Space Science Programme (NASSP). The scope of the programme needs to be broadened to accommodate the attainment of the National Space Strategy. SANSA will consider additional contributions to the programme to achieve this objective. A similar programme for EO needs to be established.

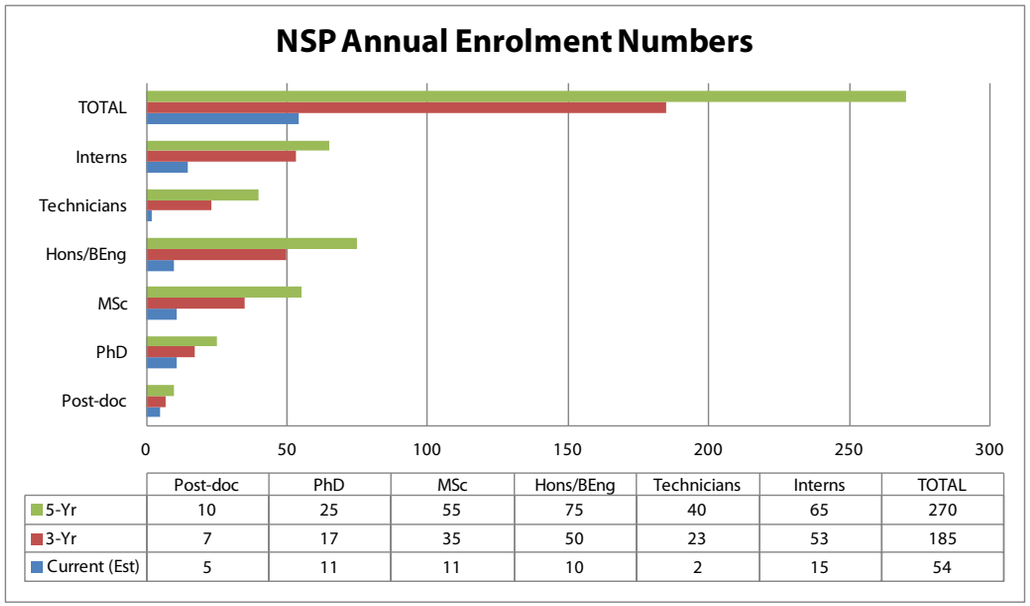
9. **Open-call & Specialised R&D Projects/Grants:** Open-call peer reviewed research projects in space science and technology will be funded to achieve the required R&D. In rare cases, targeted special projects will be funded to achieve clearly defined objectives.

8.3.3 Key Deliverables

The key deliverables of the National Space Programme over the five year period are:

The key deliverables of the National Space Programme over the five year period are:

1. **Satellite images for societal benefit:** An estimated 10 000 image scenes is to be distributed; and total of 50 Tb is to be collected and archived with a total of 250 Tb distributed for societal benefits and research purposes.
2. **R&D:** High-impact research projects in remote sensing, Earth observations, space science, satellite engineering with an increased publication record will be targeted.
3. **HCD & Science Advancement:** The NSP annual student/trainee enrolment numbers will be increased from the current estimated 54 to 185 (three-year target) and 270 (five-year target). At least two CoCs and two CoEs will be in place along with the multi-institutional National Earth Observation Programme (NEOP); space research chairs, research grants and bursary student programmes. An estimated 500 000 learners will be directly engaged.
4. **Satellite Programme:** The plan is to have a clearly defined 10-20 year satellite roadmap. Further, to have one satellite complete and launched and the second one in advanced stage of development. In addition to this, we will have a number of new technologies developed in control systems, power management, materials, optronics, etc.



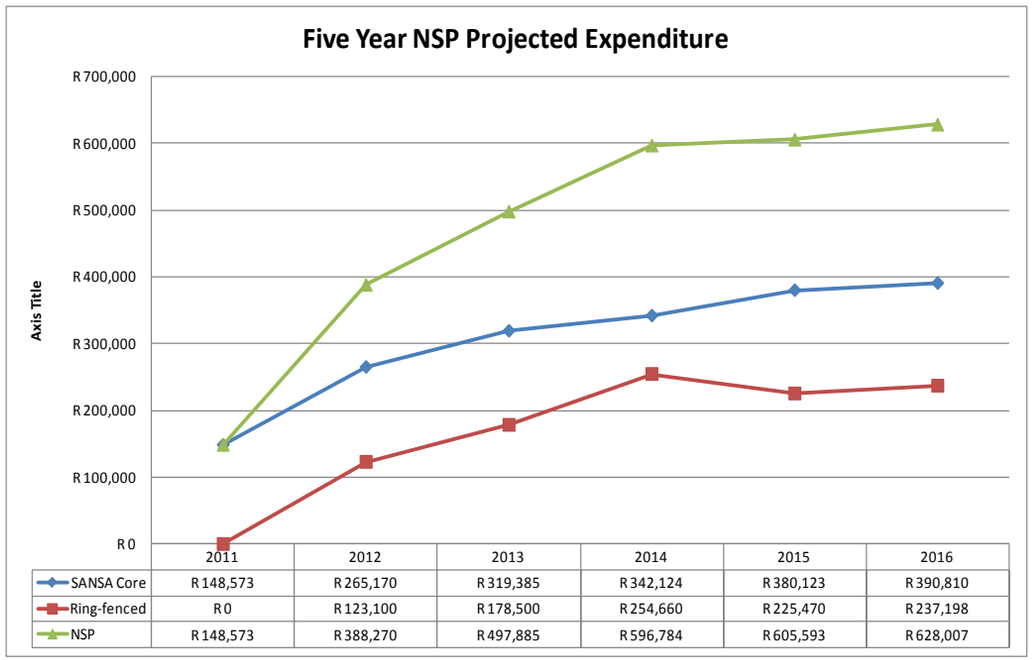
	Post-doc	PhD	MSc	Hons/BEng	Technicians	Interns	TOTAL
5-Yr	10	25	55	75	40	65	270
3-Yr	7	17	35	50	23	53	185
Current (Est)	5	11	11	10	2	15	54

8.3.4 High-level Costs

SANSA is currently engaged in a consultative process that will define the NSP in detail and its costing. Once concluded and approved the budget requirements will be finalised.

	2011/12	2012/13	2013/14	2014/15	MTEF	2015/16	2016/17	5-Yr
SANSA Core	**R 148,573**	**R 265,170**	**R 319,385**	**R 342,124**	**R 926,678**	**R 380,123**	**R 390,810**	**R 1,697,611**
SANSA Corporate Office	R 32,000	R 44,718	R 45,809	R 48,790	R 139,317	R 52,355	R 56,848	R 248,520
SANSA Earth Observation	R 45,700	R 70,733	R 73,574	R 76,931	R 221,238	R 107,856	R 101,139	R 430,233
SANSA Space Operations	R 39,300	R 50,040	R 70,394	R 89,636	R 210,070	R 72,888	R 70,289	R 353,248
SANSA Space Science	R 31,573	R 59,079	R 75,018	R 68,901	R 202,998	R 78,261	R 86,264	R 367,522
SANSA Space Engineering	R 0	R 40,600	R 54,590	R 57,865	R 153,055	R 68,763	R 76,269	R 298,088
RING-FENCED/EXTERNAL	**R 0**	**R 123,100**	**R 178,500**	**R 254,660**	**R 556,260**	**R 225,470**	**R 237,198**	**R 1,018,927v**
Satellite Development	R 0	R 80,000	R 97,000	R 145,000	R 322,000	R 100,200	R 106,212	R 528,412
Satellite Sensors CoC	R 0	R 15,100	R 25,000	R 26,500	R 66,600	R 28,090	R 29,775	R 124,465
Satelite Systems CoC	R 0	R 0	R 0	R 16,000	R 16,000	R 16,960	R 17,978	R 50,938
Earth Observation CoE	R 0	R 5,000	R 11,000	R 11,660	R 27,660	R 12,360	R 13,101	R 53,121
Space Science CoE	R 0	R 0	R 6,000	R 12,000	R 18,000	R 12,720	R 13,483	R 44,203
Earth Observation - SARChI	R 0	R 0	R 2,500	R 2,500	R 5,000	R 2,650	R 2,809	R 10,459
Space Scince - SARChI	R 0	R 0	R 2,500	R 2,500	R 5,000	R 2,650	R 2,809	R 10,459
Student Bursaries	R 0	R 1,000	R 2,000	R 4,500	R 7,500	R 5,000	R 5,300	R 17,800
Research/Special Grants	R 0	R 20,000	R 20,000	R 20,000	R 60,000	R 30,000	R 30,000	R 120,000
NASSP (Space Scie Contribution)	R 0	R 2,000	R 2,500	R 3,000	R 7,500	R 3,180	R 3,371	R 14,051
NEOP	R 0	R 0	R 10,000	R 11,000	R 21,000	R 11,660	R 12,360	R 45,020
TOTAL (National Space Programme)	**R 148,573**	**R 388,270**	**R 497,885**	**R 596,784**	**R 1,482,938**	**R 605,593**	**R 628,007**	**R 2,716,539**

With that understanding, the consolidated estimated expenditure for the National Space Programme over the five year period covered by this strategy is presented in Figure 36, and the corresponding budget trend highlighted in Figure 37. For the MTEF starting 2012/13, SANSA's core costs are estimated at R265 million, R319 million and R342 million in the next three years with an MTEF total of R927 million. Specialised ring-fenced/external costs including satellite development are also presented. These specialised ring-fenced/external projects will cost R123 million, R179 million and R255 million in the next three years with an MTEF total of R556 million. The satellite development programme has a MTEF total of R322 million including development and launch costs. The consolidated National Space Programme (NSP) will cost R388 million, R498 million, and R597 million in the next three years of the MTEF with a total of R1.5 billion over that period. The large increase in the ring-fenced budget in 2014/15 is due to anticipated satellite launch costs later that year. Over the five year period, the National Space Programme is expected to cost about R2.7 billion with R1.7 billion being core SANSA budget and R1 billion allocated to ring-fenced special projects.



	2011	2012	2013	2014	2015	2016
SANSA Core	R 148,573	R 265,170	R 319,385	R 342,124	R 380,123	R 390,810
Ring-fenced	R 0	R 123,100	R 178,500	R 254,660	R 225,470	R 237,198
NSP	R 148,573	R 388,270	R 497,885	R 596,784	R 605,593	R 628,007

Figure 37: National Space Programme five year budget projection (in R'000)

9 PUBLIC – PRIVATE PARTNERSHIPS

Not applicable

10 CONCLUSION

The dual launch of the National Space Strategy and the South African National Space Agency (SANSA) on 9th December 2010 signalled South Africa's giant leap into space science and technology – a new era in service of humanity. An era in which all South Africans fully benefit from the utilisation of space science and technology to advance all facets of human endeavour, aspiration and hope. SANSA will deliver on a wide spectrum of national priorities, including environmental and resource management; urban planning and rural development; economic growth and global competitiveness; food security and health; job creation and poverty alleviation; human capital development; technology development and innovation; science advancement amongst the youth and public engagement in science; and fostering global partnerships.

ACRONYMS

Acronym	Full Name
ARMC	African Resource Management Constellation
CAPEX	Capital expenditure
CBERS	China Brazil Earth Resources Satellite
CEOS	Committee on Earth Observation Satellites
CNES	Centre National d'Etudes Spatiales – the French Space Agency
CSIR	Council for Scientific and Industrial Research
DoC	Department of Communications
DoT	Department of Transport
DST	Department of Science and Technology
EO	Earth Observation
ESA	European Space Agency
EGNOS	European Geostationary Navigation Overlay Service
FP7	Seventh Framework Programme for Research and Technological Development
GEO	Geostationary/Group on Earth Observation
HCD	Human Capital Development
HMO	Hermanus Magnetic Observatory
ICT	Information and Communications Technology
IOT	In-orbit testing/tests
IPAP	Industrial Policy Action Plan
ISES	International Space Environment Service
KPI	Key Performance Indicator
L,S,C,Ext c, X, Ku, Ka, DBS	Different frequency bands
LEOP	Launch and Early Orbit Phase/Low earth Orbit Phase
MTEF	Medium Term Expenditure Framework
NGO	Non-Governmental Organisation
NGP	New Growth Path
NRF	National Research Foundation
NSP	National Space Programme
NSS	National Space Strategy
R&D	Research and development
RWC	Regional Warning Centre
SAASTA	South African Agency for Science and Technology Advancement
SAEON	South African Earth Observation Network
SAEOS	South African Earth Observation System/Strategy
SANAP	South African National Antarctic Programme
SANSA	South African National Space Agency
SET	Science, Engineering & Technology
TT&C	Telemetry, Tracking and Command

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