Research Infrastructures - International Cooperation

• Science is an international activity
• Science knows no borders - builds international friendship and partnership, solidarity and understanding
• Scientific and technological progress is dependent on the sharing of experience, expertise and costs across borders
• Globally – increased cooperation - grand challenges
Strategic context

• It has been increasingly recognized that science and technology are key factors in sustainable development.

• Developing human capacity and expertise for the knowledge economy are crucial to Africa’s development and to its ability to participate effectively in the global knowledge economy. This is essential for the sustainable reduction and eventual eradication of poverty in Africa

• South Africa’s National Development Plan emphasizes the need for the country to develop capacity for the global knowledge economy – Vision 2030

• Advance African agenda for science, technology and innovation
  • Support AU Science, Technology & innovation Strategy for Africa (STISA); SADC; Grand Challenge Africa
  • AU Agenda 2063

• AU-EU Partnership – implementation
• Bilateral co-operation with EU member states
SDGs and RI

RI is essential to support research needs of the SDGs since fundamental and applied research will need to play a strong role in:

- understanding and awareness of the complex distributed global natural and man-made systems.
- Providing breakthroughs/innovation needed in new materials, new drugs, new energy systems, new agriculture, distribution and transport systems….linking to socio-economic benefits
- Developing skills and capacity – growth, job creation
The SKA Project

- The Square Kilometre Array (SKA) mega-project is an international effort to build the world’s largest radio telescope (South Africa & Australia)

- South Africa has partnered with eight other African countries in the Square Kilometre Array project: Namibia, Botswana, Mozambique, Zambia, Madagascar, Mauritius, Kenya and Ghana

- It will require data processing facilities and capabilities beyond what is currently available, producing data volumes in excess of current global internet traffic
SKA1: HQ in UK; telescopes in AUS & RSA

SKA1-LOW: 50 – 350 MHz
Phase 1: ~130,000 antennas across 65 km

SKA1-Mid: 350 MHz – 24 GHz
Phase 1: 200 15-m dishes across 150 km

Construction: 2018 – 2024; Cost cap: €675M
SKA Global organisation

- Australia (DoI&S)
- Canada (NRC-HIA)
- China (MOST)
- India (DAE)
- Italy (INAF)
- Netherlands (NWO)
- New Zealand (MED)
- South Africa (DST)
- Sweden (Chalmers)
- UK (STFC)

- Full members
  - SKA Headquarters host country
  - SKA Phase 1 and Phase 2 host countries

- Interested Countries:
  - France
  - Germany
  - Japan
  - Korea
  - Malta
  - Portugal
  - Spain
  - Switzerland
  - USA

- Contacts:
  - Mexico
  - Brazil
  - Ireland
  - Russia

This map is intended for reference only and is not meant to represent legal borders.
SKA Science Drivers – the history of the universe

- Cosmic Dawn
  (First Stars and Galaxies)
- Galaxy Evolution
  (Normal Galaxies z~2-3)
- Cosmology
  (Dark Energy, Large Scale Structure)
- Testing General Relativity
  (Strong Regime, Gravitational Waves)
- Cradle of Life
  (Planets, Molecules, SETI)
- Cosmic Magnetism
  (Origin, Evolution)
- Exploration of the Unknown

Extremely broad range of science!
SKA Big Data challenge
SKA Big Data focus areas

- High Speed Streaming
- Visualisation
- Mass Storage
- Machine Learning
- Power Efficient Computing
- Algorithms & Analytics
- Sensor Networks
- Unstructured Data
SKA1 Regional Centres
Outside SKAO scope

- Required
  - capacity for reprocessing data and their analysis
  - storage for a long-term archive
  - local user support

- Intent
  - SKA partner countries planning SKA regional Centres
  - National super-computing centres
  - Provide local support to scientists
  - Development of new techniques, new algorithms
  - Deliver SKA science
The African Very Long Baseline Interferometry Network (AVN)

- The AVN is an African-owned network of VLBI-capable radio telescopes that will strengthen the science which the international VLBI community can do.
- It will help develop critical and enabling skills, regulations and institutional capacity to optimize African participation in the SKA.
- The AVN program will transfer skills and knowledge in African partner countries to build, maintain, operate and use radio telescopes and its high performance computing equipment.
The AVN project

African VLBI Network of Telescopes in Africa - ensuring readiness for SKA2

Phase 1: Ghana

Phase 2: Zambia or Madagascar

Phase 2: Namibia

Phase 2: Botswana

Phase 3: Kenya

Phase 3: Madagascar or Zambia

Phase 3: Mauritius

Phase 3: Mozambique
Big Data - MeerKAT

- South African scientists and engineers have designed and constructed the MeerKAT Radio Telescope and have developed many innovations in that process, including the development of low cost, high-performance computing modules and data storage.

- MeerKAT Science Data Processor will complete the implementation of the largest data storage system of its kind, hosted at the Centre of High Performance Computing.

- The storage system is geared for next-generation large survey telescopes such as MeerKAT and the SKA.

- As a final step in construction, MeerKAT will be integrated into SKA Phase 1, after 5 years of scientific observations.

- The South Africa Tier 1 Data Node (or Regional Science Data Centre) effectively becomes South Africa’s SKA National Facility, processing and distributing data on behalf of SA’s radio astronomy community.
Big Data - vision

Towards an African Data Intensive Research Cloud (ADIRC)

- The African Data Intensive Research Cloud (ADIRC) is an initiative born of the Square Kilometre Array (SKA) radio astronomy activities in Africa in which a research cloud infrastructure is being developed which will link African Partner Countries with the African SKA host country, SA – in order to meet the scientific, computing & research collaboration needs.

- It will be powerful distributed IT infrastructure, providing ready access to high performance computing, large dataset visualization & high volume storage facilities for collaborating research groups across Africa.

- Although originating in radio astronomy, the ADIRC will from the start also service other disciplines, bioinformatics, geosciences domains, etc.

- Centre for High Performance (CHPC) training intervention is a crucial enabler to realise an African Research Cloud Computing platform.
Steps towards an ADIRC

- South African-based “cloud” currently being prototyped and demonstrated (“SADIRC”)
  - Tier 1: MeerKAT Science Data Processor in Cape Town (National level).
  - Tier 2: Consortium of several universities in SA.
  - Tier 3: SA University-based node federated to the South African CLOUD.
Possible steps towards an African Data Intensive Research Cloud (ADIRC)

- Current proposal is to **phase** the deployment
- Phase 1: Specific partner country efforts
- In South Africa the approach is likely to be as follows:
  - Tier 1, 2 and 3 facilities: Demonstrate ability to routinely move large datasets and collaborate through federation to high speed data transport network and access.
  - Phase 1B: Infrastructure development in partner countries
  - Partner country scientists federated to SA Cloud through their universities.
  - Human Capital Development Programme would have to be implemented in all partner countries—as part of Phase 1.
  - Phase 2: Deployment of Tier 2 & 3 systems in partner countries or federating to already existing Partner country initiatives.
ADIRC – Training and skills development

The ADIRC will also serve as an important platform for the commitment to provide continued support for human capital development.

New skills which are essential to play a role in the global knowledge economy, including:

- Automation, data analysis and machine learning techniques
- Novel hardware / software co-design for power efficient and cost-effective computing
- Data flow architectures
- Systems for dealing with massive scale compute and data
- Control and monitoring systems
Overview – SKA SA bursaries awarded to partner countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana</td>
<td>19</td>
</tr>
<tr>
<td>Ghana</td>
<td>8</td>
</tr>
<tr>
<td>Kenya</td>
<td>22</td>
</tr>
<tr>
<td>Madagascar</td>
<td>35</td>
</tr>
<tr>
<td>Mauritius</td>
<td>17</td>
</tr>
<tr>
<td>Mozambique</td>
<td>4</td>
</tr>
<tr>
<td>Namibia</td>
<td>6</td>
</tr>
<tr>
<td>Zambia</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>118</strong></td>
</tr>
</tbody>
</table>
EU-Africa collaboration

- The African Data Intensive Research Cloud will be an African counterpart to the European Science Cloud
- The vision is to enable global collaboration
- The ADIRC will be a federated partner that will open up African-EU collaboration for African users of the EU cloud and European users of the African cloud.
- This would enable collaboration on major strategic big data science projects that involve EU and Africa. The global federated cloud would be the platform that knits together the global network of regional science and data centres and a research and development platform for tools for analysis and collaboration around big data hosted in the cloud at data-centric high performance computing nodes
- EU-AU Summit and implementation of priority areas could be supported and facilitated by the ADIRC
- Opportunities to partner with EU MS on various elements – HCD, etc
THANK YOU
CONTACT DETAILS

Vinny Pillay

Minister Counsellor : South Africa Embassy to Belgium and Luxembourg and Mission to the European Union

Department of Science and Technology
Tel: +32 2 512 04 10

Website: www.dst.gov.za

E-mail : Vinny.Pillay@dst.gov.za