Report

South African Geodesy Workshop: Laying the Foundation for the Establishment of the South African Geodesy Working Group (1–2 October 2025, SAAO, Cape Town)

1. INTRODUCTION

The Department of Science, Technology and Innovation (DSTI), together with the Department of Land Reform and Rural Development (DLRRD), organized the first South African Geodesy Workshop in collaboration with the South African National Space Agency (SANSA), the South African Radio Astronomy Observatory (SARAO), the University of Cape Town (UCT), and the University of KwaZulu-Natal (UKZN).

This workshop was the first national step toward the establishment of a formal South African Geodesy Working Group (SAGWG). It aimed to initiate structured coordination across the national geodesy community, and to begin drafting a framework for governance, strategy, and international alignment in support of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) and its Global Geodetic Centre of Excellence (UN-GGCE).

Specifically, the workshop supported the UN-GGCE's activities for Member States, which include setting up a national geodesy working group to implement a country-level geodesy strategy and action plan, and collaboratively carrying out the activities outlined in the UN-GGCE First Joint Development Plan (JDP). The future SAGWG is intended to lead these efforts in alignment with the UN-GGCE framework and to contribute to South Africa's eventual formal participation through the signing of the UN-GGCE Multilateral Memorandum of Understanding (MMoU), reflecting the country's commitment to international cooperation and strengthened national capacity in geodesy.

The objectives of the workshop were to:

1. Bring together key national stakeholders — including government departments, national facilities, research institutions, academia, and industry — to build a shared understanding of geodesy's national importance and the need for coordinated action.
2. Lay the groundwork for establishing the SAGWG and discuss its proposed Terms of Reference;
3. Consider the UN-GGCE's activities for Member States, including the signing of the MMoU and the implementation of country-level actions outlined in the UN-GGCE JDP;
4. Explore the concept of a National Geodesy Coordination Framework, or Strategy, including the proposed eight pillars that will guide its structure and implementation across government, academia, and industry;
5. Undertake a strengths, weaknesses, opportunities, and threats (SWOT) assessment across stakeholder institutions to identify priorities for improving national geodetic capability, infrastructure, and coordination;
6. Present and discuss the Global Geodetic Observing System for Africa (GGOS-Africa) initiative and consider South Africa's potential leadership and coordination role therein, and

7. Agree on a way forward and indicative timeline for progressing these activities and preparing for the formal establishment of the SAGWG.

The two-day programme combined plenary presentations, institutional updates, panel discussions, and interactive sessions. Day 1 focused on setting the scene — introducing the concept and importance of geodesy, outlining the geospatial and institutional landscape internationally and in South Africa, and providing updates from key institutions including DSTI, DLRRD, SARAO, SANSA, Committee for Spatial Information (CSI) and the partner universities, the University of Cape Town and the University of KwaZulu-Natal. It also included detailed sessions on the UN-GGCE and its Joint Development Plan (JDP), the proposed establishment of the SAGWG, the GGOS-Africa initiative, and the concept of developing a National Geodesy Framework / Strategy for South Africa. The first thematic pillar, *Governance, Partnerships, and Reporting*, was discussed in depth through interactive exchanges, a panel session and a live survey.

Day 2 focused on the remaining seven pillars of the proposed framework — Advocacy and Communication; Infrastructure and Operations; Spectrum Protection; Data, Standards and Open Access; Reference Systems and Regional Frames; Human Capital Development; and Research, Development and Next-Generation Supply Chain. The day included presentations, interactive group discussions, panel dialogues, and live surveys, which enabled participants to refine the proposed framework and identify priority actions for national implementation.

The workshop information and full programme are available on the official event page: https://events.sarao.ac.za/event/9/. A copy of the final workshop program is attached as **Annexure A**, the consolidated survey results are in **Annexure B**, and key actions and recommendations from the workshop are in **Annexure C**.

The workshop was organised and coordinated by the Organising Committee (OC), comprising representatives from the following institutions:

- **Department of Science, Technology and Innovation (DSTI):** Dr *Aletha de Witt (co-chair), Hubert Mathebula, Thuto Ndlovu, and Relebohile Motloung*
- **Department of Land Reform and Rural Development (DLRRD):** *Aslam Parker (co-chair), Patrick Vorster, and Siyabonga Mdubeki*
- **South African National Space Agency (SANSA):** *Jonathan Ward*
- **South African Radio Astronomy Observatory (SARAO):** *Dr Roelf Botha*
- **University of Cape Town (UCT):** ***Dr*** *Patroba Odera and Dr Siphiwe Mphuthi*
- **University of KwaZulu-Natal (UKZN):** *Dr Mulemwa Akombelwa*

Outcome summary:

The workshop consolidated national consensus on the establishment of the SAGWG and reaffirmed the need for a coordinated national approach to geodesy that is aligned with both continental and global frameworks. Participants endorsed the Eight-Pillar Framework as the foundation for developing a National Geodesy Strategy and Coordination Framework and supported South Africa's leadership role in advancing the GGOS-Africa initiative. The discussions also strengthened alignment with the UN-GGCE's global objectives, including the implementation of country-level activities under the JDP and preparation for formal engagement through the MMoU. Through presentations, panel discussions, and live surveys, participants identified key national priorities and challenges, including the need to strengthen governance and coordination mechanisms for geodesy, improve infrastructure maintenance and data-sharing systems, expand human capacity and training, and secure sustainable funding for geodetic infrastructure. The workshop concluded with an agreement on the way forward, including the drafting of the SAGWG Terms of Reference, refinement of the Eight-Pillar Framework, and the establishment of committees within the SAGWG to finalize each pillar and oversee its implementation. It was further agreed that the workshop report will be distributed to all stakeholders, that work on the

Terms of Reference will commence immediately, and that the formal establishment of the SAGWG will be completed by the end of the 2025/26 financial year.

***Figure 1**. Group photo (in-person participants): South African Geodesy Workshop – Laying the Foundation for the Establishment of the South African Geodesy Working Group (1–2 October 2025, SAAO, Cape Town).*

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2. DAY 1: Setting the Scene and Vision for South African Geodesy – 1 Oct 2025

The first day of the workshop set the strategic and conceptual foundation for South Africa's emerging coordinated geodesy framework. Participants agreed that geodesy underpins nearly every aspect of national development—from mapping and navigation to climate monitoring, disaster management, and infrastructure planning—and that the absence of coordinated national structures has limited its impact. The day therefore focused on creating a shared vision for coordination, governance, and investment.

2.1 Opening and Welcome

The opening session of the South African Geodesy Workshop was facilitated by Takalani Nemaungani, Chief Director for the Astronomy portfolio at the DSTI. Charles Mokonoto, Acting Deputy Director-General (DDG) at the DSTI, and Siyabonga Mdubeki, DDG at the DLRRD, delivered the welcoming remarks. Both speakers highlighted the critical need for a coordinated national approach to geodesy to prevent fragmentation, strengthen technical standards, and align activities across departments, national facilities, and research institutions. They underscored geodesy's foundational role in supporting national priorities such as disaster management, infrastructure planning, environmental monitoring, and spatial data governance. The workshop was framed as a first national step toward establishing the SAGWG—a collaborative structure intended to streamline geodetic activities, enhance cross-sector integration, and guide the development of a comprehensive National Geodesy Strategy that connects South Africa's scientific, policy, and operational domains in geodesy, astronomy, and space science.

2.1 Setting the Scene: Building South Africa's Geodetic Framework

This session outlined the global, regional, and national context for geodesy, establishing the foundations for South Africa's future coordination framework. Aslam Parker highlighted that geodesy—the science of precisely measuring the Earth's shape, gravity field, and rotation—is fundamental to navigation, mapping, and all spatial data applications and underpins all geospatial information. He cautioned that

Africa's reference systems remain fragmented, with countries using different mostly legacy datums, which can result in positional discrepancies of several hundred meters. He emphasized the urgent need for unified national, regional, and continental reference frames to ensure accuracy, interoperability, and effective planning. Parker underscored geodesy's importance in disaster management, infrastructure design, land administration, water management, precision agriculture, and time synchronization. He noted that geodesy not only measures the Earth but also extends its reach into space, with the celestial reference frame playing an essential role in satellite navigation, space missions, and interplanetary exploration. He highlighted the critical link between terrestrial and celestial reference frames—through Earth orientation parameters—all of which are essential for geodetic, astronomical, and space science applications. Parker concluded that South Africa, as a UN Member State, has a responsibility to align its national efforts with the UN Global Geodetic Reference Frame (GGRF) Resolution as per UN General Assembly resolution (A/RES/69/266), calling for the modernization of geodetic infrastructure and strengthened national and continental coordination.

Patrick Vorster mapped South Africa's position within the global geodetic ecosystem, referencing the 2015 UN Resolution on a GGRF for Sustainable Development, the UN-GGIM and the UN Integrated Geospatial Information Framework (UN-IGIF), the UN Subcommittee on Geodesy (UN-SCoG), and the UN-GGCE. He noted the complementary roles of international bodies such as the International Association of Geodesy (IAG) and the GGOS, the International Astronomical Union (IAU), and the International Federation of Surveyors (FIG), amongst others, and stressed the importance of modernizing South Africa's reference infrastructure and strengthening participation in international geodetic services. Vorster emphasized the need for a balanced global network of sites and the co-location of fundamental sites—incorporating Very Long Baseline Interferometry (VLBI), Global Navigation Satellite Systems (GNSS), Satellite Laser Ranging (SLR), and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS)—pointing out that the Hartebeesthoek site in South Africa is currently Africa's only fundamental site. He urged the development of additional facilities in Africa to correct this imbalance. He also reviewed South Africa's current geodetic assets, including the Chief Directorate: National Geospatial Information (NGI), SARAO, SANSA, the South African Naval Hydrographic Office (SANHO), and the Council for Geoscience (CGS), noting that a coordinated national system would enable South Africa's contribution to the global reference frame and time-series datasets.

Nicholas Brown, Head of the UN-GGCE, introduced the JDP as the roadmap for sustainable global geodesy and commended South Africa for taking a coordinated national approach through the establishment of the SAGWG. He explained that the JDP supports the 2015 UN Resolution on the GGRF and sets out practical steps for countries to strengthen governance, capacity, and infrastructure through national working groups and international collaboration. Brown emphasized that continual measurement of the Earth's orientation, shape, and gravity field is essential for reliable satellite navigation, timing, and global infrastructure systems. He highlighted the interdependence between geodesy, space science, and Earth observation, noting that 13 of 15 critical infrastructure sectors depend on accurate and reliable positioning and timing. He identified four key challenges—lack of evidence, limited awareness, weak capacity, and inadequate governance—and stressed that addressing these would unlock resources and long-term sustainability for the global geodesy supply chain. Brown encouraged adoption of open data standards, the strengthening of national and regional coordination mechanisms such as the SAGWG and GGOS-Africa, and participation in the UN-GGCE MMoU, which already includes 44 participating countries.

Aletha de Witt assessed Africa's fragmented geodetic landscape, noting that the continent has only one fundamental co-location site—Hartebeesthoek in South Africa—where all four space-geodetic techniques (VLBI, GNSS, SLR, and DORIS) are in operation. She underscored Africa's strategic importance to the global geodesy supply chain due to its vast landmass, central position, and diverse geophysical environment, while also stressing the continent's growing demand for geodesy to support population growth and sustainable-development needs. She highlighted persistent challenges, including limited infrastructure, outdated equipment, restricted data access, weak coordination, and limited funding. De Witt emphasized that establishing strong national coordination through a SAGWG and

developing a National Geodesy Strategy are essential first steps toward a coherent African framework under GGOS-Africa. She outlined progress in promoting geodesy at international forums such as the UN Science Summit and IAG Scientific Assembly and confirmed that South Africa has secured seed funding under the Africa-UK Physics Partnership (2025–2027) to support the establishment of GGOS-Africa. She concluded that building national structures and policy frameworks will provide the foundation and model for continental coordination, aligning Africa's geodetic development with the UN-GGCE JDP.

de Witt's presentation was supplemented by recorded messages of support from international partners, including Richard Gross (President of the *IAG*), Zuheir Altamimi (Immediate Past President of the *IAG*), and Bonnie Steves (President of *IAU Division A on Fundamental Astronomy*). They reaffirmed South Africa's vital role in global geodesy and astrometry—particularly through Hartebeesthoek's multi-technique site—and welcomed the establishment of a National Geodesy Working Group as a key step toward strengthening Africa's participation in global geodetic and astronomical frameworks.

2.2 Facilities and Institutional Updates

This session provided concise overviews from key national departments and institutions, each outlining their current roles, priorities, and challenges in geodesy. Collectively, the presentations showed that while South Africa possesses substantial technical capability, the absence of formal coordination mechanisms continues to limit efficiency, investment alignment, and sustainability.

Hubert Mathebula (DSTI) outlined the Department's policy and coordination mandate under the 2019 White Paper and the Science, Technology and Innovation Decadal Plan (2021–2031). He emphasised the need for an enabling policy framework to integrate terrestrial and space geodesy, align national actions with the UN-GGCE JDP, and formalise coordination through the establishment of the SAGWG and the development of a National Geodesy Strategy. He confirmed that geodesy now forms part of the National Strategy for Multi-Wavelength Astronomy (2025–2035) and sits within DSTI's Astronomy Sub-Programme, reflecting its linkages with radio astronomy and VLBI infrastructure (HartRAO, MeerKAT, SKA-Mid).

Aslam Parker (DLRRD) traced the historical evolution of South Africa's geodetic control survey network and legal mandates under the Land Survey Act (No. 8 of 1997, as amended) and the Spatial Data Infrastructure (SDI) Act (No. 54 of 2003). He highlighted the National Control Survey System (NCSS), which underpins the national cadastre and most geospatial information in South Africa, and provided an overview of the TrigNet network of 70 continuously operating GNSS reference stations, a global benchmark for precision and reliability. He underscored the need for modernization, through multi-constellation GNSS capability (GPS, GLONASS, Galileo, BeiDou), as well as densification in areas of high growth and economic impact and the need for adequate, consistent and reliable long-term funding. Parker also noted that South Africa's national geodetic reference frame (*the Hartebeesthoek94 datum*) is anchored at the HartRAO 26m telescope—the country's sole global reference tie (at the time)—and raised the importance of re-computation and stability monitoring. He stressed that spatial accuracy must be linked with spatial justice and that a coordinated approach across organs of State is essential for sustainability.

Roelf Botha (SARAO) reviewed the SARAO Hartebeesthoek site's six-decade legacy as a fundamental geodetic site, co-locating all four space-geodetic techniques (VLBI, GNSS, SLR, DORIS) and serving as Africa's only such facility. He detailed its critical role in the International VLBI Service for Geodesy and Astrometry (IVS), maintaining both celestial and terrestrial reference frames, and outlined challenges associated with ageing infrastructure and the urgent need to repair the 26m telescope's bearings to preserve South Africa's long-term VLBI time series. Botha cautioned that failure to maintain continuity would risk the loss of over 50 years of reference data. He also presented plans for

a next-generation co-location site at Matjiesfontein, designed to complement, rather than replace Hartebeesthoek, ensuring data redundancy and continuity across Africa's geodetic network.

Jon Ward (SANSA) described SANSA's GNSS Instrumentation Network and the expansion of the African Instrumentation Network (AIN) across southern and equatorial Africa. He highlighted its role in ionospheric monitoring, space-weather forecasting, and real-time GNSS data provision, as well as for ionospheric monitoring at SANSA's strategic Antarctic and sub-Antarctic stations (SANAE IV, Marion Island, Gough Island). Ward emphasised collaboration to avoid infrastructure duplication, promote data-sharing, and leverage partnerships through the Southern African Development Community (SADC). He also outlined SANSA's plans toward an operational Space-Based Augmentation System (SBAS) for southern Africa to improve GNSS precision for aviation, agriculture, and surveying, aligning national efforts with global satellite navigation standards.

Dalikhaya Mdunge (CSI Chair) and Maroale Chauke (Director: National Spatial Information Framework, which provides secretariat to CSI) presented the institutional framework of the South African Spatial Data Infrastructure (SASDI), established under the Spatial Data Infrastructure (SDI) Act. They confirmed that Geodesy has been designated as a core national data theme and that the Chief Directorate: NGI within the DLRRD serves as the Base Data Coordinator under CSI oversight. They emphasized the need for regular reporting by the SAGWG through the CSI Subcommittee on Technology, alignment with UN-GGIM and UN-GGIM: Africa pathways, and adherence to the Base Data Set Custodianship Policy signed by the Minister. The CSI underscored that sustainable Geodesy governance must be institutionalized within South Africa's broader spatial-data system through standards, policies, and cooperative-governance principles.

Collectively, the session underscored that while South Africa has strong geodetic capability, fragmented coordination and ageing infrastructure threaten long-term sustainability. Presenters agreed on the need to establish the South African Geodesy Working Group and a National Geodesy Strategy aligned with the UN-GGCE Joint Development Plan, to unify national efforts, modernize TrigNet and the Hartebeesthoek 26m telescope, and embed both space and terrestrial geodesy within broader national frameworks to ensure continuity, interoperability, and regional leadership.

2.4 Panel Discussion: Setting the Scene

Panel Discussion: The first panel discussion consolidated perspectives from government, science, and policy representatives on strengthening South Africa's national geodesy ecosystem. Panellists highlighted that geodesy underpins all spatial data, mapping, and positioning systems, forming the "invisible infrastructure" essential for defence, navigation, mining, infrastructure, and land management. They emphasised that South Africa's geodetic capacity must be seen not as a peripheral technical field but as a national strategic asset and part of the global geodesy supply chain. Discussions underscored the need for unified coordination across departments, integration of terrestrial and space geodesy, and stronger alignment with regional and international frameworks. The CSI reiterated that geodesy must be institutionalised within the South African Spatial Data Infrastructure through standards, policies, and regular reporting. Participants also stressed improved public awareness, education, and communication of geodesy's relevance, from schools to policymakers, to ensure long-term sustainability and skills development. Participants emphasized that South Africa's national geodetic systems both rely on and contribute to international reference frames and global structures, and that the SAGWG was viewed as the mechanism to unify representation from all departments in these global structures. It was proposed that geodesy should be recognized as strategic national infrastructure, with funding contributions from multiple departments—including Defence, which depends on geodetic information for national security and precision operations.

2.5 Laying the Foundations: Towards a SAGWG and GGOS-Africa

This session marked a critical turning point in defining the institutional and continental direction of South Africa's geodesy initiatives. Discussions focused on formalising the structure of the SAGWG and aligning national efforts with global and regional frameworks, including the UN-GGCE JDP and the emerging GGOS-Africa initiative.

Aletha de Witt outlined South Africa's progress in implementing the UN-GGCE activities for Member States, which include establishing a national working group, developing a country-level geodesy strategy and action plan, and contributing to the JDP through collaborative governance, data sharing, and capacity development, leveraging synergies with astronomy, space science, and high-performance computing. She stressed that establishing an effective national coordination mechanism through the SAGWG, supported by a draft Eight-Pillar Framework, was South Africa's immediate priority covering *Governance, Partnerships and Reporting; Advocacy and Communication; Infrastructure and Operations; Spectrum Protection; Data, Standards and Open Access; Reference Systems and Regional Frames; Human Capital Development; and Research, Development and Next-Generation Supply Chain*. This framework, she noted, could also serve as a model for continental coordination, through GGOS-Africa.

Aslam Parker followed with a detailed proposal for the establishment and structure of the SAGWG, including the nomination of stakeholders, the development of the Terms of Reference (ToR), and the creation of subcommittees aligned with the Eight Pillars. He noted that the group's roadmap would align with international frameworks such as GGOS and the UN-IGIF, ensuring that national structures interface seamlessly with global governance and reporting mechanisms, and called for building capacity toward a regional GNSS Analysis Centre.

Jack Radcliffe introduced the GGOS-Africa funding project, supported through the Africa-UK Physics Partnership (2025–2027). He explained that the initiative aims to assess Africa's geodetic infrastructure, develop a strategic plan for capacity and network expansion, train the next generation of African geodesists, and provide seed funding for implementation. He emphasised that GGOS-Africa will complement, rather than replace, existing initiatives such as the African Reference Frame (AFREF), the UN-GGIM: Africa, the Regional Centre for Mapping of Resources for Development (RCMRD), and the African Regional Institute for Geospatial Information Science and Technology (AFRIGIST), serving as a unifying coordination platform for continental geodesy. He proposed that the GGOS-Africa Secretariat be hosted in South Africa, with a governance structure linking African regions and existing organisations.

2.6 Panel Discussion and Survey: Laying the Foundations

Panel Discussion: The second panel discussion consolidated the key insights from the previous session on the first thematic pillar on Governance, Partnerships & Reporting, centred on the establishment of the SAGWG and the development of a National Geodesy Framework, positioning South Africa both as a model for effective national coordination and as a continental leader through GGOS-Africa.

Panellists and participants agreed that South Africa's geodetic activities remain fragmented and must transition toward an integrated national programme anchored by the forthcoming SAGWG. A unified structure would ensure that South Africa's geodetic system supports and benefits from international reference frameworks, strengthening the country's scientific, technical, and diplomatic standing in global geodesy. The CSI reaffirmed that geodesy underpins all spatial-data management and recommended embedding the SAGWG's reporting and standards mechanisms within the SASDI.

The Centre for High-Performance Computing (CHPC) emphasised the importance of data-sharing and regional collaboration, noting that initiatives such as GGOS-Africa could enable continental-scale data integration and analysis. Participants identified the establishment of a national Geodetic Monitoring

and Analysis Centre (GMAC) as a structural priority to consolidate GNSS data and analytical capacity within a coordinated national framework. This could include a GNSS Analysis Centre to support IGS participation, an IVS Analysis Centre for VLBI, and a VLBI Correlation Centre in partnership with CHPC. An inventory of GNSS receivers and CORS networks across organs of State, including SANSA and the Department of Transport, was proposed to clarify infrastructure ownership and ensure consistent access to national data assets. It was agreed that all data funded by the taxpayer must be openly accessible and properly archived, though speakers noted that such data need not be physically centralised if supported by a national metadata repository and coherent data-management system with standard identifiers and open interfaces. Reference was made to international models such as UNAVCO[1] (now part of the EarthScope Consortium)—a neutral, non-profit collaborative framework where institutions contribute infrastructure and resources under shared governance—as a potential template for South Africa's geodetic data architecture.

Participants also discussed dual-use instruments and the need to align infrastructure projects across institutions, particularly between geodesy, astronomy, and space science, to maximise efficiency and avoid duplication. Concerns were raised that the emerging GGOS framework might not be equally recognised by all communities, mapping agencies, space agencies, and astronomy,leading to fragmented investments and overlapping mandates. The panel agreed that GGOS provides the coordination framework designed to bridge these divides, integrating mapping authorities, space agencies, and the scientific community at the global level, while recognising that each country will need to adapt this to its own institutional structure. It was stressed that national implementation must be multi-disciplinary and that agencies responsible for fundamental reference data, often survey or mapping authorities, should receive sustained support alongside space and science entities that rely on those data.

A representative from Leica Geosystems emphasised that industry must be an active partner in building South Africa's geodetic capability—bringing advanced technologies, open APIs, and integration expertise to link systems across government, academia, and the private sector. They highlighted the importance of understanding the entire data chain, avoiding siloed operations, and co-developing solutions to national challenges.

The representatives from academia called for stronger research partnerships and formal MOAs between universities and public institutions to expand collaborative training and technical capacity. The discussion on human-capital development highlighted that geomatics and geodesy programmes receive far less funding than astronomy, yet the operation of the proposed geodetic facilities will require a much larger manpower base. Panellists welcomed efforts to leverage astronomy training platforms—particularly VLBI-based programmes to support geodesy—but stressed that dedicated and sustained structures for geodetic education must be established. Several participants stressed that promoting geodesy should begin at school level and continue through tertiary education to build awareness and a sustainable skills pipeline.

Interactive Survey: To capture stakeholder perspectives, an interactive survey was conducted at the end of the session, where 77 participants confirmed broad alignment on national priorities: 94% agreed that greater coordination is required for geodesy in South Africa, while only 9% found existing governance structures effective. The most significant gaps were identified as lack of coordination (64%), insufficient funding (54%), limited exposure (51%), and weak governance frameworks (43%). Ninety-three percent (93%) supported embedding geodesy within African policy agendas, and nearly 70% rated multi-domain partnerships—linking geodesy with surveying, geophysics, astronomy, space

[1] UNAVCO (originally "University NAVSTAR Consortium") was a U.S.-based non-profit organization that supported geodesy and Earth science research through the operation and coordination of GNSS (Global Navigation Satellite System) networks, data management, and technology development.

science, and climate science—as critical to national progress. Participants emphasized that establishing the SAGWG and a National Geodesy Framework is the most urgent step toward improved governance, coordination, and international alignment, and expressed near-universal support for South Africa's formal participation in the UN-GGCE through signing its MMoU. Open comments highlighted the need for a clear national strategy, stronger interdepartmental collaboration, dedicated funding, and awareness initiatives to professionalize and expand the geodetic workforce. The full survey questionnaire and detailed results are presented in **Appendix B**.

2.7 Draft National Geodesy Framework and Eight-Pillar Model

The final presentation of Day 1 consolidated the workshop outcomes into a draft national framework for coordinated geodesy in South Africa. Aletha de Witt presented the proposed National Geodesy Framework, designed to operationalise the UN-GGCE JDP through an integrated Eight-Pillar Model jointly led by DSTI and DLRRD. The framework positions the forthcoming SAGWG as the central coordination structure and provides a foundational model for regional implementation through GGOS-Africa. Derived from the activities of the UN-GGCE JDP and adapted to South Africa's context, the Eight Pillars, as shown in **Figure 2,** define the strategic structure of South Africa's National Geodesy Strategy and will be refined by the SAGWG during its establishment phase. These pillars are expected to evolve — for instance, *Advocacy and Communication* may broaden to explicitly include *Outreach*, while *Human Capital Development* will focus primarily on education and skills development. Likewise, *Spectrum Protection* may expand to include broader site-protection measures, and *Research and Development* may extend to encompass *innovation and commercialisation*. Together, the draft pillars illustrate South Africa's transition from fragmented geodetic activity toward an integrated, internationally aligned system that connects national priorities with continental coordination under GGOS-Africa and global commitments through the UN-GGCE. This presentation concluded Day 1 and provided the conceptual bridge to Day 2's discussions on the remaining thematic pillars.

***Figure 2**. Draft Eight-Pillar Framework for a National Geodesy Strategy — to be refined by the SAGWG.*

3. DAY 2: Eight Pillar Framework for a National Geodesy Strategy - 2 Oct 2025

The meeting covered discussions on the Geodesy ecosystem's eight pillars, focusing on infrastructure, operations, data standards, and reference frames. Participants explored the importance of international standards, regional reference systems, and the need to modernize existing infrastructure while addressing challenges in data sharing and funding. The meeting also addressed human capacity development in universities, advocacy efforts for geodesy, and its role in digital transformation, concluding with discussions on protecting astronomy sites and spectrum management in Africa. The meeting focused on discussing the eight pillars of the geodesy ecosystem, following up on the previous day's session.

3.1 Pillars 3, 5 and 6

Infrastructure & Operations (Pillar 3): Roelf Botha emphasised the need to assess, maintain, modernise, and secure South Africa's geodetic infrastructure to prevent further degradation of the global geodesy supply chain. He highlighted the importance of a national audit to map facilities across agencies such as the Council for Geoscience, DLRRD (NGI), SANSA, SARAO, and meteorological networks, identifying opportunities for co-location, consolidation, and shared maintenance. Botha called for long-term operational agreements to ensure the sustainability of stations and data services, with explicit attention to maintenance, cybersecurity, staffing, and land-lease arrangements. He stressed the need to shift national efforts from, primarily, data collection to integrated data analysis, correlation, and combination capabilities, to strengthen service delivery and national reporting. He proposed establishing a South African or African Geodetic Consortium, modelled on the former UNAVCO/ Current EarthScope structure, in order to pool expertise, resources and funding across institutions. Such a shared platform could manage deployment, maintenance, and data archiving for national and regional networks, ensuring stable operations and continuity of services, even under ad-hoc funding constraints at member institutions. Botha also noted opportunities for next-generation geodetic infrastructure, including new co-located sites at Sutherland, Ben Macdhui, and Matjiesfontein, with potential integration into radio astronomy facilities. He highlighted the advantages of using standardised modular station enclosures ("GeoStations") to simplify remote deployments and reduce maintenance costs. Finally, he underscored the importance of local innovation—in receiver and mechanical design, cryogenics, and monitoring systems—to build domestic capability, reduce dependence on imports, and promote technology transfer and commercialisation aligned with national development goals.

Data, Standards & Open Access (Pillar 5): Patrick Vorster linked this pillar to the UN-IGIF and South Africa's SASDI, established under the SDI Act (Act 54 of 2003). He outlined how the CSI coordinates base data themes, custodianship, curation, and delivery through its subcommittees on governance, technology, and people, in line with the UN-GGIM Fundamental Data Themes. Vorster described the hierarchy of relevant standards, including ISO/TC 211 (Geographic Information/Geomatics)—mirrored nationally by SABS TC 211—and regional coordination through SADCSTAN TC 13. He also highlighted the Open Geospatial Consortium (OGC) suite of specifications enabling interoperability across platforms, such as web services (WMS, WFS, WCS) and data encodings (GML, KML). He noted that base-dataset custodians contribute through three complementary components: geometry, attributes, and metadata, each managed and validated under coordinated custodianship to ensure completeness and consistency. Currently, ISO/TC 211 lists 104 published standards and 24 in development, with OGC providing free, functionally equivalent versions for many, including ISO 19111 (referencing by coordinates) and ISO 19162 (WKT for CRS). He further noted the OGC Geodetic Grid eXchange Format (GGXF) as a practical emerging standard for geodetic data exchange. He highlighted that South Africa remains the only African participating member in ISO/TC 211, noting the need for wider continental engagement and capacity building. Specific standards most relevant to geodesy include ISO 19111 (Spatial referencing by coordinates) and ISO 19161-1 (Geodetic References - Part 1: International terrestrial reference system (ITRS), together with their South African equivalents (SANS 19111:2023 and SANS 19161-1:2023). The key takeaway was

clear: adopting open, standards-based practices is essential to achieve interoperability of geospatial and geodetic data, ensure compliance with the SDI Act, and position South Africa within the international standards community.

Reference Systems & Regional Frames (Pillar 6): Aslam Parker linked the theme to South Africa's role in global and continental geodesy. Parker clarified the difference between reference systems—the theoretical blueprints defining the origin, axes, and scale—and reference frames, their realisation through observations using VLBI, GNSS, SLR, DORIS, and leveling. He reviewed major global terrestrial reference systems—WGS-84, ITRS/ITRF, CGCS 2000, and PZ-90 and its realisations—and explained that Hartebeesthoek94, South Africa's official geocentric coordinate reference system, is based on the WGS-84 ellipsoid and tied to ITRF91 (epoch 1994.0), with the Hartebeesthoek 26m telescope as its origin. TrigNet operates on newer realisations (ITRF2014/epoch 2018.18), requiring transformations to the legal datum. The current WGS-84 realisation (G2269) aligns with ITRF2020 (epoch 2024-01-01) to within 1cm per component. Parker stressed the need to update the national datum to newer ITRF solutions and incorporate velocity models to reflect continental motion. Regional frames such as AFREF simplify tectonic modelling by constraining coordinates to the dominant Nubian Plate, but he cautioned that national modernisation should proceed in parallel with—not wait for—continental alignment. South Africa, as the Southern African regional coordinator for AFREF, must help revitalise continental data contributions toward a new computation; the last comprehensive continental solution dates to ~2014. Mphuthi outlined the transition from a levelling-based system tied to early-1900s mean-sea-level to a geoid-consistent, International Height Reference Frame (IHRF)-aligned vertical reference frame, supported by GNSS/levelling re-validation, gravity densification, a refined national (quasi)geoid, and policy adoption with updated EPSG codes and conversion tools managed by NGI. Together, these initiatives form South Africa's roadmap for aligning its horizontal and vertical reference systems with ITRF and IHRF standards, ensuring geospatial interoperability across national, regional, and global levels.

Panel Discussion: The panel discussion consolidated key insights from the three pillars—Infrastructure and Operations, Data Standards and Open Access, and Reference Systems and Regional Frames—into a unified call for coordinated national and continental action. Participants agreed on the urgency of conducting a comprehensive national audit of geodetic infrastructure across agencies to identify duplication, maintenance needs, and opportunities for consolidation. This should inform a Cabinet-level brief on the "cost of ignorance" if critical systems are not maintained. The discussion underscored the need to formally recognise geodetic assets such as HartRAO as part of South Africa's *critical national infrastructure*, after lessons from the COVID-19 lockdown demonstrated the essential nature of timing and positioning services. Open access to raw, publicly funded data was broadly supported, though participants acknowledged that value-added products may require cost-recovery mechanisms to ensure sustainability. The panel also highlighted the importance of shared data platforms, common standards, and secure access systems to protect investments and improve interoperability. Participants noted that geodesy's true impact extends beyond publications, enabling economic growth, digital services, and national security—yet remains undervalued in policy frameworks. They called for developing new metrics that capture these broader societal benefits, improving data visibility through the use of Digital Object Identifiers (DOIs), and preserving historical datasets that underpin South Africa's spatial reference systems. Finally, the panel emphasised the need for stronger coordination between scientific (IAG/AFREF) and intergovernmental (UN-GGIM: Africa) processes, continental collaboration through centres of excellence, and long-term investment in GNSS and VLBI infrastructure to secure South Africa's leadership in sustaining global and regional reference frames. The session reinforced that geodesy is not only a technical discipline but a pillar of national and continental resilience.

Interactive Survey: To capture stakeholder perspectives, an interactive survey was conducted at the end of the session, completed by 70 participants. Results showed overwhelming agreement that geodesy should be recognised as part of South Africa's critical national infrastructure (96%), with most

respondents rating current infrastructure as adequate (53%) but under strain, citing funding (81%), maintenance (79%), and technical skills shortages (60%) as the top operational risks. Nearly half (46%) believed that long-term maintenance funding is not secured, and 64% supported regional infrastructure sharing (e.g., GNSS hubs). Half of respondents (50%) preferred an open-access model for geodetic data, while a third (34%) favoured a hybrid model balancing public access with cost-recovery for value-added services. The biggest barriers to open data were funding (26%), policy restrictions (17%), and limited technical capacity (17%). There was strong consensus that legacy data and historical records must be prioritised for preservation (90%) and that metadata and persistent identifiers (e.g., DOIs) are critical to improving visibility and traceability (74%). Three-quarters (74%) agreed that South Africa's national reference system requires modernisation, with 89% supporting the development of a formal roadmap for a modern geodetic reference system (GRS) aligned with ITRF and IHRF standards. Respondents emphasised the importance of AFREF—rated *critical or useful* by nearly 80%—but highlighted weak coordination mechanisms (47% rated them as such) and uncertainty over who should lead AFREF coordination. Open comments reinforced that geodesy must be treated as the foundation of all spatial and digital infrastructure, requiring improved funding models, institutional clarity, and high-level policy recognition. The full survey questionnaire and detailed results are presented in **Appendix B**.

3.2 Pillars 2 and 7

Human Capital Development (Pillar 7): Patroba Odera, Siphiwe Mphuthi (University of Cape Town) and Mulemwa Akombelwa (University of KwaZulu-Natal) presented an overview of the state of geodesy teaching, training and research across South African universities. They emphasised that geodesy underpins a wide spectrum of national priorities – from land administration to environmental change and reference-frame maintenance – and is integral to the country's GNSS-based positioning, height systems and industrial productivity. Currently, only six institutions teach geodesy within surveying or geomatics programmes – UCT, UKZN, and four Universities of Technology (DUT, MUT, TUT and CPUT) – with very few postgraduate students continuing into MSc or PhD-level research. Curricula are strongest in satellite positioning and geodetic surveying (GNSS, RTK, PPP, network adjustment and quality control), yet major skill gaps persist in physical geodesy – gravity data handling, geoid modelling, computation techniques, and uncertainty budgets – as well as in practical exposure to national infrastructure such as TrigNet, Hartebeesthoek multi-technique facilities, and gravimetric facilities. Research output is moderate in positioning applications but very limited in reference frames, Earth rotation, geodynamics and gravity-field modelling. Key challenges include fragmented research, the absence of specialised facilities and sustained funding, and the lack of a national framework to coordinate teaching and research in geodesy. The speakers called for the establishment of a nationally coordinated training and research network, joint student supervision between universities and technical institutions (e.g., SARAO, SANSA, NGI, and CGS) and seed funding for equipment, field campaigns, and shared laboratories. They recommended aligning South African curricula with global reference standards and leveraging international training platforms and grants. The concluding call to action was to invest in a dedicated institutional focal point for geodesy capacity building and formalise data-sharing and joint-supervision frameworks to grow the next generation of geodesists.

Advocacy, Communication & Outreach (Pillar 2): Aletha de Witt used examples drawn from her own experience to illustrate how geodesy can be better communicated and promoted. She emphasised that this pillar should explicitly include outreach, since advocacy, communication, and outreach are inseparable, and invited participants to share their own success stories to strengthen collective visibility efforts. De Witt highlighted that geodesy remains *"the world's best-kept secret"* and that promoting it requires targeted engagement at policy, scientific, professional, and public levels. Examples included advocacy through the DSTI Executive Committee, where a policy submission on geodesy was approved with support from the IAG, UN-GGCE, and GGOS; inclusion of geodesy in the UN Science Summit;

and participation at the African Astronomical Society (AfAS) conference and the IAU General Assembly in 2025, which helped bridge astronomy and geodesy. She also showcased regional and international advocacy through the UN-GGCE Capacity Development Workshop for Africa (Nairobi, Kenya, 2025), GGOS-Africa, and the IAG Scientific Assembly 2025, and highlighted training and outreach through the Development in Africa with Radio Astronomy (DARA) project (since 2015), ongoing IVS VLBI Training Schools, and the SIRGAS 2025 Virtual School, which have helped built African expertise in geodesy and geodetic VLBI. Within the GGOS Strategic Plan, she noted global efforts to raise awareness through flyers, videos, policy briefs, and the GGOS Geodesy Cartoon Competition. She concluded by urging participants to champion geodesy in every forum—policy, professional, scientific, or informal—reminding the audience: *"If we don't talk about geodesy, who will?"*

Panel Discussion: The panel discussion consolidated insights from both sessions, focusing on geodesy's visibility, integration with other disciplines, and the urgent need for a coordinated strategy to strengthen training, employment, and advocacy. Participants underscored that geodesy must be embedded across national systems — from education and professional training to civil engineering, digital transformation, and policy frameworks — to unlock its full societal and economic value. Participants noted that geodesy underpins infrastructure design, monitoring, and digital construction models, yet remains largely absent from engineering codes and national standards. Stronger engagement was urged between the geodetic, civil engineering, Building Information Modelling (BIM), and digital infrastructure communities to ensure alignment in modelling, positioning, and spatial reference frameworks. Participants also pointed out that while geodesy is represented in some conferences and sectoral initiatives, activities remain fragmented; the newly proposed SAGWG will be instrumental in coordinating these efforts and strengthening cross-sectoral participation.

Academic participants highlighted the challenge of limited funding, fragmented curricula, and low postgraduate numbers. They called for integrated, ecosystem-based teaching that exposes students to geodesy's links with hydrology, environmental monitoring, defence, and disaster management. It was noted that geodesy is currently taught within geomatics programmes rather than as a stand-alone discipline, and that a lack of funding constrains the establishment of a dedicated national programme. It was agreed that national coordination, exchange programmes, and targeted bursaries — including alignment with the Presidential PhD Programme — could help develop the next generation of geodesists. Employment pathways were another key concern: graduates struggle to find posts despite national skills gaps. The panel proposed stronger collaboration with government departments and private entities to create new geodesy positions, demonstrate the discipline's value to decision-makers, and mainstream it into national development planning. Participants further emphasised the importance of bringing in science-communication specialists who can articulate geodesy's societal relevance in clear, accessible terms to policymakers and funders. The discussion concluded with a strong call for a National Geodesy Strategy as an urgent priority. Such a framework would align advocacy, human-capital development, and policy engagement; ensure ministerial ownership across relevant portfolios; and position geodesy as a critical enabler of national infrastructure, digital transformation, and sustainable development.

Interactive Survey: To capture stakeholder perspectives, an interactive survey was conducted at the end of the session, completed by 61 participants. The results showed a strong consensus that geodesy remains poorly visible to policymakers and the public (67%), and that policy briefs (43%) and media campaigns (41%) are viewed as the most effective forms of advocacy. Respondents identified government as the top priority audience for engagement (56%), followed by the public (20%), and emphasised the importance of incorporating geodesy into education and outreach from early learning onward. Nearly 60% indicated that South Africa does not have enough trained geodesists, with training programmes (33%) and knowledge transfer (21%) identified as the most urgent capacity gaps. A resounding 95% supported the expansion of scholarships and grants specifically for geodesy, while 62% reported inadequate budget support for early-career posts. Almost half of the participants described current partnerships between universities and industry as weak (48%), calling for stronger coordination

mechanisms, updated academic curricula, and the establishment of a National Centre of Excellence or South African Research Chairs Initiative (SARChI) Chair to anchor training and research. Open comments reinforced that geodesy's story must be told through its societal relevance—navigation, mapping, positioning, climate resilience, and economic development—to build broader public and political recognition. The full survey questionnaire and detailed results are presented in **Appendix B**.

3.3 Pillars 4 and 8

Spectrum Protection (Pillar 4): This session outlined South Africa's framework for protecting radio-quiet and dark-sky environments essential to astronomy and geodesy. Tebogo Mashile opened with an overview of the Astronomy Geographic Advantage (AGA) Act (2007), enacted to preserve areas with exceptional conditions for optical and radio astronomy. She described how the Karoo Central Astronomy Advantage Area (KCAAA) and Sutherland Central Astronomy Advantage Area (SCAAA) regulations restrict radio emissions, electrical interference, and light pollution within defined zones. More than 1 300 permit applications have been processed under this regime, balancing development with protection of the national key-point astronomy sites. Mashile highlighted that the DSTI signed a Memorandum of Agreement with the Independent Communications Authority of South Africa (ICASA) in 2018 to coordinate regulation of the radio-frequency spectrum. ICASA, a national spectrum regulator under the Department of Communications and Digital Technologies (DCDT), supports DSTI in technical assessments, enforcement of the AGA Act, and representation at international forums. Mashile also drew attention to the growing risk posed by low-Earth-orbit (LEO) satellite constellations, which introduce both radio-frequency interference and optical contamination. South Africa participates in the International Telecommunication Union (ITU) and the UN Committee on the Peaceful Uses of Outer Space (COPUOS), contributing to new recommendations for global protection of both astronomical and geodetic VLBI sites, including Agenda Item 1.16 of the WRC-27 Working Party 7D.

Audrey Dikgale then introduced the National Astro-Tourism Strategy (2023–2033), launched in September 2024 and gazetted in May 2025. Led by DSTI in partnership with the Department of Tourism (DoT), the Northern Cape Department of Economic Development and Tourism (DEDAT), and the National Research Foundation (NRF) facilities, the strategy links sky protection with inclusive local development through dark-sky certification, SMME support, and the integration of Indigenous celestial knowledge. Selaelo Matlhane provided the technical and regulatory context for radio-frequency spectrum management, explaining that spectrum is a finite shared resource among telecommunications, astronomy and geodesy. All South African radio telescopes are registered in the Master International Frequency Register, granting international protection under ITU Radio Regulations. He confirmed that geodetic VLBI is recognised by the ITU as a radio-astronomy service technique, protected under Recommendation ITU-R RA.769 interference thresholds. Matlhane noted that new-generation geodetic VLBI systems require a broader operational bandwidth (approximately 2–14 GHz) than currently allocated, and that interference from primary commercial users remains a major risk to sustaining geodetic VLBI operations.

Research, Development and Next-Generation Supply Chain (Pillar 8): Aletha de Witt introduced the pillar by defining its goal: to build an advanced, innovation-driven geodesy ecosystem that integrates R&D, emerging technologies, and multi-domain collaboration across astronomy, geodesy, and space science. She framed the discussion around six interlinked imperatives — Next-Generation Needs, R&D and Innovation, Emerging Technologies, Global Trends, African Solutions, and Multi-Domain Collaboration — positioning them as the foundation for a resilient, future-oriented geodetic supply chain. De Witt emphasised that this supply chain must operate as a two-way system: African countries must articulate their capability needs and accuracy requirements to international organisations, while those global partners should in turn provide shared standards, training, and technological interfaces that enable reciprocal growth. She noted that Africa is too often seen as merely a data provider within international geodesy networks, rather than as an equal partner in innovation and technology development. Demonstrating South Africa's leadership through the Astro2Geo K-band

VLBI Project, she argued that the continent has both the expertise and the strategic position to contribute new solutions — not just infrastructure — to the global geodetic community. She showcased the Astro2Geo project as a South African-led international collaboration that delivered the world's most precise celestial reference frame. The project pioneered higher-frequency VLBI observations, innovative scheduling and correlation techniques, and machine-learning-based ionospheric calibration. De Witt highlighted its dual impact on astronomy and geodesy, demonstrating African innovation and scientific leadership in global precision-reference-frame research.

Roelf Botha described SARAO's R&D and infrastructure-modernisation programme to secure the next generation of geodetic capacity. A recent surface-scan campaign of the Hartebeesthoek 26 m telescope confirmed capability and readiness for higher-frequency VLBI operation. He outlined plans for establishing a new fundamental geodetic site at Matjiesfontein to provide redundancy to the Hartebeesthoek site, taking advantage of its clearer weather conditions for optical techniques and lower radio-frequency interference for VLBI, thereby enhancing continental coverage, reference-frame stability, and co-location of space-geodetic systems. Botha also presented the development of self-sustained, solar-powered GeoStation platforms, already deployed at remote sites across Southern Africa, and proposed a distributed GeoStation network to strengthen and interlink national and regional observing assets and support the long-term resilience of the African geodetic supply chain.

Nandi Mtethwa presented the Africa Earth Observation Challenge (AEOC) — a continental open-innovation programme co-founded by SANSA and the Research Institute for Innovation and Sustainability (RISS) in 2015. AEOC bridges research and entrepreneurship by supporting start-ups that apply satellite and geospatial data to agriculture, climate, disaster management, and urban planning. More than 300 entrepreneurs from 40 countries have participated. She described AEOC's next phase, which includes regional innovation hubs, gender-equity and youth initiatives, and AEOC Junior for school-age learners, culminating in the African Space Innovation Fund to finance early-stage ventures. The initiative embodies a pan-African, end-to-end innovation funnel that links education, R&D, incubation, and commercialisation to build sustainable capacity and inclusive growth in Africa's space- and geo-technology sectors.

Panel Discussion: The closing panel discussion explored how spectrum regulation, infrastructure resilience, and innovation intersect across South Africa's national geodetic system. Participants agreed that protecting the country's geodetic assets requires a broader, integrated framework that links radio-frequency management, physical infrastructure protection, and long-term data resilience. The panel recommended renaming and broadening Pillar 4 to *"Protection and Resilience of Geodetic Assets"*, ensuring that it encompasses radio-quiet zones, co-located instruments, data archives, and environmental risks such as cloud cover, flooding, and RFI. Mashile outlined how the AGA Act serves as the legal instrument declaring the Northern Cape an Astronomy Advantage Area, safeguarding the SKA and other observatories. Participants proposed extending this model to include geodetic assets such as GNSS, VLBI, SLR, and other co-located systems. It was emphasised that measures to improve resilience should not reduce the scientific sensitivity of instruments or shift the burden of interference mitigation onto observatories themselves.

The participants emphasised the increasing vulnerability of infrastructure to climate impacts, radio interference, and GNSS disturbances. Botha noted that persistent cloud cover and high atmospheric moisture often disrupt satellite-laser ranging operations at Hartebeesthoek, underscoring the need for redundancy through the planned Matjiesfontein fundamental geodetic site. Participants also discussed the need for comprehensive national resilience planning with risk mapping, maintenance schedules, and disaster-response protocols. Further discussion addressed GNSS signal reliability and interference risks. Reports of GPS signal scrambling causing simultaneous data outages across multiple receivers underscored the need for redundancy and multi-constellation GNSS resilience. Participants recommended legislative protection for permanent geodetic receivers similar to that which protects survey beacons under the Land Survey Act. It was agreed that geodetic resilience requires

diversification of reference systems, technical redundancy, and enhanced coordination between national and international partners.

Another priority was the long-term protection of data and archives. Participants stressed that geodetic data, calibration logs, and historical records form part of South Africa's national scientific heritage and must be preserved through FAIR-compliant, secure digital repositories. It was agreed that data resilience should be explicitly integrated into the revised framework alongside infrastructure protection.

The discussion also raised the urgent need to restore national gravity measurement capacity following the loss of the GFZ-owned gravimeter previously hosted at the South African Astronomical Observatory (SAAO). The CGS was identified as an essential partner for this work, with potential for new collaborative initiatives between CGS, SARAO, and universities to re-establish ground-based gravity measurements and align them with terrestrial and satellite observations. Participants also highlighted the need to include instruments based in Antarctica and on the sub-Antarctic islands within the national network, recommending that the Department of Forestry, Fisheries and the Environment (DFFE) formally join the SAGWG. These instruments, managed by SANSA and SARAO, contribute critical long-term datasets for space weather, Earth rotation, and reference-frame stability.

The panel concluded that spectrum management and infrastructure protection must be integrated into a unified national framework for protection and resilience that forms a core element of South Africa's emerging National Geodesy Strategy. This would ensure the safeguarding of critical infrastructure and data, while maintaining the country's leadership in sustainable, world-class geodetic science.

Interactive Survey: To capture stakeholder perspectives, an interactive survey was conducted at the end of the session and completed by 48 participants. The results reflected strong consensus on the need for coordinated advocacy, ethical data governance, and national investment in geodesy research and innovation. Almost 90% supported joint geodesy–astronomy advocacy to protect radio-quiet spectrum for scientific use. Similarly, 88% endorsed embedding Collective Benefit, Authority to Control, Responsibility, and Ethics (CARE) principles into South Africa's open-science and data-governance policies to ensure fair and ethical management of local geodetic data. A clear majority (63%) agreed that resilience must include factors beyond spectrum protection, such as physical-infrastructure integrity, environmental risks, and data preservation. Open comments reinforced the need to protect GNSS and other geodetic assets, strengthen policies for physical-infrastructure safeguarding, and adopt a holistic approach to reliability and resilience. Respondents strongly supported national prioritisation of geodesy within science policy (94%), but only 40% believed the country currently has adequate means to adopt emerging technologies, with 54% saying support is only partial. Access to high-performance computing (HPC) was viewed as critical or important by nearly 70% of participants, highlighting computational capability as a key enabler of modern geodesy. In terms of research and development priorities, most participants favoured focusing on infrastructure development (46%), followed by new techniques (19%), innovation (17%), and regional capacity building (13%). Open feedback called for stronger human-capital development, continental collaboration, and the recognition of geodesy as a strategic discipline underpinning space, Earth observation, and infrastructure planning. The full survey questionnaire and detailed results are presented in **Appendix B**.

3.4 Closing Remarks

Mr Takalani Nemaungani, Chief Director: Astronomy, DSTI, opened the closing session by thanking participants for their strong engagement and reaffirming the partnership between DSTI and the DLRRD. He noted that geodesy is a core component of South Africa's Multi-Wavelength Astronomy Strategy (2025–2035) and a bridge between astronomy and national development. Mr Nemaungani expressed support for formalising this collaboration through an inter-departmental agreement or memorandum of understanding, reflecting high-level government commitment. He commended the organising

committee for their leadership and called for continued momentum toward establishing the SAGWG and implementing a coordinated national roadmap.

Mr Siyabonga Mdubeki, Deputy Director-General and Surveyor-General, DLRRD, delivered the workshop summary and outlined the way forward. He praised the workshop's spirit of collaboration and technical depth, noting that South Africa's geodetic infrastructure is a strategic national asset with global reach. He emphasised that the country must move from fragmented activities to a coordinated, inclusive approach that links departments, research institutions, and regional partners. Mr Mdubeki confirmed plans to establish the SAGWG before the financial year-end and to develop a National Geodesy Roadmap aligned with the UN-GGCE Global Geodesy Roadmap, defining current capabilities, identifying gaps, and setting a transformation path toward a sustainable national framework. He highlighted opportunities for greater alignment with initiatives such as GGOS-Africa and AFREF, stronger links with entities like the CSIR and CHPC, and the need to translate workshop outcomes into coordinated implementation. Mr Mdubeki concluded by commending the organisers and participants for their commitment and reaffirming South Africa's readiness to play a leading role in strengthening geodesy at national, continental, and global levels.

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4. KEY REFLECTIONS FROM THE ORGANISING COMMITTEE

The Organising Committee met on 3 October 2025 to review outcomes from the National Geodesy Workshop. Members agreed that the workshop was highly successful, with strong engagement and learning across sectors. While participation included several key national and institutional stakeholders the committee noted the need to engage additional key stakeholders who were not represented or only minimally involved—including the Council for Geoscience, Department of Transport (DoT), South African Weather Service (SAWS), Department of Public Works and Infrastructure (DPWI), the Department of Water and Sanitation (DWS), the mining sector, and the Department of Forestry, Fisheries and the Environment (DFFE).

Participants expressed strong support for establishing the SAGWG to strengthen coordination across these entities and align national efforts with continental and global frameworks. The committee emphasised the need to clearly define how the national framework will interface with GGOS-Africa, UN-GGCE, UN-GGIM-Africa, and other related regional and international scientific services. It was agreed that DSTI and DLRRD will jointly submit a concept note, covering both the SAGWG and GGOS-Africa initiatives along with the final workshop report, to their respective EXCOs for approval.

The committee also recommended conducting a national audit of geodetic infrastructure, including public and privately managed systems, to understand existing capabilities, governance, and data control. This audit should involve engagement with Eskom, the Department of Transport, and other infrastructure custodians operating GNSS and survey control systems.

Further priorities include restoring national gravity observation capacity, incorporating gravity analysis within GGOS-Africa and SAGWG activities, and inviting the DFFE to participate given the importance of Antarctic and sub-Antarctic instrumentation. Members reaffirmed that GNSS stations should be multi-purpose (e.g. SANSA stations) and that data-sharing should be strengthened through the future Working Group.

Administrative follow-ups were confirmed: verifying CPD registration, finalising online and manual attendance registers, incorporating Zoom and panel Q&A into the report, and collecting pillar summaries from each lead. The Organising Committee will form the backbone of the future SAGWG, pending EXCO approval and the development of a Terms of Reference outlining membership, governance, and subcommittees.


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5. REPORT APPROVAL

This report was reviewed and approved by the Organising Committee of the South African Geodesy Workshop 2025.

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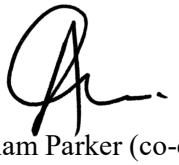

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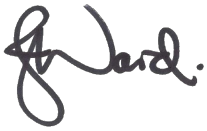

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APPENDIX A: Workshop Programme

Day 1 — Overviews + Pillar 1 (Governance, Partnerships & Reporting)

Time	Item	Lead/Owner	Session chair/ moderator
08:30–09:00	Registration & Tea/Coffee	Thutho Ndlovu (DSTI)	
09:00–09:15	Welcome & Setting the scene	C. Mokonoto (Acting DDG DSTI) + S. Mdubeki (DDG DLRRD)	Takalani Nemaungani (DSTI)
09:15–09:30	What is Geodesy and Why is It Important?	Aslam Parker (DLRRD)	Roelf (SARAO)
09:30–09:45	The Geodesy Ecosystem (Globally, Locally, and Regionally)	Patrick Vorster (DLRRD)	Roelf (SARAO)
09:45–10:00	UN-GGCE: 1st Joint Development Plan (JDP)	Nick Brown (UN-GGCE)	Roelf (SARAO)
10:00–10:15	Towards a SAGWG and GGOS Africa: Building local and regional capacity	Aletha de Witt (DSTI)	Roelf (SARAO)
10:15–10:30	Panel Discussion / Q&A	All session speakers	Moderator: Roelf (SARAO)
10:30–11:00	Tea/Coffee Break		
11:00–12:10	Lightning updates from various institutions	Hubert Mathebula (DSTI), Aslam Parker (DLRRD), Roelf Botha (SARAO), Jonathan Ward (SANSA), Maroale Chauke (CSI)	Siphiwe (UCT)
12:10–12:30	Panel Discussion / Q&A	All speakers from this session	Moderator: Siphiwe (UCT)
12:30–13:30	Lunch		
13:30–13:45	Towards a National Strategy for Geodesy in SA	Aletha de Witt (DSTI)	Jonathan (SANSA)
13:45–14:00	Establishment and Structure of the SAGWG	Aslam Parker (DLRRD)	Jonathan (SANSA)
14:00–14:15	Laying the Foundations for GGOS Africa	Jack Radcliffe (UMan)	Jonathan (SANSA)
14:15–14:30	Panel Discussion / Q&A	All speakers from this session	Moderator: Jonathan (SANSA)
14:30–15:00	Breakout Session	All participants	Jonathan (SANSA)
15:00–15:30	Tea/Coffee Break		
15:30–15:45	Feedback from breakout session	Aslam Parker (DLRRD)	Pierre (SANSA)
15:45–16:00	What We Heard → What We'll Do	Aletha de Witt (DSTI)	Pierre (SANSA)

Day 2 — Implementation for Pillars 2–8 (overview and interactive sessions)

Time	Item	Lead/Owner	Session chair/moderator
08:30–09:00	Arrival & Tea/Coffee	Thutho Ndlovu (DSTI)	
09:00–09:05	Welcome, Recap & Objectives For the Day	Aletha de Witt (DSTI)	Patroba (UCT)
09:05–09:20	Pillar 3: Infrastructure & Operations	Roelf Botha (SARAO)	Patroba (UCT)
09:20–09:35	Pillar 5: Data, Standards & Open Access	Patrick Vorster (DLRRD)	Patroba (UCT)
09:35–09:50	Pillar 6: Reference Systems & Regional Frames	Aslam Parker (DLRRD)	Patroba (UCT)
09:50–10:05	Panel Discussion / Q&A	All speakers from this session	Mod: Mulemwa (UKZN)
10:05–10:30	Breakout Session	All	Mulemwa (UKZN)
10:30–11:00	Tea/Coffee Break		
11:00–11:20	Feedback from breakout session	Roelf Botha (SARAO)	Hubert (DSTI)
11:20–11:35	Pillar 7: People (HCD)	P. Odera & S. Mphuthi (UCT) & M.Akombelwa (UKZN)	Hubert (DSTI)
11:35–11:45	Pillar 2: Advocacy & Comms	Aletha de Witt (DSTI)	Hubert (DSTI)
11:45–12:00	Panel Discussion / Q&A	All speakers from this session	Moderator: Hubert (DSTI)
12:00–12:30	Breakout Session	All	Hubert (DSTI)
12:30–13:30	Lunch		
13:30–13:50	Feedback from breakout session	Siphiwe Mphuthi (UCT)	Aslam (DLRRD)
13:50–14:00	Pillar 4: Spectrum Protection	T. Mashile (DSTI) and S. Matlhane (SARAO)	Aslam (DLRRD)
14:00–14:15	Pillar 8: R&D & Next-Gen Supply Chain	A de Witt (DSTI), R Botha (SARAO) and N Mtethwa (RISS)	Aslam (DLRRD)
14:15–14:30	Panel Discussion / Q&A	All speakers from this session	Mod: Aslam (DLRRD)
14:30–15:00	Breakout Session	All	Aslam (DLRRD)
15:00–15:30	Tea/Coffee Break		
15:30–15:50	Feedback from breakout session	Aletha de Witt (DSTI)	Roelf Botha (SARAO)
15:50–16:15	Summary, Highlights of Workshop, and Way Forward	Aslam Parker (DLRRD)	Roelf Botha (SARAO)
16:15–16:30	Close & communiqué	Takalani Nemaungani (DSTI), DDGs (Mr C Mokonoto - DSTI + Mr S Mdubeki - DLRRD)	Takalani Nemaungani (DSTI)

APPENDIX B: Key Actions and Recommendations form the Workshop

- DSTI and DLRRD to issue an open call for nominations to the South African Geodesy Working Group and draft the ToR.
- DSTI and DLRRD to formalise partnership through an MoU for geodesy collaboration.
- DSTI and DLRRD to sign the UN-GGCE Memorandum of Understanding.
- DSTI and DLRRD to take the geodesy strategy to Cabinet.
- SAGWG to be established by the end of the financial year.
- SAGWG to develop a roadmap aligned to the UN-GGCE Global Roadmap on Geodesy.
- SAGWG to refine the subcommittee structure to guide implementation of the Eight-Pillar Framework.
- SAGWG to develop a National Strategy for Geodesy in South Africa.
- Develop a clear interface and alignment framework between SAGWG, GGOS-Africa, UN-GGCE, and UN-GGIM-Africa to ensure coherent governance and reporting.
- SAGWG to conduct a comprehensive national audit of geodetic infrastructure (public and private) in coordination with Eskom, DoT, and other custodians to map existing assets and data-control responsibilities.
- SAGWG members to identify and include any missing stakeholders in the Geodesy Working Group.
- Initiate follow-up engagement with unrepresented key stakeholders (CGS, DWS, SAWS, DPWI, DFFE, and the mining sector) to secure formal participation in the SAGWG.
- SAGWG to work towards establishing a regional analysis centre for geodesy.
- SAGWG to address the gap in gravity measurements for geodesy applications.
- SAGWG to address the need for regional reference frames.
- SAGWG to investigate how to expand geodesy work into Africa through centres of excellence or GGOS Africa.
- SAGWG to investigate the development of a South African Geodetic Consortium to pool resources.
- SAGWG to consider contributions to information services that will benefit telecommunications.
- SAGWG to consider the cost of ignorance regarding geodetic infrastructure maintenance.
- SAGWG to develop a centralized repository or formal interfaces for GNSS data sharing.
- SAGWG to develop standards across the African continent.
- SAGWG to consider expanding the Spectrum Protection pillar to include protection and resilience for geodetic infrastructure.
- SAGWG to assess existing geodetic infrastructure to avoid duplication and ensure equitable resource allocation.
- SAGWG to explore expanding scholarships specifically for geodesy.

- SAGWG to develop short learning programs and crash courses on geodesy for high-level government employees.
- SAGWG to develop a database of conferences and platforms where geodesy should be represented.
- SARAO to repair the 26-meter radio telescope at Hartebeesthoek to extend its life by 20 years.
- SARAO to continue operating the 15-meter and VGOS telescopes in parallel with the 26-meter for 10 years to transfer the reference point.
- SARAO/SANSA to upgrade / enhance the geodetic infrastructure at Marion Island, Gough Island and Antarctic bases.
- SARAO/SANSA to continue expanding GNSS infrastructure in Africa through partnerships.
- Dr. Radcliffe and team to organize the first GGOS Africa workshop in Q2 2026.
- Universities to update curriculum to better incorporate geodesy ecosystem understanding.

APPENDIX C: Survey Results

Survey

Results for "Survey on Pillar 1: Setting the scene & Foundations"

77 people responded to this survey

Questions

Do you think more coordination is required for geodesy and related activities in SA?

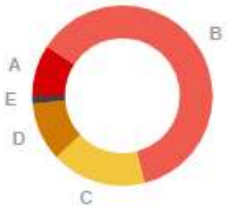
Answered: 76

- A. Yes: 72 (94.74%)
- B. No: 1 (1.32%)
- C. Unsure: 3 (3.95%)

How effective are current governance structures in representing geodesy nationally?

Answered: 76

- A. Very effective: 7 (9.21%)
- B. Somewhat: 47 (61.84%)
- C. Not effective: 13 (17.11%)
- D. Unsure: 8 (10.53%)
- E. No selection: 1 (1.32%)



Should geodesy be explicitly included in African policy agendas, e.g. African Union Agenda or other regional or continental agendas?

Answered: 76

A. **Yes**: 71 (93.42%)

B. **No**: 1 (1.32%)

C. **Maybe**: 4 (5.26%)

D. **Unsure**: 0 (0.00%)

How important is it to strengthen multi-domain partnerships (eg. surveying, geophysics, astronomy, space science, climate, defence)?

Answered: 76

A. **Critical**: 52 (68.42%)

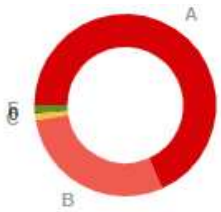
B. **Important**: 22 (28.95%)

C. **Useful**: 1 (1.32%)

D. **Not a priority**: 0 (0.00%)

E. **Unsure**: 0 (0.00%)

F. **No selection**: 1 (1.32%)



What is the biggest gap in current governance?

Answered: 76

Here governance implies the regulations / rules / process to follow, not government

A. **Lack of coordination**: 49 (64.47%)

B. **Lack of reporting**: 19 (25.00%)

C. **Lack of partnerships**: 33 (43.42%)

D. **Lack of Exposure**: 39 (51.32%)

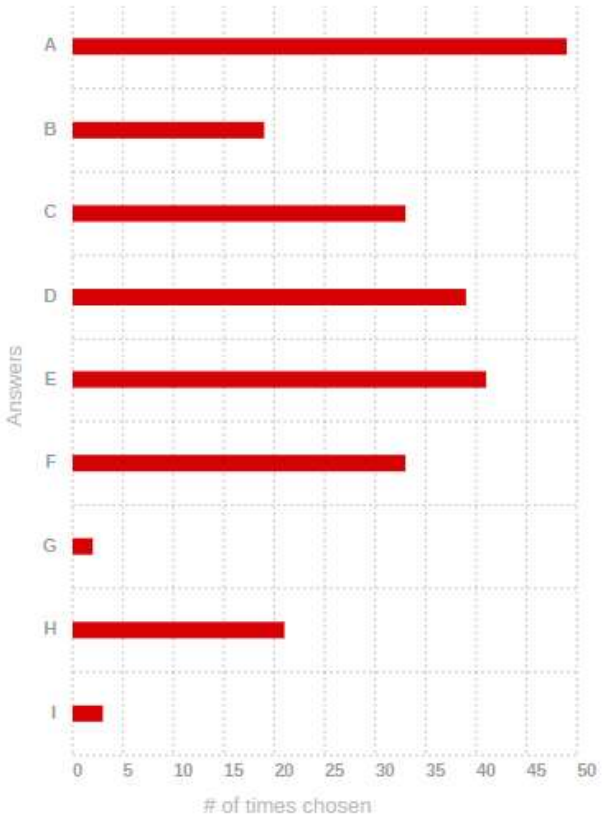
E. **Insufficient funding**: 41 (53.95%)

F. **Lack of governance frameworks**: 33 (43.42%)

G. **Other**: 2 (2.63%)

H. **All of these**: 21 (27.63%)

I. **Unsure**: 3 (3.95%)



Opinion: What one step would most improve geodesy governance in South Africa?

Answered: 53

Facilitate more workshops

We need to take stock of all geodesy related efforts and consolidate some of the efforts and have regular engagements.

Working together to find a suitable geodesy, mostly we should move with time.

Promote cooperation among government department and private sector, so that there is proper guideline and direction in performing geodetic work

implementation and institutionalization of the South African Geodesy Working Group (SAGWG) as a national coordinating authority.

National strategy

Co ordination

Regional and national working groups. Educating the public, private and gov orga on how cross cutting Geodesy actually is

The establishment of South Africa's working group is a good step as I believe the group will improve the governance of geodesy

Having outreach programs on the importance of the geodetic reference frame in a manner that targets how people are consuming media products

Collaboration between professions.

National exposure/awareness of the international impact and footprint of the network, and work being done.

Better coordination between interested organisations/departments at a structural (not only personal) level

Government driven strategy

Strategy Roadmap

Coordinate and have as part of the program for most universities and colleges for students studying related programs

Recognition of the fundamental value of geodecy at the highest decision making levels.

Adopt a clear national geodetic pol icy and legal updates - for example align the land survey act/ NGI mandates with modern geodesy

Partnership of all stakeholders

Promote public participation

Raised exposure and awareness of the international impact and footprint that local and regional Geodesy has, allied to tighter workflows and KPI's.

Better placement and as an integral of the science, research, outreach, and professionalisation in the relevant fields.

This is a good start.

Working group establishment, Framework development Signing agreements with the international related stakeholders

Currently the field is fragmented , if coordination is neglected this will results to duplication , inconsistency

I think having a geodesy governing body

Establish national coordination

SA WG for Geodesy

Research and coordination at a global scale are needed. The importance needs to be emphasized to encourage understanding from decision-makers.

Awareness

Data sharing

Partnership

A unified data and information centre for all geospatial daya

Collaboration, taking stock of existing legislation that geodesy related.

Development of strategy, framework

More collaboration, involvement of youth from lower to higher learning will prepare them, build a collaborative nation.

South Africa should have one official geodetic system, managed by a single authority, that everyone can use.

Establishing geodesy governance body will unify the national geodesy strategy, strengthen South Africa`s international role.

Collaboration amongst interested stakeholders and exposure

Legislative framework

establish a unified geodetic authority

Coordination

Exposure

Getting all stakeholders to participate

Develop integrated geospatial portals

Establishing a formal, national coordination mechanism for its geodetic activities

Provide more funding and professionalising it as profession

MORE FUNDING AND PROFESSILISING IT AS A PROFESSION,FUND ENTRY LEVEL JOB POST.

The most critical step that would most improve geodesy governance in SA is to establishment and operationalization a portal to facilitate governance

Create a National Geospatial Governance Act (or equivalent policy) that: Centralizes authority: Appoints a single national geospatial authority

Awareness and governance framework

Implementation of a framework which will make it possible for all relevant stakeholders to work together.

A suitable governance framework should be designed and an effort to be made to implement the framework by partnership with relevant organizations.

Other comments on any of the questions / any other notes / suggestions?

Answered: 18

NA

None

None.

Improved communication and coordination

Coordination to reduce duplication of effort in a funding constrained environment, ensuring entities work toward common goal not encroaching mandates

None

It is important to start at in SA make it a pilot case study and then move to neighboring countries in assisting them to create working groups. Ther

I think this is a great step in coordinating all geodetic activities in the country

None

Prioritize education in the grassroots level

Informative presentations

I think signing the UN-GGCE is the step in the right direction, it would enhance international collaboration and data sharing.

Making national data available for research candidates

None

No

NA

Ensures stewardship and resourcing: Secures long-term funding, a clear governance charter, and accountability mechanisms for data custodianship.

None

Do you think that signing the UN-GGCE memo would be beneficial in SA? Why?

Answered: *50*

Yes, so that we can strengthen and coordinate meaningful partnerships globally.

Yes, it would assist SA in being more advanced both in technology and in the field of Geodesy.

yes

Yes

Yes. International cooperation and consistency of data

Yes, It will help SA align

Yes. For international exposure and support.

Yes

Yes it would. Partnership, good governance and raised awareness and vital to ensuring funding. Funding provides that the good work continues.

Yes, but it needs to be more that just another hollow MoU and needs to see action

Yes - we need to have political will and buy-in at high level, to have it filter down

Yes -- Global stakeholders

Yes, to assist accessing GGRF to support science, society, and global development. And have our AFREF alignment with international standards.

Yes, externally it will raise South Africa's profile and internally it will commit South Africa on the international stage.

Yes, for alignment and funding, I guess

Yes. It would bring a sense of responsibility to all parties voncerned

Yes

Yes. SA is uniquely positioned for Geodetic research and satellite work, challenges remain however and "going Global" would force best practice upon

Yes it as a basis for commitment and motivate for future policy and funding support

Yes, but will need political will.

Yes, access to funding,

Yes for political reasons and reporting purposes

Yes. This will provide necessary colaborations to maintain and use a high-quality and accurate geodetic reference frame

Yes

Yes - support and exposure

Yes, it would contribute to the need for global collaboration.

Yes, to participate in global space.

Yes it beneficial

Not sure. As long as it translates to action and not just more meetings

We need to ensure that memo serves the vision of the working group.

Yes, holistic approach to benefit the country

Yes, South Africa would benefit from this union in upgrading the geodetic infrastructure of the country

Signing the UN-GGCE memo would benefit South Africa by aligning its geodetic system with global standards, strengthening skills and partnerships, and
Enhance integration into global reference system and support infrastructure
Yes
Yes, it will strengthen the engagement in the country and expose SA globaly
yes, it would strengthen the national geodetic infrastructure
Yes
Yes
Yes, various institutions can hold themselves accountable
very beneficial for south Africa, partnership with international bodies will open door of success, e.g. benefitting on international funding, upgrade
Active member of the global geodesy supply chain.
Yes,it will offers SA significant benefits by enhancing its national geospatial infrastructure, which enables improved decision-making.
N/A
NA

Yes, signing the UN-GGCE memo would be beneficial because it is an explicit policy action (PA 4) within South Africa's proposed Policy approach

Yes, the UN-GGCE memo could be beneficial for South Africa, but with important caveats. The benefits alignment with geospatial governances

yes, It will ensure the high quality and sustainable Global Geodetic Reference Frame (GGRF) to support good policy development .

Yes, SA will benefit from being part of the global community.

Yes. It will help to improve geodesy governance.

Survey

Results for "Survey on Pillars 2 & 7: Advocacy and Comms, People"

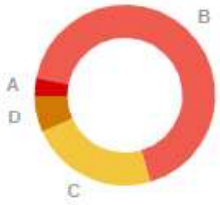
61 people responded to this survey

Questions

Is geodesy visible enough to policymakers and the public?

Answered: *61*

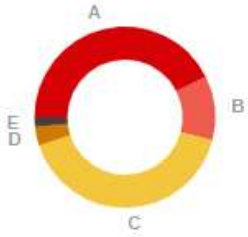
- **A. Yes**: 2 (3.28%)
- **B. No**: 41 (67.21%)
- **C. Somewhat**: 14 (22.95%)
- **D. Unsure**: 4 (6.56%)



What type of advocacy is most effective?

Answered: *61*

- **A. Policy briefs**: 26 (42.62%)
- **B. Business cases**: 7 (11.48%)
- **C. Media campaigns**: 25 (40.98%)
- **D. Other**: 2 (3.28%)
- **E. No selection**: 1 (1.64%)



If "Other" - please list

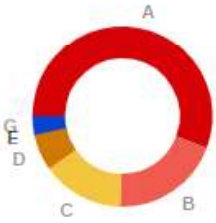
Answered: 9

Also case studies on the benefits of applications of Geodesy
Policy Briefs
Economic case: how does geodecy influence the economic wellbeing of the country
Engagements at various events including all of the above options
Outreach activities
Strategic alliance with national economic principles.
Business cases and schools outreach
Campaigns, case studies, involvement of communication specialists
plans should be made to start introducing it from early learning

Which of these groups are the most important to be targeted for advocacy?

Answered: *61*

- **A. Government**: 34 (55.74%)
- **B. Public**: 12 (19.67%)
- **C. Industry**: 9 (14.75%)
- **D. Research**: 4 (6.56%)
- **E. Other**: 0 (0.00%)
- **F. Unsure**: 0 (0.00%)
- **G. No selection**: 2 (3.28%)



What type of organisation are you affiliated with?

Answered: *54*

- *RICS, SAGC, SAGI*
- *Government*
- *Education /research*
- *Tertiary Education*
- *Research*

Government
Research
South African National Space Agency
Space Agency
SAGC
Government
Reasearch
Aerospace
DLRRD
Academic
Government
SOC
Government, academics and private sectors
Research

Research Council
Government
Gov
DLRRD
Educational institution
Government.
Government
Government entity
Government
Government
National mapping organization
Government
Operations/Research
Both government and industry key

Department of Land Reform and Rural Development
SAGC
NGI
Government
government
Government
SOE
government
National Geographic
A private land surveying company
Associated Mapping Professionals Uganda
Geodesic Surveyors and Consultants
SAGC
government

South African Natioanl Space Agency

South African Geometics Council

Surveying

Government

government

Government

Ajayi Crowther University Oyo, Oyo State Nigeria

How effective are current communication efforts in your organisation?

Answered: *61*

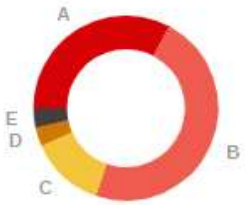
A. Effective: 20 (32.79%)

B. Limited: 29 (47.54%)

C. Not happening: 8 (13.11%)

D. Unsure: 2 (3.28%)

E. No selection: 2 (3.28%)



What's the best "story" we can tell to promote geodesy?

Answered: 33

Everything happens somewhere

How it links to other disciplines

The impact it could do to the public. EG prevention of natural disasters.

South Africa has been a leading role in Geodesy in Africa and contribute tremendously to the continent in strategy to transform from legacy systems to modern reference frame. It can also demonstrate the societal benefits of free acess to terrestrial geodetic infrastructure

UN-GGCE has promotional material which can be leveraged to depict how geodesy is part of everyday life for all

The underlying value of geodecy: how is it built into our every day lives, ie GNSS applications, global change

The coolness of positional knowledge.

It will be measuring earth to proctect our future. Through expansion and preservations

Geodesy will be the foundation of everything we do pretty much second to AI

Promote Geodesy from Primary and High schools; undergraduate students

Link the Science to tangible (or otherwise) outcomes that people can see or attest to in their everyday lives and experiences. People shouldn't see the science as far removed from them. Doing this (closing that gap) while maintaining the integrity of the science information or content itself will be the ultimate balance.

Training session or knowledge sharing can promote awareness to everyone involved. weather as a student or at the working environment.

That we use geodetic information to travel around from point A to point B. And that it is used in the supply-chain of goods and services.

Emphasise the physical dynamics of earth movement.

All accurate measurement stems from geodesy, including your drone, gps etc.

How Geodesy impacts service delivery, especially in disater areas

Why is it powerful; tell a story of the satellite revolution from 1957 onwards

Everything revolves around space and satellites

depends whether it's aimed at government, other sciences, industry, public?

We know technical achievements and need to relate simpler

To instill the love of country and everything that has to do with it, including what it means to be the most southern country in Africa, how it is affected by the sun and so on. It has a potential to be great just like any country in the world.

HOW SCARCE IT IS.

ITRF & Hartebeesthoek94 relation.

start at the early leaning stages

It affects almost everything that we do

It's the invisible science that underpins everything modern society depends on: positioning, navigation, timing, mapping, climate monitoring, and disaster resilience.

story of its essential role in modern life, from the GPS technology that guides us to infrastructure projects and the scientific understanding of Earth's changing shape and gravity.

Geodesy is everything and everything is geodesy

Integrating geodesy concept in school's curriculum

The Map That Guides Our Future. Connect to geodesy: explain that to plan roads, settlements, and disaster responses, you need precise, consistent measurements of the Earth—coordinates, elevation, boundaries, and how they change over time. That's geodesy.

The ability to predict climate/ weather pattens.

Geodesy is crucial for development and it is not only relevant to academics.

Impact of no geodesy work/ research

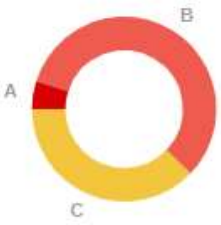
Does South Africa have enough trained geodesists to meet national needs?

Answered: *61*

A. Yes: 3 (4.92%)

B. No: 35 (57.38%)

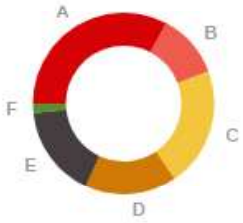
C. Unsure: 23 (37.70%)



What's the biggest Human Capacity Development gap for geodesy in South Africa?

Answered: *61*

- **A. Training programmes**: 20 (32.79%)
- **B. Recruitment**: 7 (11.48%)
- **C. Knowledge transfer**: 13 (21.31%)
- **D. Funding**: 10 (16.39%)
- **E. Awareness**: 10 (16.39%)
- **F. No selection**: 1 (1.64%)



Should South Africa expand scholarships/grants specifically for geodesy?

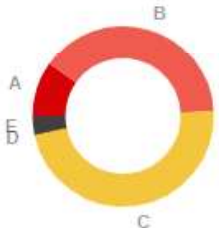
Answered: *61*

- **A. Yes**: 58 (95.08%)
- **B. No**: 0 (0.00%)
- **C. Unsure**: 3 (4.92%)

How effective are current partnerships with universities and industry?

Answered: *61*

- **A. Strong**: 6 (9.84%)
- **B. Adequate**: 24 (39.34%)
- **C. Weak**: 29 (47.54%)
- **D. None**: 0 (0.00%)
- **E. No selection**: 2 (3.28%)



Should South Africa expand scholarships/grants specifically for geodesy?

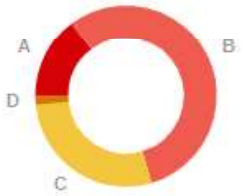
Answered: *61*

- **A. Yes**: 55 (90.16%)
- **B. No**: 0 (0.00%)
- **C. Unsure**: 3 (4.92%)
- **D. No selection**: 3 (4.92%)

Do you think there is sufficient budget support for scholarships in geodesy?

Answered: *61*

- **A. Yes**: 9 (14.75%)
- **B. No**: 34 (55.74%)
- **C. Unsure**: 17 (27.87%)
- **D. No selection**: 1 (1.64%)



Do you think there is adequate budget support for early-career posts?

Answered: *61*

- **A. Yes**: 9 (14.75%)
- **B. No**: 38 (62.30%)
- **C. Unsure**: 14 (22.95%)

Do you have a signed agreement with at least one university to co-deliver a formal geodesy training programme in the next academic year?

Answered: *61*

- **A. Yes**: 4 (6.56%)
- **B. No**: 42 (68.85%)
- **C. Unsure**: 15 (24.59%)

What would your recommendations be to strengthen geodesy training in South Africa?

Answered: 33

Short learning programmes, crash courses for high level government employees accross all entities / ministries. For CupCake to perhaps add it to his speech /State of the Nation address. For the SAGC to speak louder. For universities to update curricula

Encourage support for training

Advocacy and sourcing of funds

The national strategy should identify posts dedicated to fund in government and research institutes

Centre of Excellence (CoE) under the DSTI-NRF grants programme

Tell the school goers about it in order to spark interest.

Awareness and Career opportunities

Build one core narrative which will involve different disciplines tying to people , prosperity and our planet

We need more collaborations between research institutions, and perhaps with private players as well. We also need to advocate for 'scientifically inclined' government officials at a political level (in parliament), especially in the science portfolios. The reason we find it difficult to convince government of the use of science (in general) is because politicians really do not understand. We need more scientists in government (parliament).

I think exploring how it can also be incorporated into other fields of study at undergraduate and then become a specialization at Postgraduate. Of course the core subjects should be packaged to form a strong foundation.

Raise public awareness of the science and get some level of buy-in. Provide funding both for further study and for creating employment opportunities.

Funding that will allow training, workshops, knowledge sharing and awareness of Geodesy.
Funding for geodetic instruments and community engagement activities.
Government budget approval.
Acknowledge its importance and teach it from undergraduate level up like UCT. Include it in high schools.
Short courses, webinars
Design geadesy focused programmes at Universities
Formalize coordination structures and expand practical training and exposure
Collaboration with other stakeholders in the industry e.g Institutions of higher learning, RCMRD...etc
Early exposure at high school, maybe, most people get to know Geodesy at workplace.
increasing its exposure by offering an introductory Geodesy course as a cross-disciplinary elective within diploma/degree program
Exposure, introduce it to children in high schools.
NA
Follow UN-GGCE lead.
early learning
Influence on learning of physics and pure mathematics in schools.

Influence on learning of physics and pure mathematics in schools.

A Sarchi chair or community of Parctice for Geodesy

To strengthen geodesy training in South Africa, recommendations include establishing a National Geodesy Working Group to coordinate efforts, fostering collaboration between government, academia, and industry, developing nationally-relevant geospatial training programs

Government involvement

Develop National Geodesy Training and Research Centre, and modernise curriculum.

Align and upgrade higher education curricula. 2. Create a national geodesy curriculum framework with accreditation standards and learning outcomes. 3. Expand practical training and apprenticeships. 4.) Invest in regional GNSS and geodetic infrastructure

Sufficient funding should be dedicated to geodesy programs.

Sufficient Funding should be available Training program and knowledge transfer should be embarked on by geodesy expert in South Africa

Survey

Results for "Survey on Pillars 3, 5 & 6: Infrastructure, Standards and Systems"

70 people responded to this survey

Questions

Should geodesy be recognised as part of critical national infrastructure?

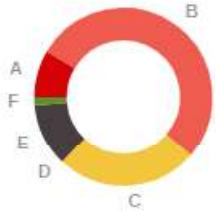
Answered: *70*

- **A. Yes**: 67 (95.71%)
- **B. No**: 0 (0.00%)
- **C. Unsure**: 2 (2.86%)
- **D. No selection**: 1 (1.43%)

How would you rate the condition of South Africa's geodetic infrastructure?

Answered: *70*

- **A. Strong**: 6 (8.57%)
- **B. Adequate**: 37 (52.86%)
- **C. Weak**: 18 (25.71%)
- **D. Very weak**: 0 (0.00%)
- **E. Unsure**: 8 (11.43%)
- **F. No selection**: 1 (1.43%)



Do you think long-term maintenance funding is secured for critical infrastructure?

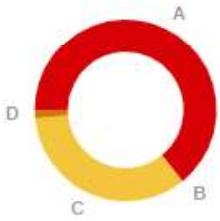
Answered: *70*

- **A. Yes**: 19 (27.14%)
- **B. No**: 32 (45.71%)
- **C. Unsure**: 17 (24.29%)
- **D. No selection**: 2 (2.86%)

Should South Africa share infrastructure regionally (e.g. GNSS hubs)?

Answered: *70*

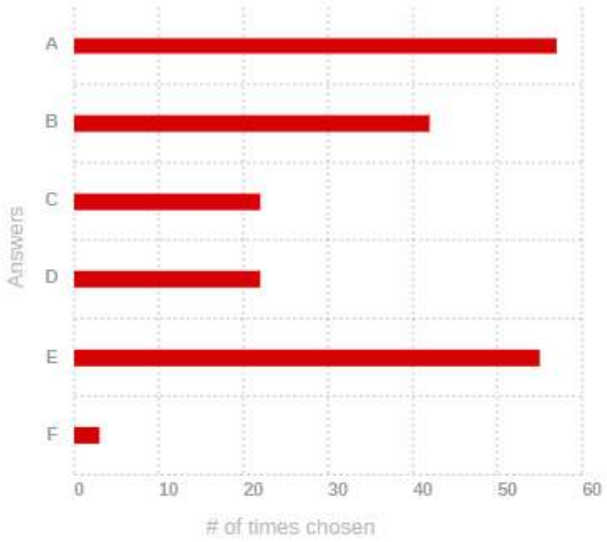
- **A. Yes**: 45 (64.29%)
- **B. No**: 0 (0.00%)
- **C. Conditional**: 24 (34.29%)
- **D. Unsure**: 1 (1.43%)



What are the top operational risks?

Answered: *70*

- **A. Funding**: 57 (81.43%)
- **B. Technical Skills**: 42 (60.00%)
- **C. Cybersecurity**: 22 (31.43%)
- **D. Land-use issues**: 22 (31.43%)
- **E. Infrastructure ukeep and maintenance**: 55 (78.57%)
- **F. Other**: 3 (4.29%)



General feedback new or related to Pillar 3

Answered: *19*

None

What is the status of connectivity of infrastructure to access data?

Intergovernmental collaboration is also a huge operational risk.

Lack of maintenance and funding

An infrastructure audit is required to avoid duplications but also for equitable resource allocation, upkeep and optimal use. A strategy/framework is also requred to facilitate infrstructre establishment and long term operationa and maintenance.

Long term, sustainable, operational funding is the biggest risk. Under-funded areas are also prone to brain-drain through the exodus of critical skills from the field. Single points of failure or a lack of robust succession planning for for critical skills and positions in the field of Geodesy

Theft

It is important to have share date in one portal

Leadership and policies, need to support simple processes for accessing technical infrastructure required to implement data centres

Urgent upgrades and maintenance required for VLBI

Hosting equipment can significantly enhance infrastructure, but this potential is often undermined by excessive red tape and delays particularly around agreements/contracts, import regulations, customs duties, and taxes.

DLRRd does not recognise the importance of geodetic infrastructure

There is need for shared access.

There's a huge need on infrastructure investment.

Maintaining the Hartebeesthoek94 datum (26m) is critical for research and for SA mapping

Important to have a long term roadmap of Geodesy so that proper infrastructure plan such as computing, data and connectivity can be planned for such future requirements.

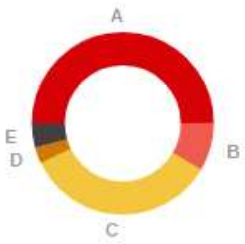
No

to be able to maintain the geodetic infrastructure, we need to charge.

Do you think geodetic data should be Open Access or a charged-for service?

Answered: *70*

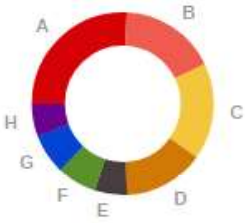
- **A. Open access**: 35 (50.00%)
- **B. Charge-for**: 6 (8.57%)
- **C. Hybrid**: 24 (34.29%)
- **D. Unsure**: 2 (2.86%)
- **E. No selection**: 3 (4.29%)



What is the biggest barrier to open geodetic data?

Answered: *70*

- **A. Funding**: 18 (25.71%)
- **B. Policy Restrictions**: 12 (17.14%)
- **C. Technical capacity**: 12 (17.14%)
- **D. Awareness**: 10 (14.29%)
- **E. Visibility and Acknowledgement**: 4 (5.71%)
- **F. Private and Industry networks**: 5 (7.14%)
- **G. Unsure**: 5 (7.14%)
- **H. No selection**: 4 (5.71%)



What indicators can be used to evaluate geodetic research impact beyond traditional metrics?

Answered: 21

look into the illustrating the value of having geodetic infrastructures and societal impact and which developmental goals that geodesy enables

Angaaz

Impact of infrastructure on livelihoods

AI complemented

Awareness and education of policy makers

Practical impact to the communitiesx

Prediction and prevention of natural disasters

Unify the GNNS and allow multiple usage eg , satellite,vlbi etc

The quality and consistency of data available on a public data center

Impact of papers and not number of publications

operations / data collection - station / equipment

Collaborate with DLRRD , Sansa and NRF and align with a set research agendam

Its impact on solving social geospatial issues such as inequality.

Initiate Geodetic conference for research to be presented, have different working groups on geodetic, issue call for Proposal specific geodetic topics

PIDs and Data cite, track downloads with a free user-account system

Impact on society

unsure

Upkeep of the technology and science related to geodesy.

geodetic research impact can be evaluated through Altmetrics (tracking online mentions in news, blogs, and policy documents), usage metrics (downloads, views), policy adoption (citations in policy documents or new regulations).

extent to which datasets are accessed and integrated into scientific domain

Data Quality Accuracy of result

Should legacy data and records be prioritised for preservation?

Answered: *70*

A. Yes: 63 (90.00%)

B. No: 0 (0.00%)

C. Unsure: 5 (7.14%)

D. No selection: 2 (2.86%)

Do you think metadata and Persistent IDs (eg DOI's) contribute to the visibility and discoverability of research?

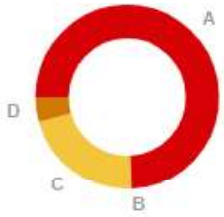
Answered : 70

A. **Yes**: 52 (74.29%)

B. **No**: 0 (0.00%)

C. **Unsure**: 15 (21.43%)

D. **No selection**: 3 (4.29%)



What indicators can be used to evaluate geodetic research impact beyond traditional metrics?

Answered: 16

Again, angaaz

The impact it does on communities

See above

Adoption of common standards when looking at GGOS create a new reference system

Duplicate question

Economic impact, societal benefit, eg survey of communal land

It transformative effectiveness

Through presentations and engagements amongst all stakeholders involved.

Impact to society

NA

DOMES and future xDOMES

unsure

Upkeep of the technology and science related to geodesy.

Beyond citations, geodetic research impact can be evaluated using altmetrics (online mentions in news, blogs, social media)

interdisciplinary collaboration

Data Quality Accuracy of result

Does South Africa's national reference system need modernisation?

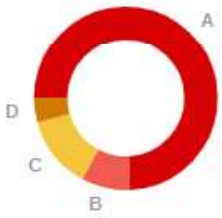
Answered: *70*

A. Yes: 52 (74.29%)

B. No: 6 (8.57%)

C. Unsure: 9 (12.86%)

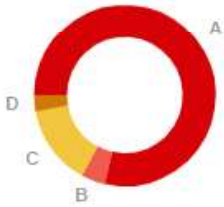
D. No selection: 3 (4.29%)



Do you understand the need for Regional Reference Frames?

Answered: *70*

- **A. Yes**: 55 (78.57%)
- **B. No**: 3 (4.29%)
- **C. Unsure**: 10 (14.29%)
- **D. No selection**: 2 (2.86%)



Should South Africa develop a formal roadmap for a modern GRS?

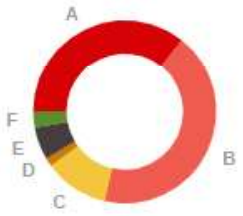
Answered: *70*

- **A. Yes**: 62 (88.57%)
- **B. No**: 0 (0.00%)
- **C. Unsure**: 6 (8.57%)
- **D. No selection**: 2 (2.86%)

How important is AFREF for Africa's geodesy capability?

Answered: *70*

- A. **Critical**: 25 (35.71%)
- B. **Useful**: 30 (42.86%)
- C. **Somewhat**: 8 (11.43%)
- D. **Not important**: 1 (1.43%)
- E. **Unsure**: 4 (5.71%)
- F. **No selection**: 2 (2.86%)



Who should lead coordination of regional frames?

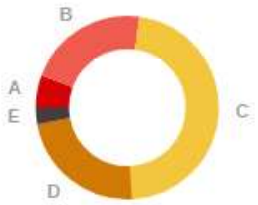
Answered: *70*

- A. **AFREF**: 20 (28.57%)
- B. **UN-GGIM Africa**: 11 (15.71%)
- C. **IAG**: 1 (1.43%)
- D. **SAGWG**: 14 (20.00%)
- E. **GGOS-Africa**: 5 (7.14%)
- F. **Other**: 0 (0.00%)
- G. **Unsure**: 17 (24.29%)

How effective are current mechanisms for sustaining regional frames?

Answered: *70*

- **A. Strong**: 4 (5.71%)
- **B. Adequate**: 15 (21.43%)
- **C. Weak**: 33 (47.14%)
- **D. Unsure**: 16 (22.86%)
- **E. No selection**: 2 (2.86%)



General comment / feedback on modernising reference systems?

Answered: *15*

- *It is critical and it is time that geodesy is treated as a priority since it is the foundation or backbone for anything spatial or digital*
- *Move to action faster*
- *It will need consultation with the industry (Surveyors). Many of them do not like frequent changes.*
- *Huge asset to the economy on a Marco and micro economic scale. Developing assets, both human and infrustructure will always be advantageous to the country*
- *Funding must be sourced*
- *Security to prevent theft*
- *AFREF has begin to build its CORS however this is met with major challenges eg funding and political factors*

Long term, sustainable, operational funding is the biggest risk. Under-funded areas are also prone to brain-drain through the exodus of critical skills from the field. Single points of failure or a lack of robust succession planning for for critical skills and positions in the field of Geodesy

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It is important to have share date in one portal

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Maintaining the Hartebeesthoek94 datum (26m) is critical for research and for SA mapping

Important to have a long term roadmap of Geodesy so that proper infrastructure plan such as computing, data and connectivity can be planned for such future requirements.

No

to be able to maintain the geodetic infrastructure, we need to charge.

We need clarity on role of GGOS Africa and UNGGim Africa working group on Geodesy
There is need for clear and well coordinated guidelines for establishment and management of the reference that easily tie into the global reference systems.
SA should invest in it's own Navigation satellite system to enhace sovereignty and security, improve connectivity and modernising local referencesystems. Overall the workshop was informative thanks you
Africa needs its own general reference frame
none
No
modernisation will ensure precession in geodetic data
none

Survey

Results for "Survey on Pillars 4 & 8: Spectrum protection and R&D"

48 people responded to this survey

Questions

Should geodesy advocacy be joined with astronomy at the ITU?

Answered: *48*

A. **Yes**: 43 (89.58%)

B. **No**: 2 (4.17%)

C. **Unsure**: 2 (4.17%)

D. **No selection**: 1 (2.08%)

hould national open science policies leverage Collective benefit, Authority to control, Responsibility and Ethics (CARE) principles?

Answered: *48*

i.e. indigenous data governance - the right to create value from indigenous data in ways that are grounded in indigenous world views and realise opportunities within the knowledge economy

A. **Yes**: 42 (87.50%)

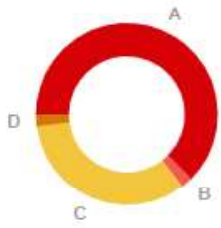
B. **No**: 1 (2.08%)

C. **Unsure**: 5 (10.42%)

Should we add other factors (other than spectrum protection) to enable resilience?

Answered: *48*

- **A. Yes**: 30 (62.50%)
- **B. No**: 1 (2.08%)
- **C. Unsure**: 16 (33.33%)
- **D. No selection**: 1 (2.08%)



General comments and suggestions

Answered: *10*

- *GNSS site protection*
- *Protection of physical health infrastructure against interference.*
- *Policy.*
- *Protection of physical infrastructure*
- *General cover for any factors that may be mitigating critical geodetic infrastructure*
- *Geodetic infrastructure and spectrum protection*
- *None*
- *NA*

none

Spectrum protection is a foundational element of reliable communications, navigation, and sensing. Effective protection requires a holistic, proactive approach that combines policy, technology, governance, and capacity-building

Should South Africa prioritise geodesy R&D as part of national science policy?

Answered: *48*

A. Yes: 45 (93.75%)

B. No: 0 (0.00%)

C. Unsure: 3 (6.25%)

Does South Africa have the means to adopt emerging technologies given the current levels of support?

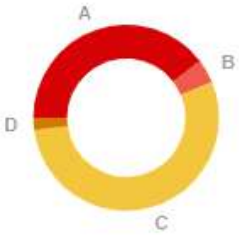
Answered: *48*

A. Yes: 19 (39.58%)

B. No: 2 (4.17%)

C. Partly: 26 (54.17%)

D. Unsure: 1 (2.08%)



How important is HPC access for geodesy activities in South Africa?

Answered: *48*

- **A. Critical**: 13 (27.08%)
- **B. Important**: 20 (41.67%)
- **C. Moderate**: 6 (12.50%)
- **D. Not important**: 0 (0.00%)
- **E. Unsure**: 9 (18.75%)

Where should South Africa focus R&D efforts?

Answered: *48*

- **A. New Techniques**: 9 (18.75%)
- **B. Infrastructure**: 22 (45.83%)
- **C. Innovation**: 8 (16.67%)
- **D. Commercialisation**: 1 (2.08%)
- **E. Regional Capacity**: 6 (12.50%)
- **F. Other**: 0 (0.00%)
- **G. Unsure**: 2 (4.17%)

General comments / feedback?

Answered: 5

We need R@D acroos

Human capital critical and then focus on the continent capacity

Cultivate awareness and interest in Space Studies and Earth observations.

geodesy should be recognised as a strategic discipline.

It covers strategic focus, research topics, methodologies, and implementation considerations you can adapt to a national, corporate, or cross-sector program.