

Evolving Digital Research Infrastructure Ecosystems: A Metascience Perspective

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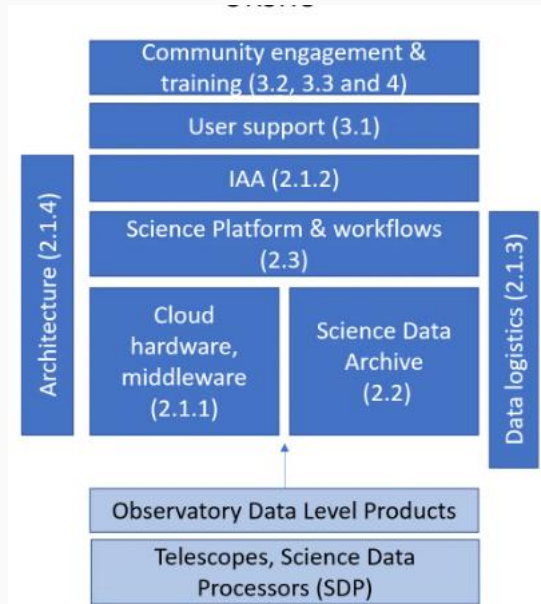
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How do we maximise the impact of digital research infrastructure?



Impact is created by an ecosystem, not a stack

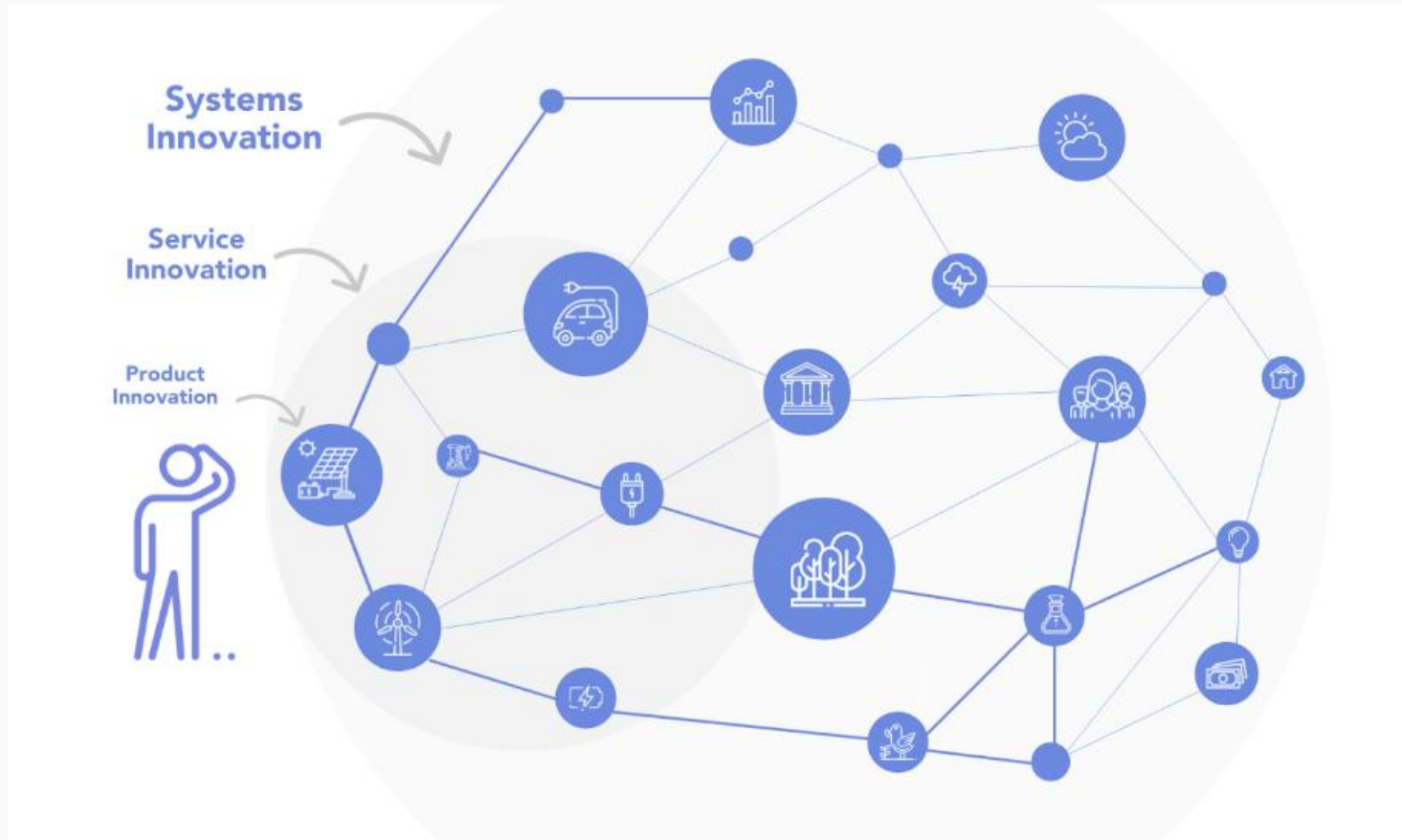


The stack shows the components



Ecosystem in context

From infrastructure thinking to systems thinking



Technology

Hardware, software, data, and architecture

Services

Access, support, workflows, and platforms

People

Researchers, technical professionals, and communities

Environment

Institutions, governance, funding, and incentives

We need systems that can learn under uncertainty

Technology is changing

New hardware, architectures, facilities, and energy constraints

Communities are changing

Cross-disciplinary research, new users, and evolving professions

Delivery models are changing

Federation, funding models, and long infrastructure lifetimes

We can't eliminate uncertainty.

But we can build a system that can absorb and learn from it.

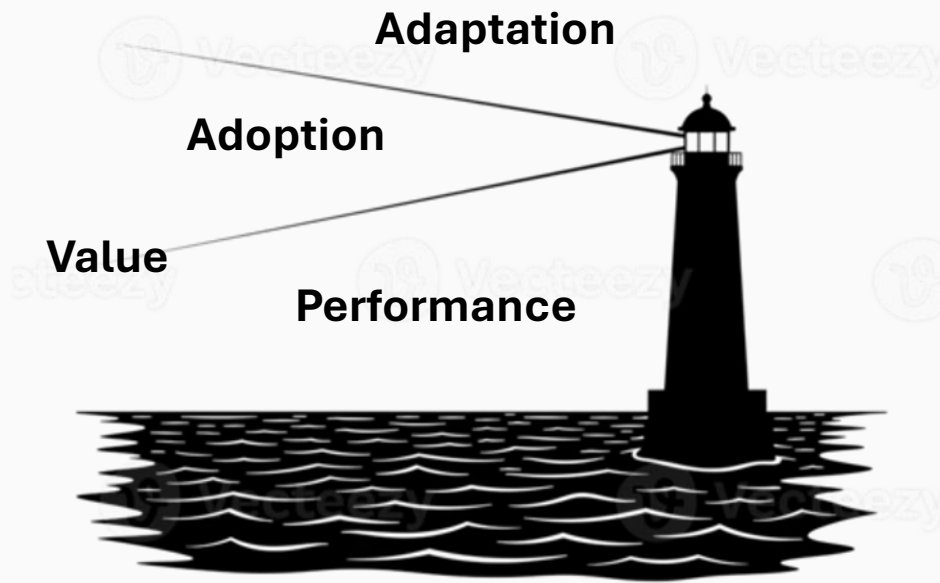
Why now?

Metascience helps us understand and improve research systems

Applying scientific methods to understand and improve how research systems operate.

Metascience can help us understand:

- how DRI facilities, services, skills and capabilities are co-designed, developed and delivered;
- how their research and socio-economic impact can be maximised;
- how they contribute to institutional, national and strategy priorities.



Metascience for digital research infrastructure is emerging

Measuring research data reuse in scholarly publications using generative artificial intelligence: Open Science Indicator development and preliminary results

Lauren Cadwallader, Iain Hrynaszkiewicz, parth sarin, Tim Vines

RESEARCH ARTICLE | MAY 12 2026

Professional work in an era of FAIR data sharing: vulnerabilities, negotiations and sacrifice ✓

Allison Littlejohn ✉; Francisco Durán del Fierro; Eileen Kennedy; Louise Chisholm

✚ Author & Article Information

Journal of Workplace Learning (2026) 38 (6): 529–545.

Article | [Open access](#) | Published: 29 February 2024

Does large-scale research infrastructure affect regional knowledge innovation, and how? A case study of the National Supercomputing Center in China

[Haodong Yang](#), [Li Liu](#) ✉ & [Gaofeng Wang](#) ✉

[Humanities and Social Sciences Communications](#) 11, Article number: 338 (2024) | [Cite this article](#)

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Distributed Peer Review at ALMA: An Empirical Comparison with Panel-Based Review

John M. Carpenter and Andrea Corvillón

Published 2026 July 8 • © 2026. The Author(s). Published by IOP Publishing Ltd on behalf of the Astronomical Society of the Pacific (ASP).

[Publications of the Astronomical Society of the Pacific](#), Volume 138, Number 7

Citation John M. Carpenter and Andrea Corvillón 2026 *PASP* 138 074504

arXiv:2509.13436v2 [cs.SE] 10 Oct 2025

Is Research Software Science a Metascience?

Evan Eisinger

Michael A. Heroux

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The entrepreneurial university and development of large-scale research infrastructure: exploring the emerging university function of collaboration and leadership

[Open access](#) | Published: 20 September 2023

Volume 49, pages 334–366 (2024) | [Cite this article](#)

ukSRC as a testbed for DRI innovation



Why ukSRC is a useful testbed

- Its mission is to maximise value from the UK's investment in SKAO
- It is developing DRI within the globally federated SRCNet & UK DRI landscape
- It supports research infrastructure intended to operate for decades
- Services, capabilities, and communities are still evolving
- It offers opportunities to test, learn, and adapt during development

SKAO

SRC | Net

SKAO Regional Centre Network

uk | SRC

SKAO Regional Centre United Kingdom

Generate evidence about what helps digital research infrastructure ecosystems succeed.

UCL

UK SKA Regional Centre

A facility for the UK radio astronomy community:
Enabling UK science community to lead the exploitation of SKA data
Maximising the UK's return on the UK's SKAO investment.

Support and enable the UK radio astronomy research by providing a UK Digital Research Infrastructure, science support, and training ecosystem

And

Ensure the SRCNet* is delivered with the necessary capabilities and capacity to support SKAO science.

The UK pledges of the resources needed for the SRCNet globally (UK international pledge is ~15%).

*The SRCNet is the sole route to access SKAO science data. It is a critical part of the SKA delivery
Critical path to delivery of any SKAO science.

ukSRC: a facility that delivers services to UK researchers

...essential added value for the UK. Key services beyond SRCNet.

Common/global Science support (MVP)

Globally federated services

Global SRCNet partnership

ukSRC

...essential national infrastructure needed for ukSRC (& SRCNet)...

Maximising UK Science delivery
Science support – UK;
RD&I – continuous development;
Community development, training etc

UK federated & distributed
UK-based infrastructure & services
(storage, compute)

UK SKAO community

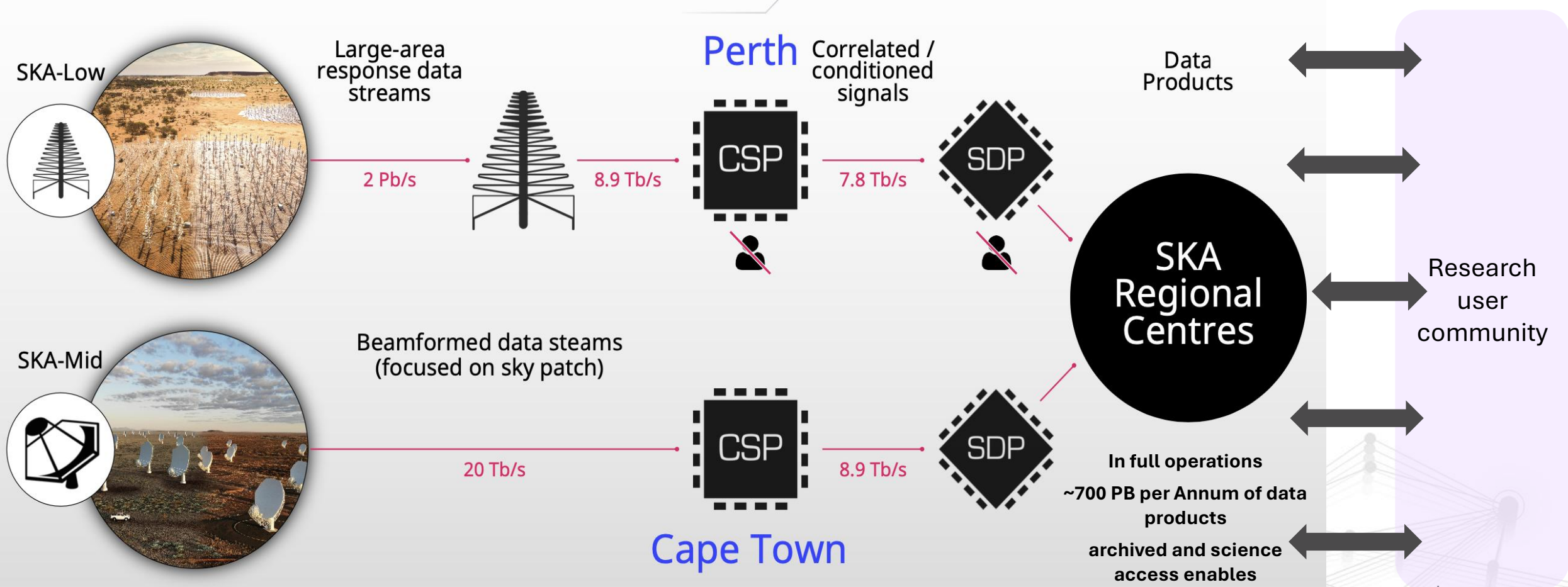
- Future SKAO users
- Pathfinder users
- Precursors users

Deliver services for SKAO + existing / future Radio astronomy facilities

Science service (data storage, compute, science support) for UK radio astronomy and testbed for SRC development :
...e-MERLIN to LOFAR2.0, MeerKAT, HERA, ..etc. and SKAO....

From telescope to user – critical role of the SRCNet

Exabyte-scale data challenge - federated global solution.



Data rates/volumes are subject to change as the systems and projects are refined

uk | SRC

SRCs are outside of SKAO construction costbook

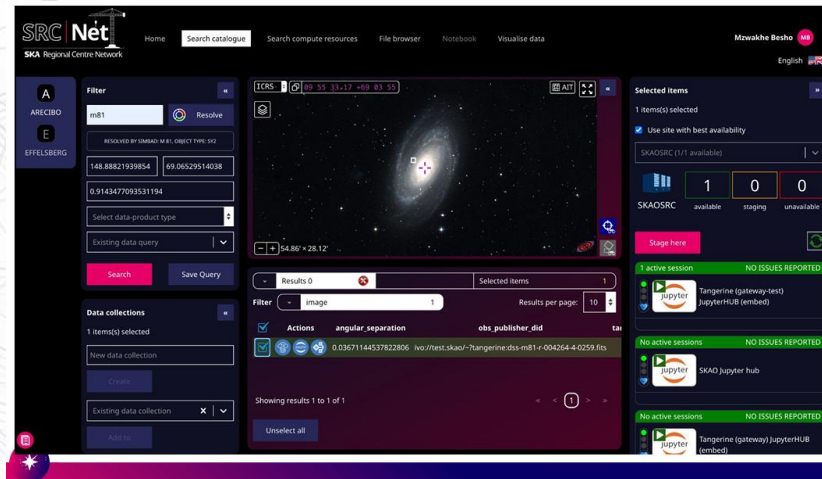
Case Study 1: New infrastructure changes research practice

What helps communities transition to new ways of working?

- SKAO data volumes exceed what individual countries can manage alone.
- Researchers will no longer download data to local environments
- New workflows, skills and collaborative practices will be required Analysis will only be possible via the science gateway



SRCNet Science Gateway
(Credit: Chris Skipper, ukSRC)



uk | SRC

How can we support the transition to new ways of working?

Research Questions

- How are SKA transforming how we work?
- What are the hidden challenges?
- How can we overcome these?



Science
Operations
Support

uSRC Early
Access
Schemes

Challenge	Captured
Professional Identity	I don't feel I'm doing the work of an astronomer.
Academic Creativity	As areas of work are automated I feel I have less freedom.
Trust erosion	As I work indirectly with people/ systems I am not building trusted relationships.
Difficulty evidencing contributions	As I work in bigger networks, I find it difficult to show my contributions. This is a problem especially for early career colleagues.
Communication problems	As I work with a wider group of people outside my discipline who don't understand my work.
Access to infrastructure	Not everyone has equal access.

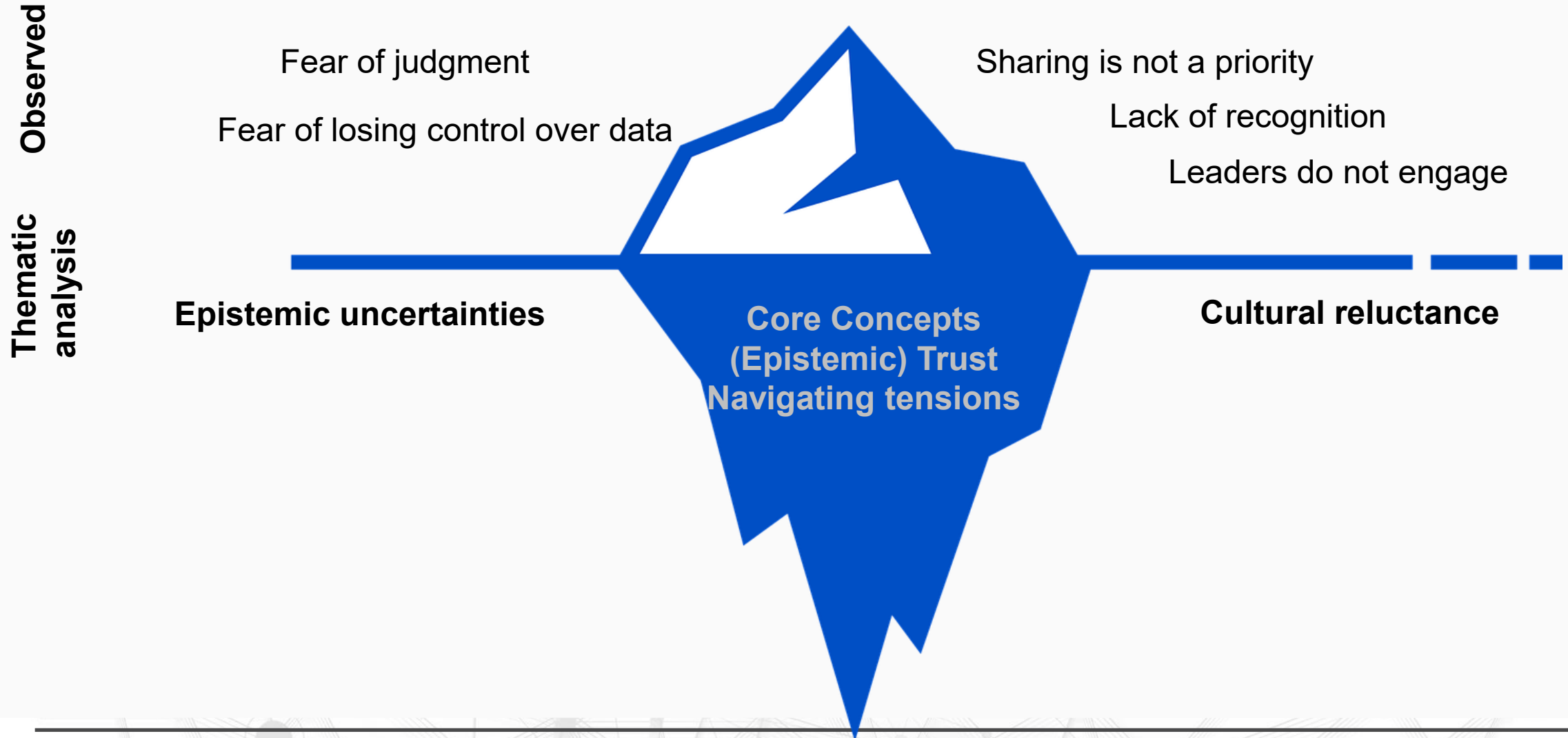
Case Study 2: Increasing the reuse of data

→ *How can we create conditions for data sharing?*

Implementing FAIR data principles involves more than technology and metadata. It also depends on:

- Professional practices and community norms
 - Trust, incentives and recognition
 - Professional identity and researcher agency
 - How people respond to changes in their working environment
-
- What are the social and cultural barriers to data sharing across UKRI DRI investments

Ethnography research led to a new conceptual framework that enables reframing of social and cultural barriers to data sharing



Create the conditions for sustainable data sharing

- **Enabling and empowering individuals**
Recognise the time, effort and contributions involved.
- **Harnessing data across disciplines and traditional boundaries**
Create spaces where communities can navigate uncertainty and conflicting values.
- **Maximising value through the lifecycle of DRIs**
Align incentives and recognise diverse knowledge and contributions, increasing epistemic diversity

Culture changes when people have agency, recognition and trusted spaces in which to learn.

Generalized Framework: creating and implementing novel professional development approaches



Case Study 3: The value of benchmarking lies in the decisions it informs

INVEST

Inform procurement and infrastructure choices in ukSRC & SRCNet

ADVISE

Guide researchers towards appropriate hardware and resources across SRCNet

ADAPT

Track performance as services and workloads evolve

Extended the ReFrame/ExCALIBUR framework

- Continuous benchmarking
- Integrating across ukSRC infrastructure
- Publish to confluence

Three cases, one learning system

Metascience helps us understand and improve research systems

ADOPTION

New ways of doing science

How communities transition to changing infrastructure and research practices

VALUE

Cultures of data sharing

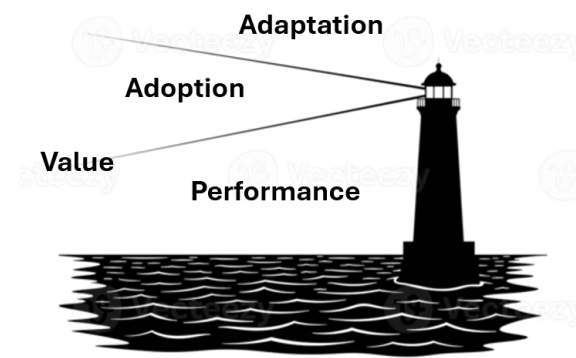
How trust, incentives, identity, and recognition affect reuse

PERFORMANCE & ADAPTATION

Continuous benchmarking

How performance evidence improves infrastructure and investment choices

Together, the cases connect people, practices, and technology to better decisions.



Build the infrastructure, and build its capacity to learn

Metascience helps us understand and improve research systems

- Learn from communities as research practices change
- Learn from evidence as services and technologies develop
- Share learning across organisational and national boundaries
- Use that learning to improve decisions as the ecosystem evolves

**Contributes to maximising the return on investment
in digital research infrastructure and SKAO**

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