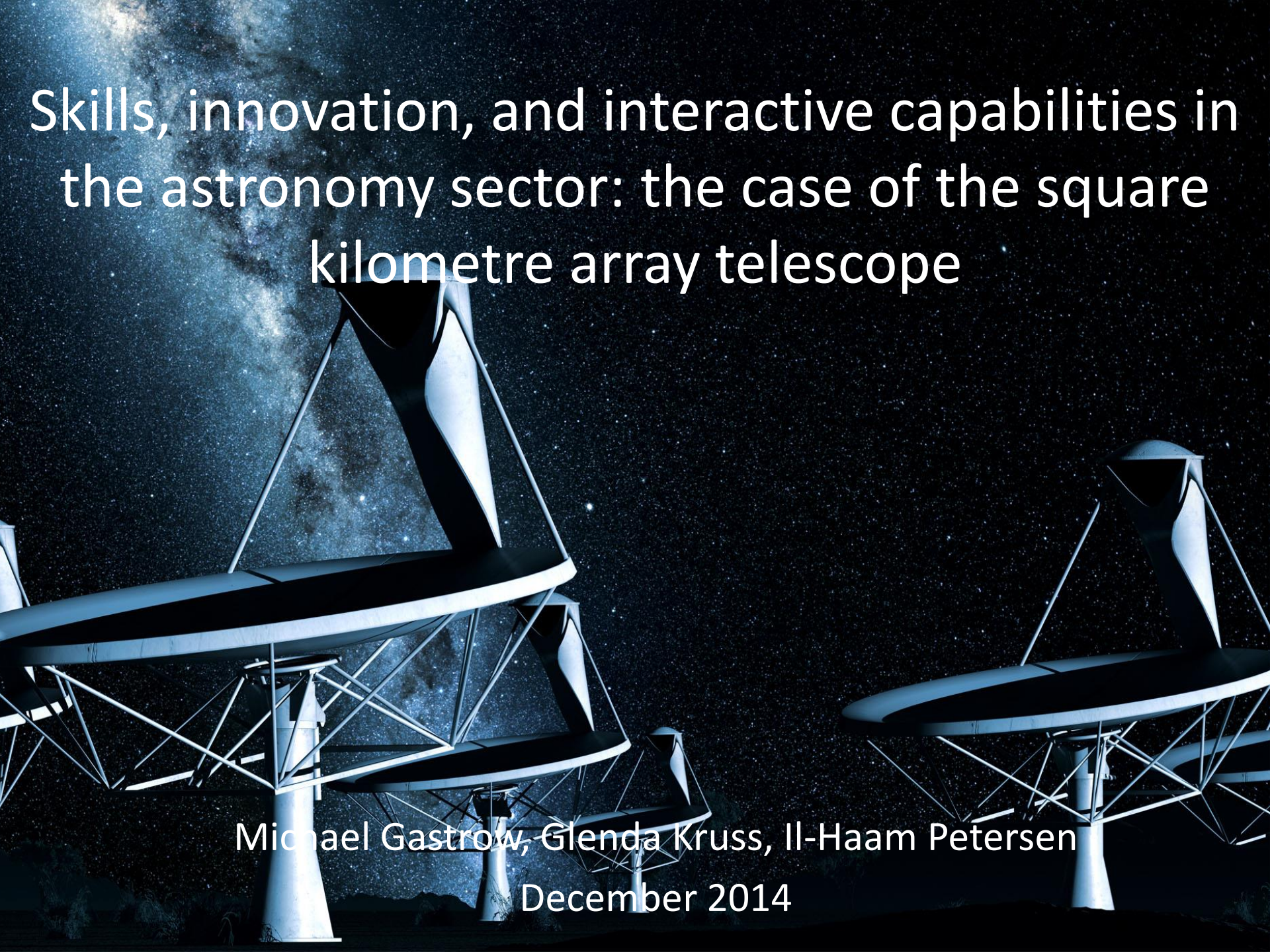
Skills, innovation, and interactive capabilities in the astronomy sector: the case of the square kilometre array telescope



Michael Gastrow, Glenda Kruss, Il-Haam Petersen

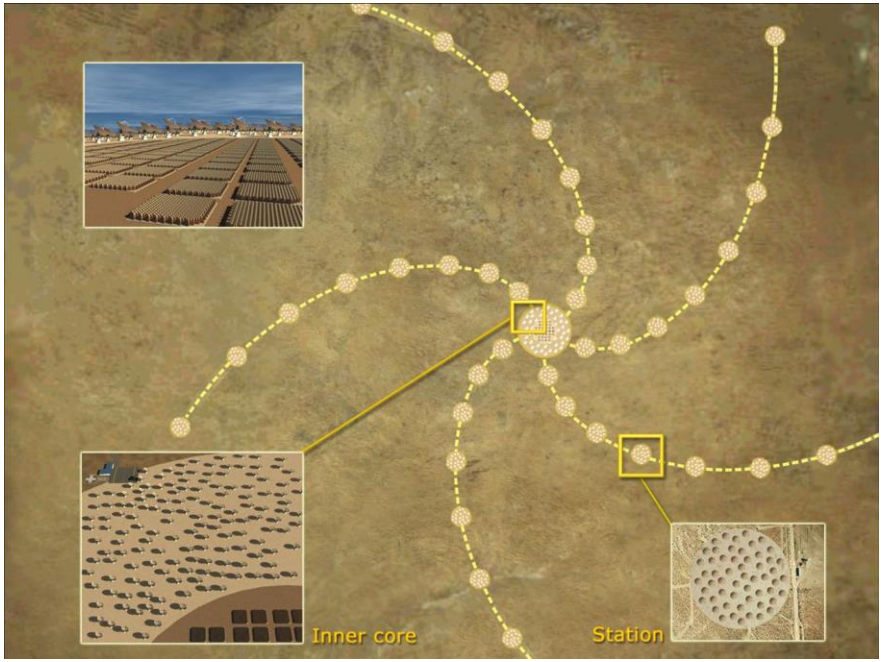
December 2014

Outline

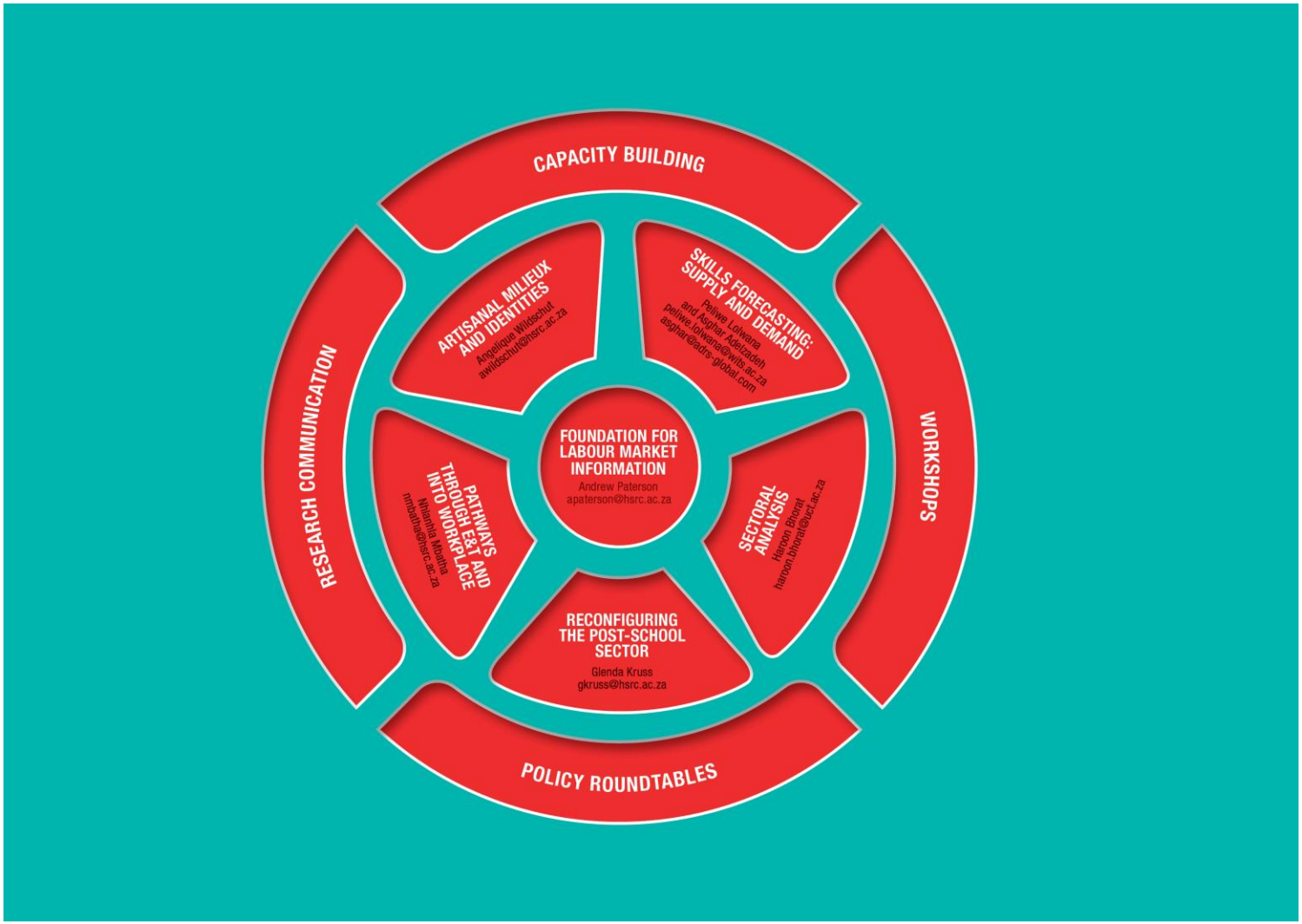
- Astronomy and the SKA
- The Labour Market Intelligence Research Partnership
- Research question and theoretical framework
- Methodology
- The Astronomy Sectoral System of Innovation
- Skills demand
- Skills supply
- Interactive capabilities
- Challenges
- Success factors

South African Astronomy and the Square Kilometre Array

- How do **galaxies** evolve and what is dark energy?
- Are we alone? **SETI**?
- How were the first **black holes** and **stars** formed?
- What generates the giant **magnetic fields** in space?
- Was **Einstein** right?
- **Blue sky** research…



The Labour Market Intelligence Research Partnership



Skills alignment through interaction

LABOUR MARKET INTELLIGENCE PARTNERSHIP

We can create projections for skills needed in specific sectors…

But these have limited utility without also understanding how organisations **interact** to match the supply of and demand for skills…

Our **research question**: How do we address skills gaps by improving alignment between the E&T system and employers?

Innovation systems framework

LABOUR MARKET INTELLIGENCE PARTNERSHIP

- **Systemic framework**: innovation and knowledge / actors and relationships
- **Knowledge generation role of universities**: strategies and mechanisms
- Focus on **skills development**, and across the post-school system
- **Potential value?**

Research approach

LABOUR MARKET INTELLIGENCE PARTNERSHIP

Theoretical stance: **innovation systems approach / dynamic interactive capabilities**

- What are the main components in the **SSI** addressing skills needs?
- How do **employers** meet routine and non-routine skills needs?
- How do **public and private sector intermediary organisations** build network alignment?
- What are the interactive capabilities of the **E&T system** to address the skills needs of employers?
- What is the nature of mis/alignment between skills supply and demand?
- What are the challenges/constraints/threats to growth and skills development?

> Identify opportunities for improved interaction and system configuration

Methodology

- **Mapping the SIS**
- Key informant **interviews**
- **Analysis** focussing on:
  - Competences
  - (Dynamic, interactive) capabilities
  - Network (mis)alignment
  - Opportunities for improvement

Innovation System for Astronomy and the SKA

LABOUR MARKET INTELLIGENCE PARTNERSHIP

CAPABILITY BUILDING PROCESSES IN THE ASTRONOMY SECTORAL SYSTEM OF INNOVATION

SKILLS DEMAND

SKA organisation:
- SKA (international organisation)
  - SKA (South African project office
  - KAT-7
  - MeerKAT
  - African VLBI network
  - Science projects and partnerships

Firms in the SKA value chain:
- IBM, Intel, Neotel, Aurecon, etc.
- In-depth case study firms:
  - Stratosat Datacom
  - EMSS Antennas
  - Tellumat

National Science Facilities:
- SAAO
- SALT
- HMO
- HartRAO
- Smaller astronomy facilities

Science Councils:
- CSIR

Interpreting & implementing policy

MECHNISMS/STRATEGIES

Org linkages (knowledge & experience)

Resources (e.g. bursary programmes)

Skills movement (graduates, upskilling)

Sector interms (International)
- IAU
- OAD
- AERAP
- NRAO
- EU Space Agency

Sector interms (SA)
- SAAO
- SANSA
- NASSP
- DST
  - Astronomy Desk
- NRF
  - Deputy DEO: Astronomy (= NRF sub-agency)

SKILLS SUPPLY

SKA organisation:
- SKA (South African project office)
  - Human Capital Development Programme

South Africa HEI:
- UCT
- UWC
- US
- CPUT
- Rhodes
- Wits
- UFS
- NWU
- UNISA
- UKZN

International HEI:
- Draws on global pool of skills from multiple sources and e.g.:
  - Oxford
  - Berkeley
  - CASPER
  - ASTRON
  - Rutgers

E.g. SALT partners = Nicolaus C Polish Academy of Sciences, t Rutgers, the State University o Gronigen, the University of Wi Canterbury (New Zealand), the Hill, Dartmouth College, Carn Kingdom SALT Consortium (U Observatory, the University of Lancashire, the University of N University of Southampton.

FETs:
- Kimberley

Interpreting & implementing policy

Policy

DST 10 Year Plan Pan

Astronomy Geographic Advantage Act (2007)

DST Astronomy Desk

Tacit political support

KEY

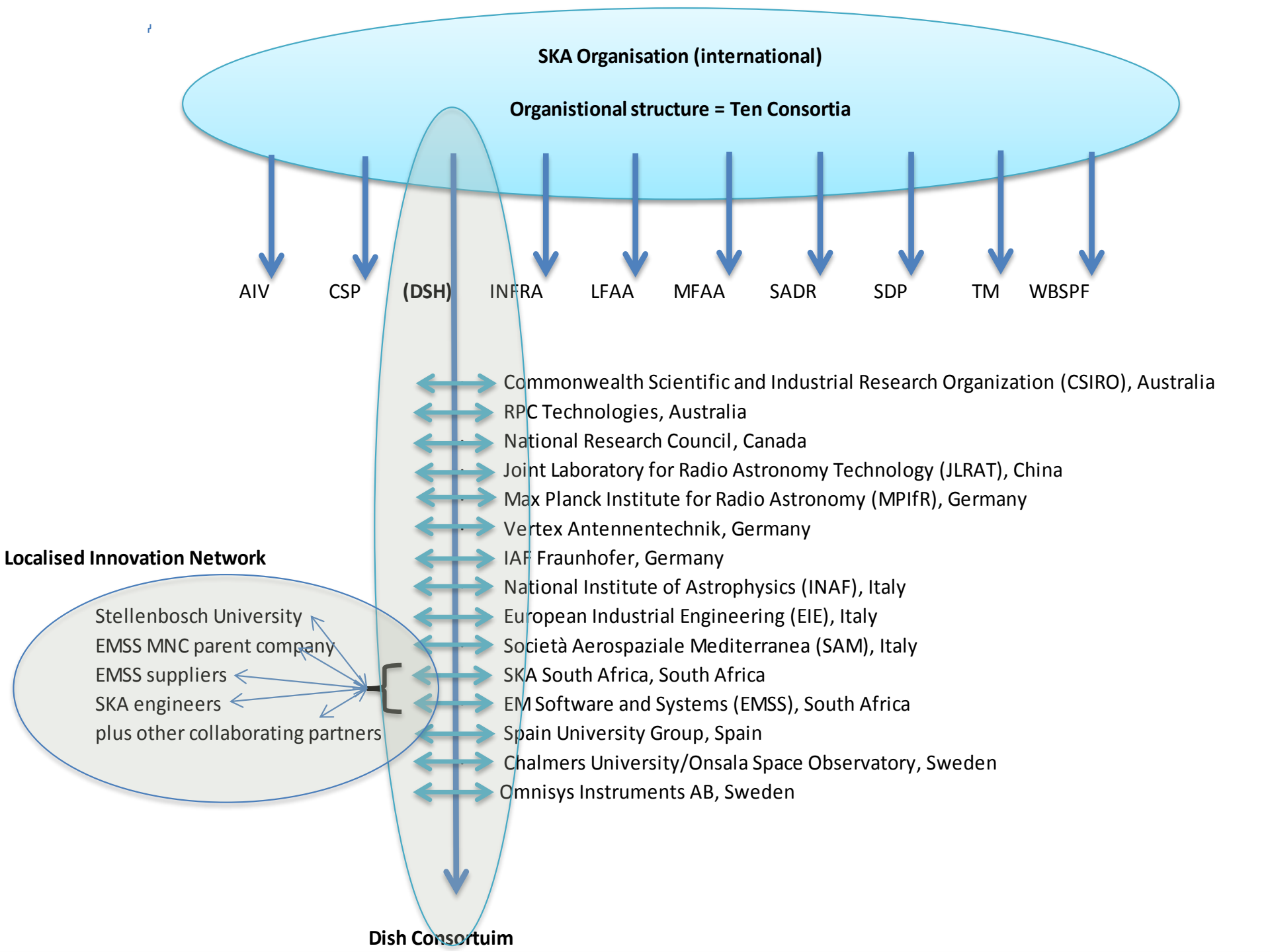
Interaction

Policy incentives/stipulations

interms = Intermediaries

Sub-system

dynamic interactive capabilities


SKA Organisation (international)
Organistional structure = Ten Consortia
AIV
CSP
(DSH)
INFRA
LFAA
MFAA
SADR
SDP
TM
WBSPF
Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia
RPC Technologies, Australia
National Research Council, Canada
Joint Laboratory for Radio Astronomy Technology (JLRAT), China
Max Planck Institute for Radio Astronomy (MPIfR), Germany
Vertex Antennentechnik, Germany
IAF Fraunhofer, Germany
National Institute of Astrophysics (INAF), Italy
European Industrial Engineering (EIE), Italy
Società Aerospaziale Mediterranea (SAM), Italy
SKA South Africa, South Africa
EM Software and Systems (EMSS), South Africa
Spain University Group, Spain
Chalmers University/Onsala Space Observatory, Sweden
Omnisys Instruments AB, Sweden
Localised Innovation Network
Stellenbosch University
EMSS MNC parent company
EMSS suppliers
SKA engineers
plus other collaborating partners
Dish Consortuim

Skills demand and interactive capabilities

SKA

Formal structures and mechanisms:

- HCDP
- Universities working group
- SKA design consortia
- Technology forecasting

Tacit interactive capabilities:

- Informal relationships with key actors
- Scientists and engineers within HEIs

Firms

Searching for skills:

- More network mechanisms
- Less market mechanisms

Formal mechanisms:

- SKA design consortia
- Global innovation networks

Skills supply and interactive capabilities

- **Universities:**
  - Niche competences and capabilities:
  - Institutions
  - Departments (e.g. Astronomy)
  - Faculties (e.g. Engineering)
  - Individual academics
  - NASSP
  - Universities Working Group
- **FET**?

Example: University of Stellenbosch Engineering faculty

- Responsive teaching and learning
- Responsive research and innovation + collaborative R&D networks
- Academic networks
- Advisory boards
- 5 year review process
- Academic time allocations for working in industry
- Contract R&D for industry
- Funding for equipment
- Close engagement with engineering professional body
- Invited speakers from firms
- Strategic interaction with GOV

Intermediaries

Public Sector

SA:

- DST
- NRF
- SAAO
- DHET (SIPs)
- Policy support

International:

- NRAO
- AERAP

Private Sector

- IAU
- OAD

Lessons for policy: interaction and systemic alignment

LABOUR MARKET INTELLIGENCE PARTNERSHIP

Challenges:

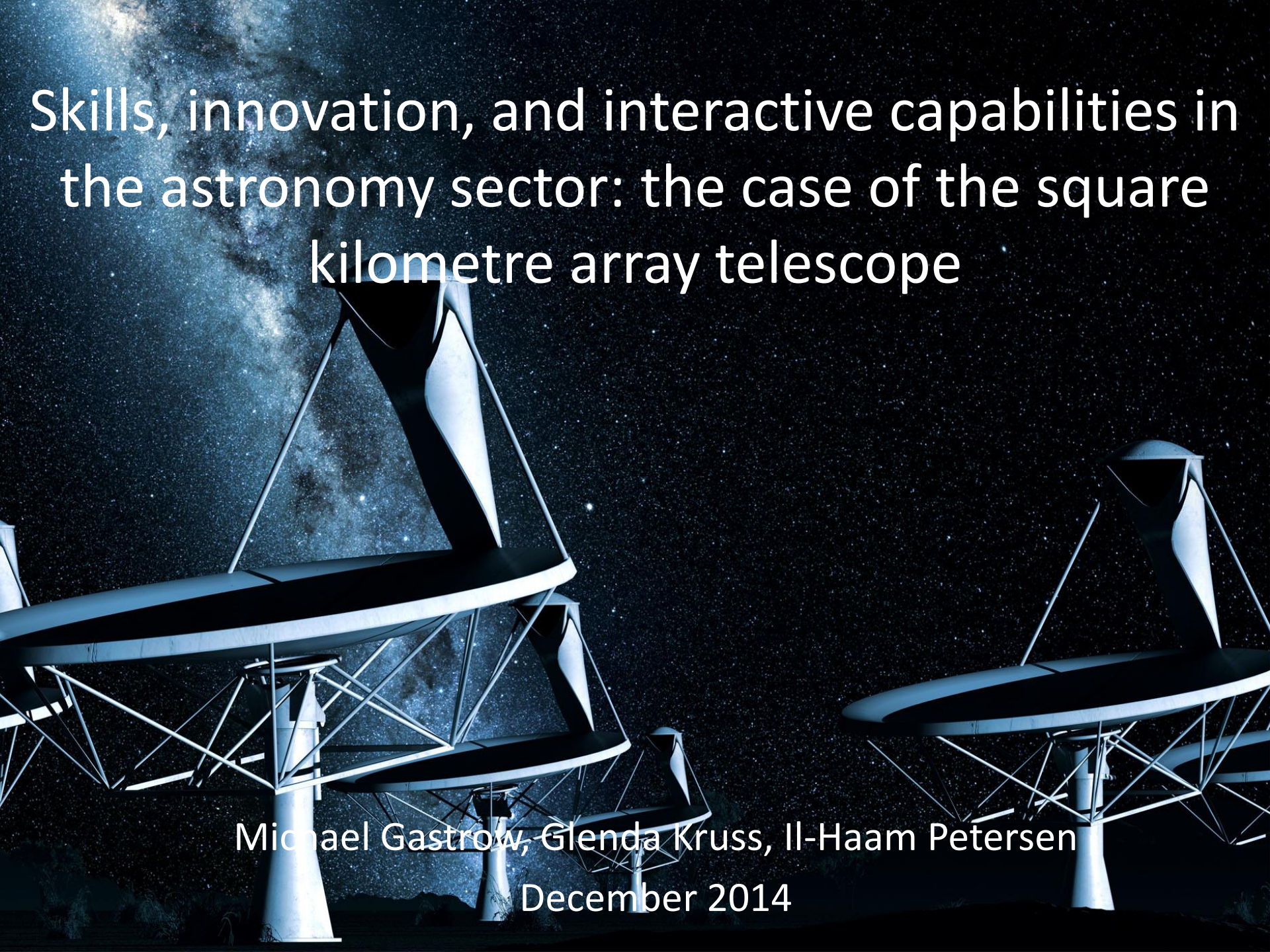
- Sourcing international skills
- Slow rate of undergrad curriculum change
- FET limitations

Successes achieved through:

- Funding
- Risks
- Policy
- Interactive capabilities in the SKA
- Interactive capabilities in the higher education system
- Skills planning
- Formal and informal networks connect employers and universities

Q: *can this success be replicated in other knowledge-intensive sectors?*

Skills, innovation, and interactive capabilities in the astronomy sector: the case of the square kilometre array telescope



Michael Gastrow, Glenda Kruss, Il-Haam Petersen

December 2014