The SKA approach to sustainable research

Simon Berry, SKA Organisation
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SKA: HQ in UK; telescopes in AUS & RSA

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

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

Exploring the Universe with the world's largest radio telescope
Hardware in South Africa

SKA-P2: Karoo (China/Germany/Italy), 24 April 2019
Hardware in Australia

AAVS1: AU/IT/NL/UK

1.6MW solar/battery power station: operational
SKA HQ: Jodrell Bank, UK

Exploring the Universe with the world’s largest radio telescope
SKA: A global Research Infrastructure

Potential Future Members

Members of the SKA Organisation
Host Countries: Australia, South Africa, United Kingdom

African Partner Countries

SKA Observatory will be established as an Intergovernmental Organisation in 2020, taking over from the SKA Organisation. It will undertake the construction and operation of the telescope.

As of March 2019, confirmed SKA Observatory members are

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Timeline

Key dates:

• Q1 2019: Convention signing ✔
• Q4 2020: Construction activity begins
• Q3 2023: Science Commissioning starts, community involved
• 2027/8: SKA1 construction complete
• 2028 onwards – full science operations
• 2030’s: construction upgrade to SKA2
• ......science and operations ongoing
Long term Sustainability

• Multi-decade lifetime

• Encompassing national facilities

• Multi-phased construction
  • Ongoing upgrades

• Periods of construction, operation and overlapping construction and operation

• Host countries as partners not ‘landlords’

MAIN RECOMMENDATIONS

1. Establish and maintain excellence through the entire lifecycle of RIs by all appropriate means, by securing adequate framework conditions, and by opening the RIs up to the world.

2. Ensure that RIs have the right people in the right place at the right time by strengthening and harmonising national research and educational systems to make sure that all essential skills are available.

3. Harmonise and integrate a vision for convergent operation of RIs and e-Infrastructures in Europe to ensure cost-effective service provision to the user communities.

4. Fully exploit the potential of RIs as innovation hubs by incorporating strategies for their development into national and European innovation policies.

5. Set up effective means of determining the economic and wider social value of RIs, and incorporate these benefits into science-policy-society dialogues.

6. Establish adequate framework conditions for effective governance and sustainable long-term funding for RIs at every stage in their lifecycle, together with effective management.

7. Foster broader coordination at National and European levels when designing processes for planning and supporting national and pan European RIs and so enhance their strategic value.
Sustainable governance

- SKA Organisation member governments agreed to develop an Intergovernmental Organisation in 2015

- Rationale:
  - Appropriate for a genuinely global research infrastructure of SKA’s scale
  - Government commitment: political stability, funding stability
  - A level of independence in structure
  - ‘Freedom to operate’, specifically through procurement process, employment rules etc

- Building an organisation based on successful IGOs such as CERN, ESO, ESA etc

- Negotiations started October 2015 – led by Italian government.
Convention signing – 12th March
Science excellence

(Cosmic Dawn: First Stars and Galaxies)

(Galaxy Evolution: Normal Galaxies z~2-3)

(Cosmology: Dark Matter, Large Scale Structure)

(Cosmic Magnetism: Origin, Evolution)

(Cradle of Life: Planets, Molecules, SETI)

(Testing General Relativity: Strong Regime, Gravitational Waves)

(Exploration of the Unknown)
21st Century Observatories

LIGO: operational

JWST: 2020

ALMA: operational

SKA: 2028

ELT: 2024

CTA: 2024

Radio waves, Microwaves, Infrared, Ultraviolet, X-rays, Gamma
Computing Challenges (SKA1)

**SKA-LOW**
- ~2 Pb/s
- 7.2 Tb/s
- 8.8 Tb/s

**SKA-MID**
- ~5 Tb/s (over 600 km)
- ~250 PFlops
- @Cape Town

**Global Traffic in 2020 ~500 Tbps**
- ~50 PFlops
- ~600 PB/yr

**SKA Regional Centres**
- @Perth

**AWS, IBM, Google, Nvidia, SGI, Intel, ...**

Global Traffic in 2020 ~500 Tbps

Exploring the Universe with the world’s largest radio telescope...
SKA Regional Centres (c.f. CERN Computing Grid)

Observatory Data Products flow from the Science Data Processors in Perth and Cape Town to SRCs around the globe
Socio-economic impact and innovation

- **Now:**
  - Already ‘local’ impacts (on sites and in hosting countries) happening and evidence there: real economic and other factors being tracked now
  - Looking ahead to ‘real direct’ impacts: industrial contracts and IP in construction

- **Soon:**
  - Construction phase activities: ‘juste retour’, innovation impacts, policy impacts
  - Continuation of hosting country impacts, and broader global involvement/outcomes
  - Science preparation

- **Later:**
  - Science impacts and returns
  - Operations phase ‘juste retour’?

- **Later still:**
  - Subsequent construction phases.....
  - Subsequent operations phases.....
  - Science.... etc
Innovation, generation of new IP
Economic return from innovation
Tracking impact

• SKAO involved in OECD, ESFRI, RI-PATHS and other discussions on impact:
  – Aim to have central reporting framework in place
  – Resource base for stakeholders to access relevant impact information

• STFC report on UK-SKA impacts and economic benefits – August 2018
Local impacts: South Africa

Industry activity
Contracts
Labour and employment
SKA SA's investment impact on the Northern Cape

The total amount of money spent in the Northern Cape through KAT-7 and MeerKAT

**R220 MILLION**

this includes: This information includes figures up until November 2016.

- **R134 MILLION**
  - Amount spent at local suppliers for the construction of MeerKAT and other related projects

- **R1 MILLION**
  - The amount spent on training 351 people from Northern Cape communities

- **R1.7 MILLION**
  - Amount spent on material sourced from local suppliers for equipment for the building of the Hydrogen Epoch of Reionisation Array (HERA)

- **7284**
  - Total number of employment opportunities created through the construction of KAT-7, MeerKAT and other related projects

- **72**
  - The number of FET students funded by SKA in the Northern Cape since 2011

- **9**
  - Number of SKA funded students from local communities enrolled at universities

- **8**
  - Number of schools where structured Human Capital Development programmes are conducted. These include Carnarvon High School, Carnarvon Primary School, Williston High School, Nico Bekker Primary School, Loxton Primary School, Vosburg Primary School, Brandvlei Primary School and Brandvlei High School, involving more than 4 000 learners

- **120 000 HA**
  - Nature reserve to be declared and protected for future generations

- **219**
  - Farmers and farmworkers provided with fixed broadband connectivity via satellite [V-SAT] since December 2015

The SKA SA project has invested heavily in the Northern Cape province, from upgrading knowledge centres to creating jobs and providing deserving students with much-needed academic funding. With its partners, SKA SA has contributed towards social and technological development in areas such as Carnarvon, Vosburg, Williston, Van Wyksvlei and Brandvlei.

SKA SA has five focus investment areas in the Northern Cape:

- Investing in the youth
- Supporting community upliftment programmes
- Developing small to medium enterprises
- Nurturing learners' talent
- Ensuring communication connectivity

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Site activities: Australia

- Indigenous Land Use Agreement (ILUA) with the Wajarri aboriginal group of the region required
- Scope includes direct monetary benefits to a trust fund managed by them
- Indirect monetary benefits includes:
  - Employment and contracting opportunities
  - Liaison and business development officers
  - Education: cadetships, apprenticeships, mentoring, school visits
  - Support for art programmes
  - Cultural: support for Wajarri cultural displays for interpretive centres
  - Value ~€10’sM
Societal impact

- 125k Euro work package within the Jumping JIVE H2020 project
- Funds trainers from EU radio observatories to help with the DARA basic training
- Funds a seminar series to advertise DARA programme
- Funds African students to attend EU radio astronomy training events
- Funds staff exchanges between EU and AVN countries
Public appeal...

- SETI: huge public interest

- Significant private investment already

- Careful balance needed in future – science priorities vs other agendas
Conclusions

- SKA at critical point:
  - Design activities moving towards construction readiness
  - Poised for new organization being established
  - Huge national momentum and visibility already in South Africa and Australia
  - SKA Observatory will create global entity
  - Science primary driver, but careful planning already underway for ongoing sustainability through project lifetime
Thank you

www.skatelescope.org