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

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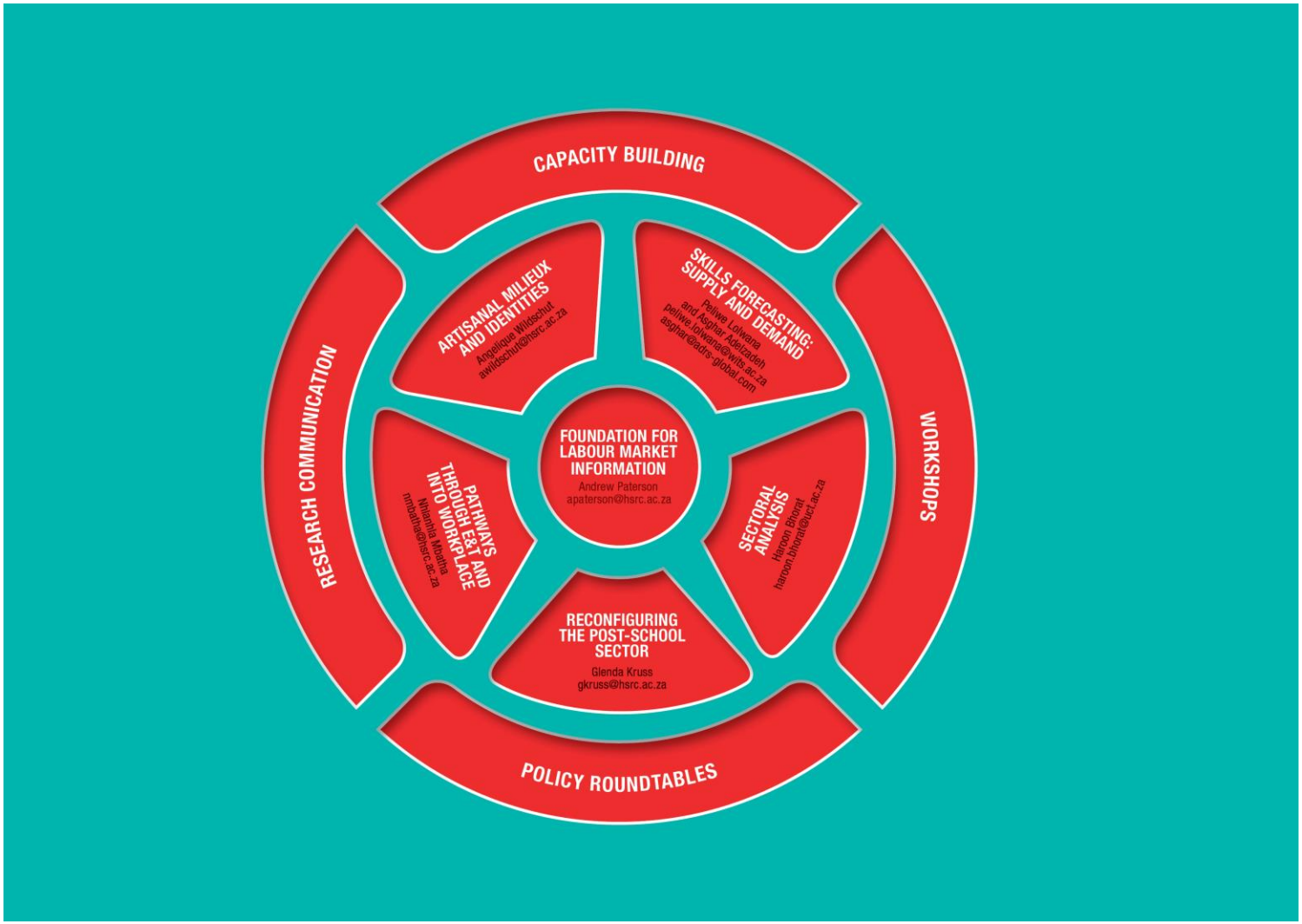
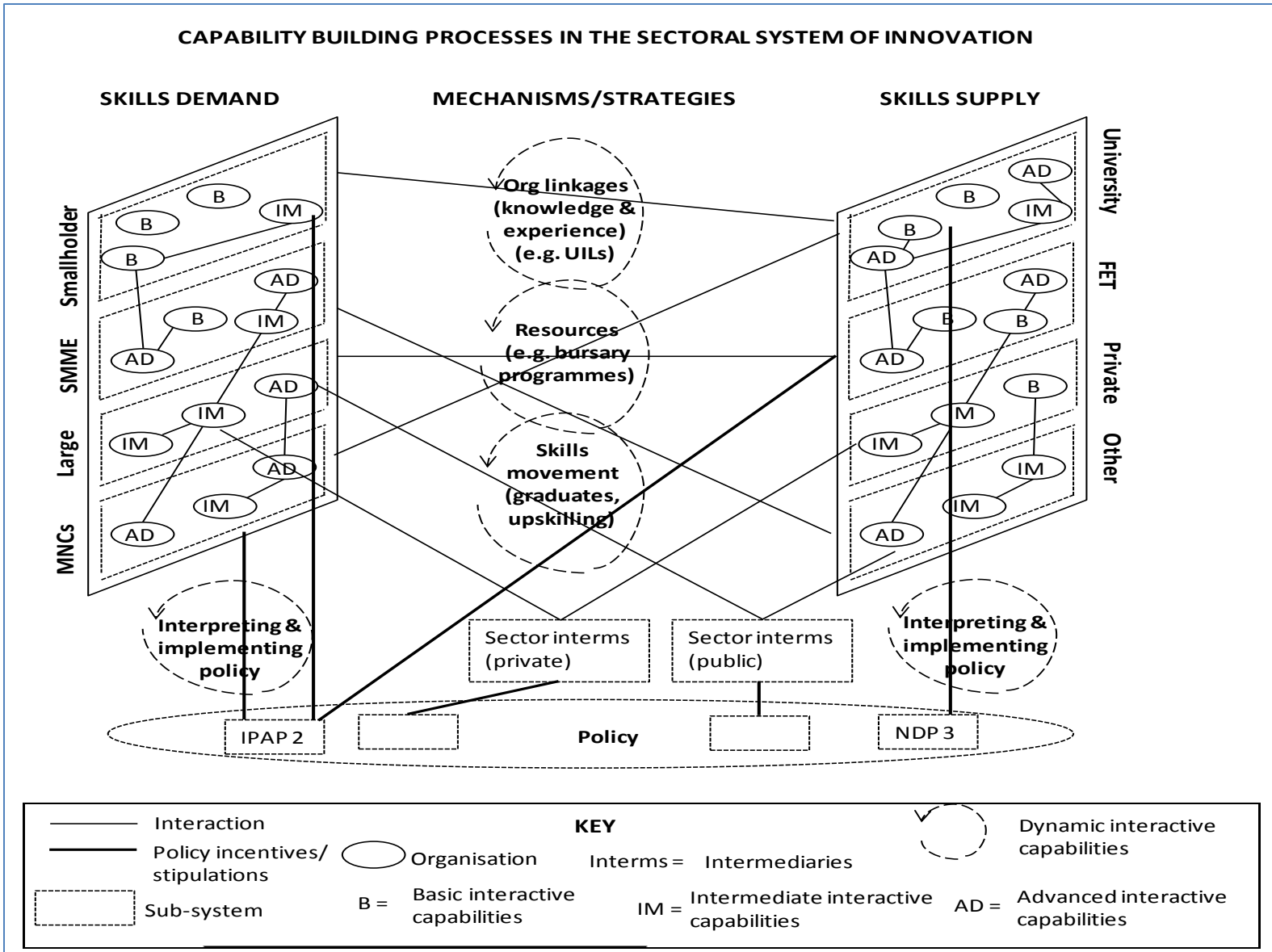
The Labour Market Intelligence Research Partnership



Working framework



Methodology

- Sector background research
- Interviews and questionnaires with senior management/scientists/engineers from:
  - SKA/MeerKAT
  - Three firms in the SKA's innovation network
  - Seven universities
  - Eight intermediaries
  - One science facility
  - One FET college

Growth in astronomy - but a shortage of astronomers

Institution	2005	2010
UCT	10	29
SAAO	15	25
UWC	0	8
UNW	6	7
HartRAO	5	7
KAT	0	6
UKZN	7	6
Wits	3	4
UJ	2	3
UFS	2	2
UNISA	3	1
Rhodes	3	1
Stellenbosch	0	1
UniZul	1	1
TOTAL	58	100

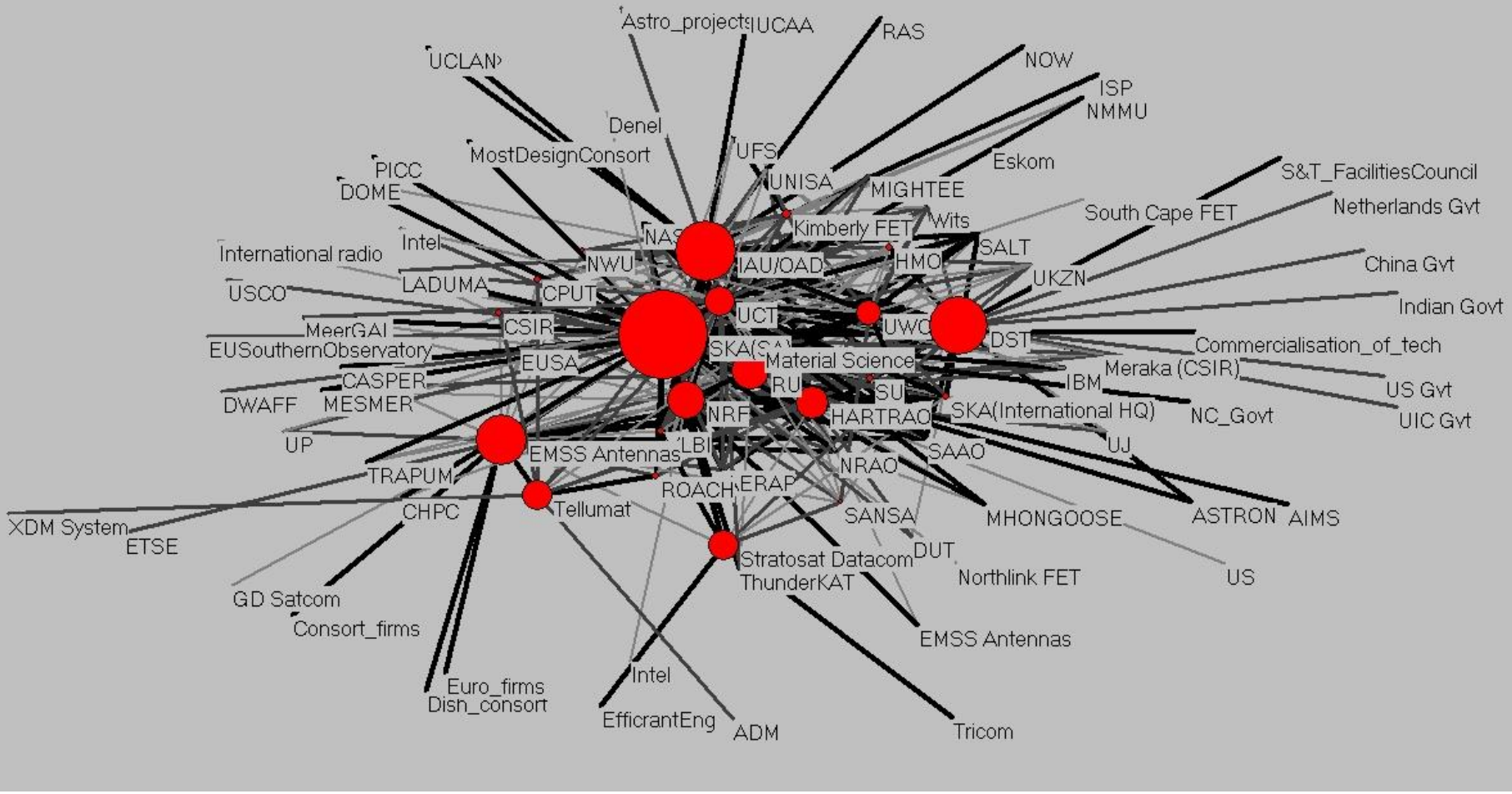
70% of South Africa's optical astronomers are foreign (SAAO)

SA Astronomy positions are advertised on the AAS (American Astronomical Society) web page, which acts as a global portal.

SKA is driving growth in demand. E.g: Bharuth-Ram estimates an additional 60 PhD astronomers required to fully utilise MeerKAT

2005 date: Paterson, A., Kruss, G., and Wildschut, A. 2005. *Support for Astronomy and the SKA facility.* Report commissioned by the SKA Bid Committee.
2010 data: Bharuth-Ram, K. 2011. *A decadal strategy for human capacity development in astronomy and astrophysics in South Africa*. National Research Foundation.

Network structure and alignment



Interactive capabilities at the SKA

- Human Capital Development Programme
  - Strategic role
  - Outputs
  - Managing change
  - Management of skills and learning

- Interactions with: Intermediaries, universities, firms…

I think it is brilliant how they have done it. It's an essential component of the SKA and I think it has won them the SKA bid - for the world to see that it's not just about building hardware, but it's building a community, building a community with broad skills - not just the astronomers, but the engineers, the computer skills, etc. So, I think it was essential and it was a very clever part of the SKA project to incorporate that from the beginning.

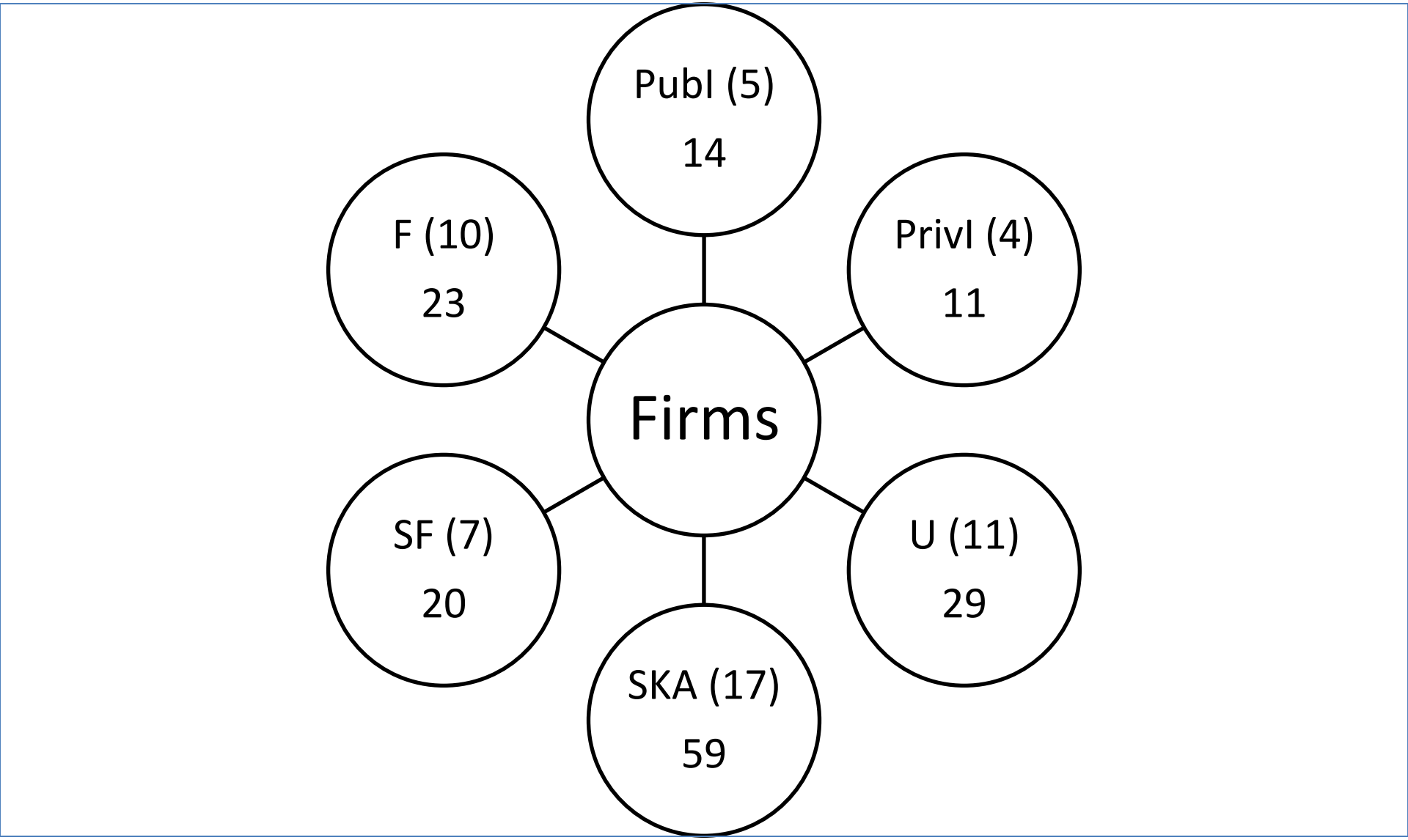
(interview: university astronomer)

Firm strategies to address skills needs

- Firms use an array of tactics to connect with niche areas within the higher education system, thereby meeting their skills and knowledge requirements.
- Smaller firms rely more on informal networks to gather intelligence on skills supply, and to connect with pockets of excellence where they may recruit the required individuals.
- Larger firms rely more on formal mechanisms and market structures, such as graduate recruitment programmes.
- However, overall, network structures predominate over markets structures for addressing firms' skills needs.

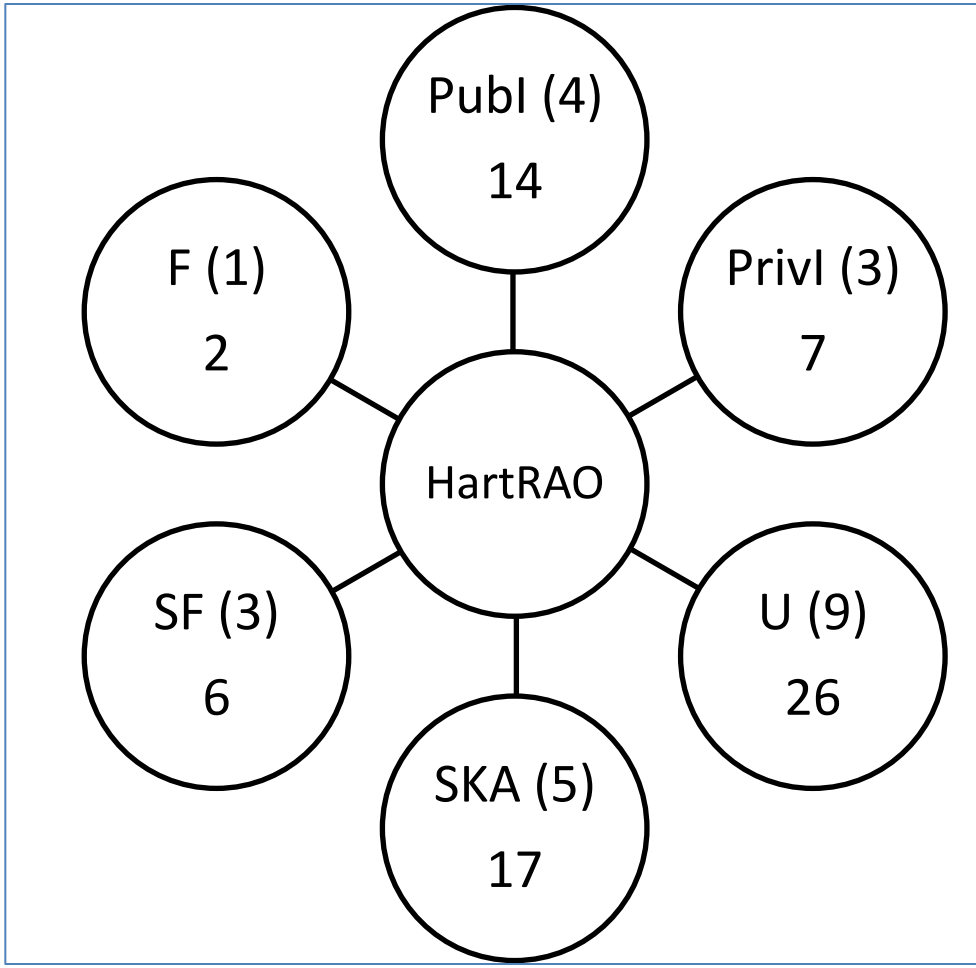
"It's very small. We know all the lecturers in Stellenbosch, we're even part of the [SKA conference] for bursars and all the bursars that they put through in the astronomy field, and we go there, we look around, we present to them, we listen, we buy them beer… and find the good students and we okay them. So I would say a steady supply of two or three that might be interested and we don't have a vacancy, we just told them to "keep at it. Call us in a month, if you don't come right". (Interview: MD of SKA partner firm)

Firms' network characteristics



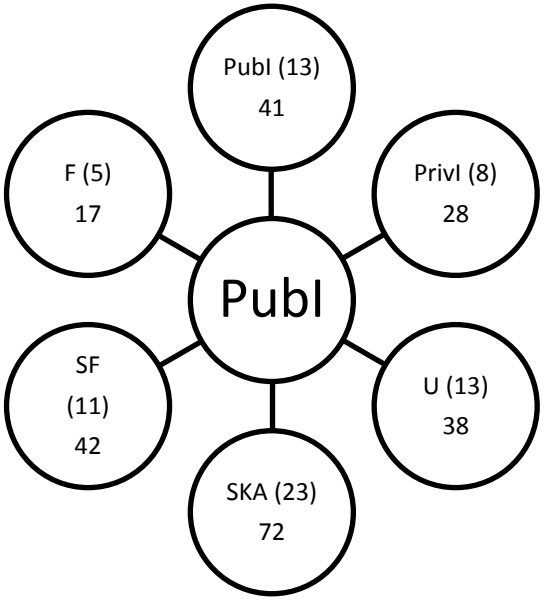
The role of science facilities

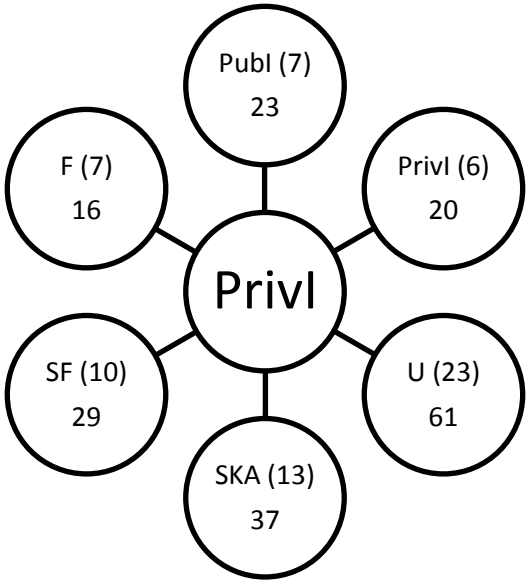
- SAAO/Optical
- HartRAO:
  - VLBI/Ghana (training)
  - NASSP (postgrad work)
  - MeerKAT (training)
  - DUT (work exp.)
  - SKA (bid)
  - SKA (tech development)
  - Constraint: funding



The roles of intermediaries

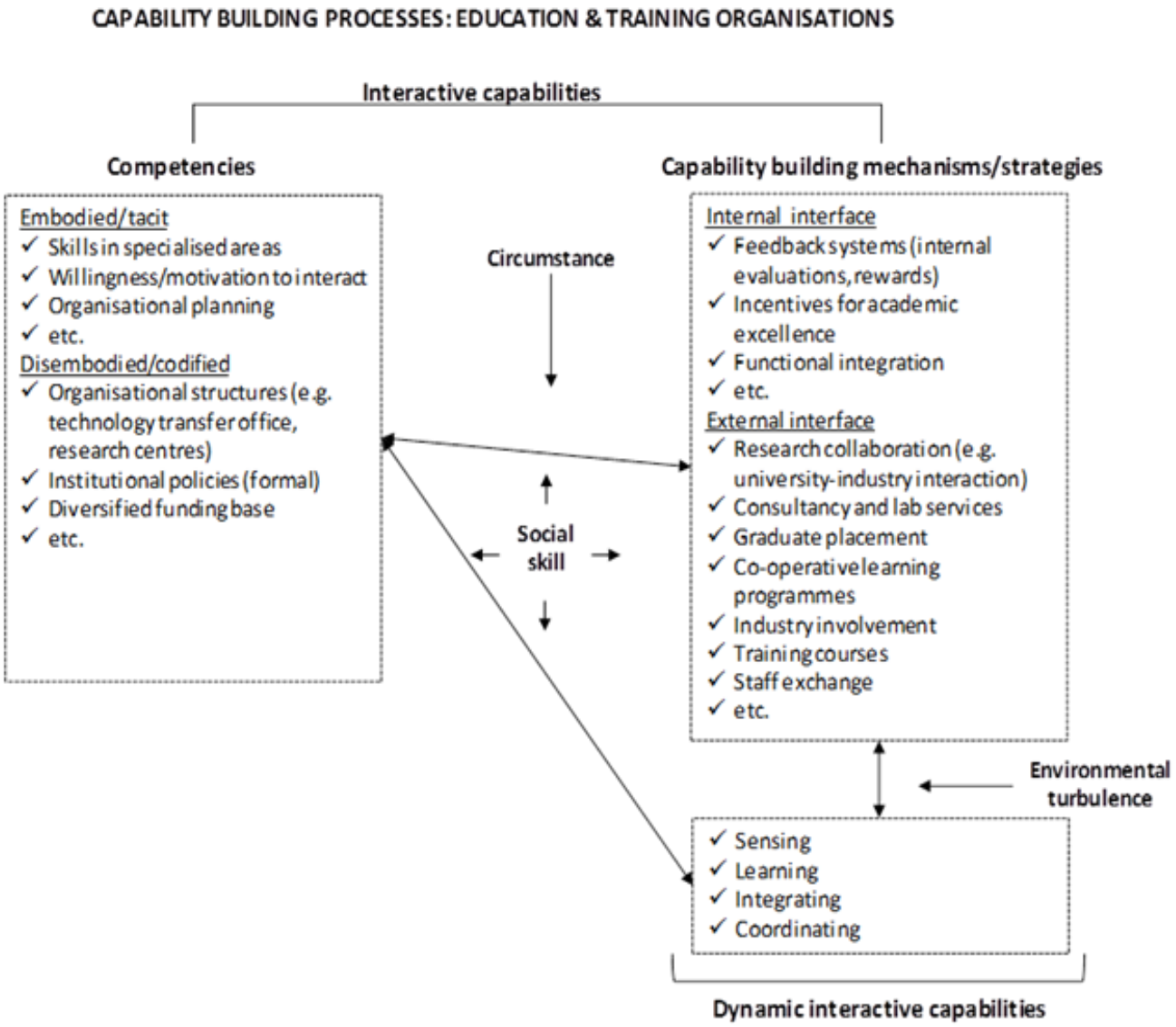
Intermediary function	Public intermediaries	Private intermediaries	Intermediary functions of other actors
Funding and resources	DST, NRF, AERAP		SKA
Strategic direction	DST		SKA
Skills planning	DHET		SKA, NASSP, universities
Network building	AERAP, NRAO, DST	IAU/OAD	SKA, NASSP, universities, firms, science facilities
Knowledge transfer and diffusion	AERAP, NRAO	IAU/OAD	SKA, universities, firms, science facilities





The roles of universities in building network alignment and interaction

Sample:
UCT
Rhodes
Stellenbosch
UWC
UKZN
Wits
DUT



Interactive structures, mechanisms, capabilities	
Outside the university	SKA HCDP + Universities Working Group Sector conferences/networking options **Astronomy**: NASSP + NASSP curriculum workshop **Engineering**: ECSA
Institutional level	*Weak/indirect relevance*: institutional planning, professional support and development, transference into the workplace
Faculty/ Departmental level	Highly responsive teaching and learning + research and innovation Research and innovation networks + Collaborative research (incl SKA) **Engineering faculties:** Advisory boards, 5-year review, Academic time allocations for working with industry, Contract R&D for industry, Funding for equipment, Close engagement with the engineering professional body (supports time for industry activity + sets curricula), Invited speakers from firms, alumni networks…
Individuals	NB: personal relationships and networks Relationships and resource mobilisation underpinned by strong tacit interactive capabilities and informal mechanisms

The importance of academic time off to work in industry:

"In 2002, because of my work in [confidentiality constraint], I found that many companies in south Africa were coming to me both for educational training requests and also for specific jobs. What I found was that I couldn't handle it as an Academic. It was too onerous, as people have to meet deadlines in industry. So what I did then was I carved out a day a week with the Engineering Faculty with university's support, as many of my colleagues have. I worked on it professionally, and then I got a couple of my post-doctoral students involved, and in fact now my company has got two former SKA post-doc students who now are associates in the company".

(academic interview – Stellenbosch)

The importance of informal networks and tacit interactive capabilities:

"We collaborate with other scientists, but we don't really have formal agreements, as such, but we tend to work with people who we meet at a conference, or ... someone's interested in your research, you work with that person…. We discuss curriculum changes fairly often. For example, if there's something urgent John just phones me, he says, look, Carlo Francesco came back from this SKA meeting, we found this is where we see the SKA going, can we have a chat with you, you're the expert in this field, and then we went for the meeting, and then he said, okay, we've identified this as something, let's accept this one. "

(academic interview – Wits)

Kimberley FET College

- Efforts by the SKA to engage have been only partially effective due to limited competences and interactive capabilities. Like other colleges, Kimberley FET college is challenged by under-qualified staff and limited internal and external interface structures (except for employing people from industry).
- Dynamic interactive capabilities are stretched as the college responds to changes in technology, changes in curricula, and changes in government oversight. Environmental scanning and feedback from employers are limited and informal.
- FET engaged with the SKA to discuss skills requirements - were seeking to formalise these requirements into an accredited course for radio astronomy technicians.
- Evidence for a broader engagement, seeking to identify the causes of poor performance and low outputs, and thus look for ways to improve, is lacking. FET management blamed poor performance on the actions of the SKA, citing poor student selection as the main cause.
- Full analysis of College policies and strategies is not possible as the Principal refused access.
- FET colleges thus an area where the SKA can effect considerable improvement in its network – maybe working to build FET interactive capabilties

Concluding thoughts

What can the DHET and DST learn from this research?

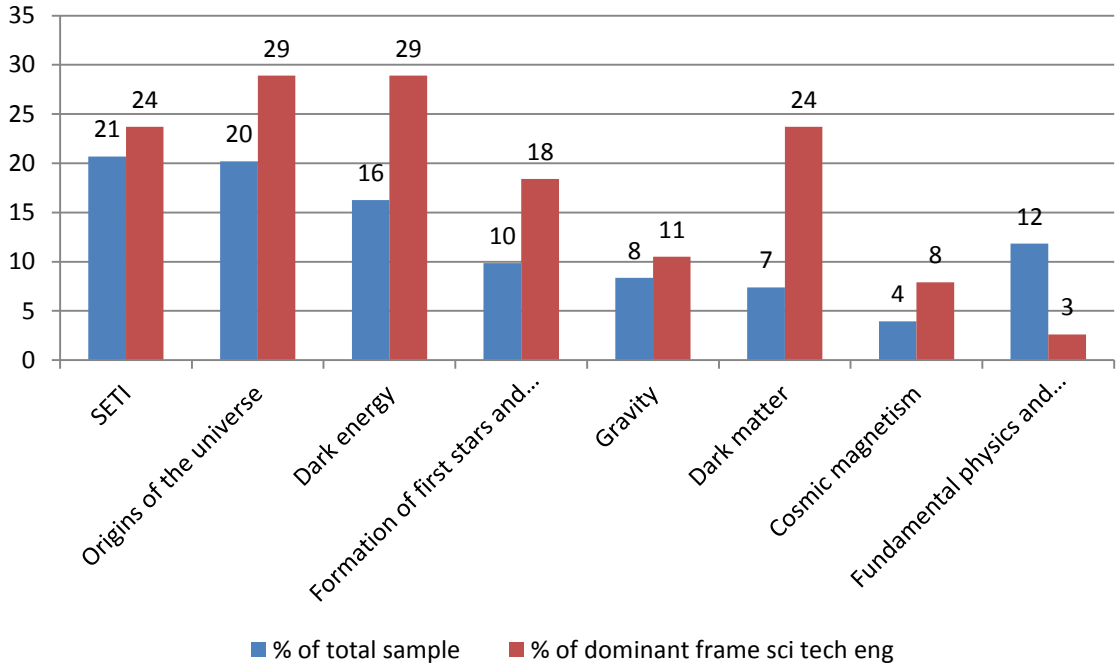
What can the SKA learn from this research?

- Partnerships and interactions do not happen by themselves – they need active management
- Both formal and informal channels are important to systemic alignment
- The HCDP is (reportedly) a strategic and operational success. Highlights that intensive engagement and skills planning/management are core to SKA project
- Skills and knowledge *networks* and more important than skills and knowledge *markets*.
- The SKA is a showcase of South African capabilities and thus a science policy and skills policy benchmark
- FET colleges are a weak spot in the SKA's innovation system

Forthcoming research 1

Representations of the SKA in the media. Content analysis of 274 news media articles and 1588 Twitter posts in 2011/12, including:

- Publication
- Changes in coverage
- Tone
- Sources of information
- Science research questions
- Technological aspects
- Precursor instruments
- The SKA as an organisation



- Funding , policy ,governance, political support
- The SKA as a symbol of globalised science in an African context
- Issues of conflict and controversy, including the site allocation process, the question of fracking, and the project's development context.

Forthcoming research 2

Public attitudes towards the SKA and astronomy. Nationally representative sample (n=3500) through household surveys. Allows complex demographic analysis and multivariate analysis.

Questions include:

- Attitudes towards astronomy
- Sources of information about astronomy
- Knowledge about the SKA
- Attitudes towards the SKA

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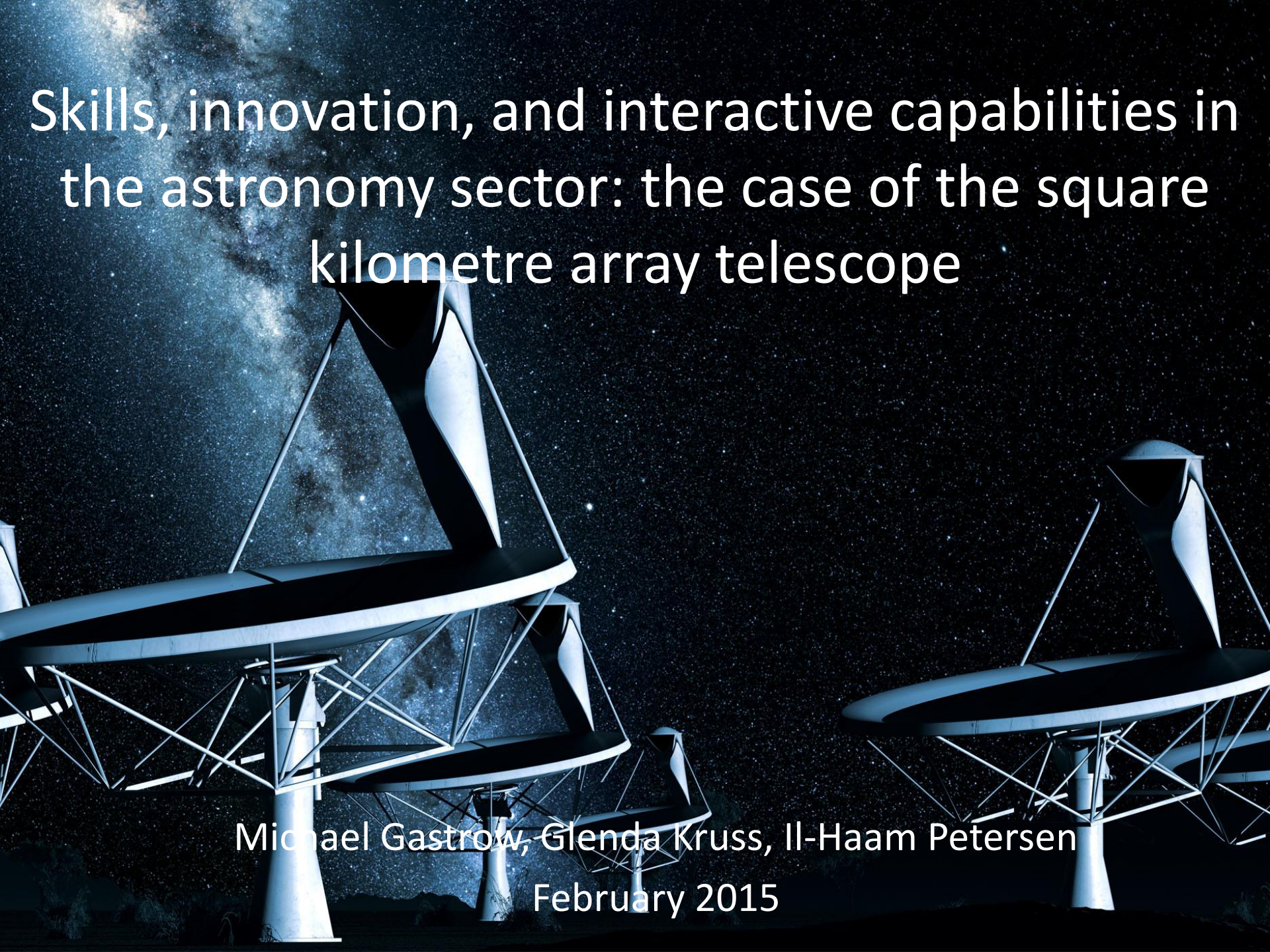

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