We acknowledge the Traditional Owners of the land on which our research infrastructure and community operate across the Australian continent, and pay our respects to Elders past and present.

We recognise the connection they have with land, sea, sky and waterways for tens of thousands of years.

Developing a Research Data Strategy in a Complex System

Rebecca Farrington (AuScope)
Tim Rawling (AuScope)
Jens Klump (CSIRO)
Lesley Wyborn (ANU, ARDC)
Paul Gruba (University of Melbourne)

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Overview

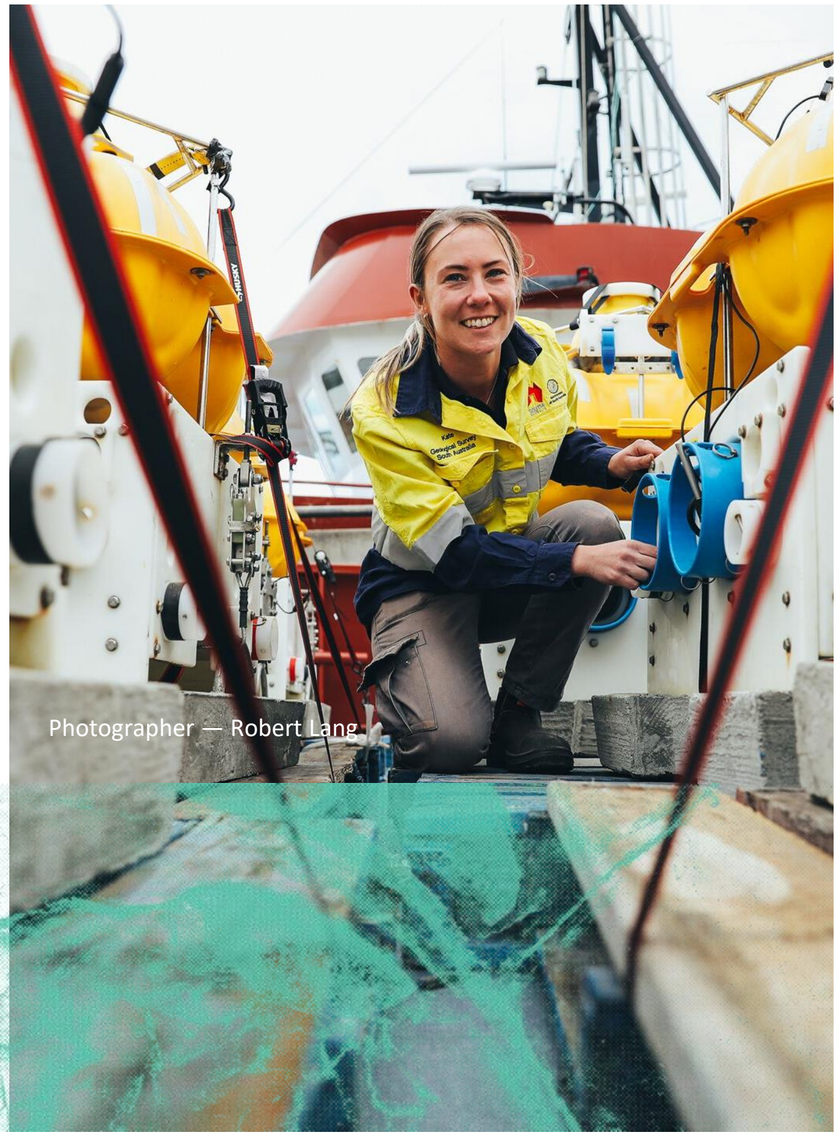
— What is AuScope?

— Tools used to scope, define and progress

AuScope’s Research Data Systems

— Research Data Systems Claims

— Example: FAIR data principles



Australia's Integrated Geoscience Research Infrastructure

Earth Modelling Software

Data Delivery Platforms

Research Infrastructure Experts

Board & Management

FAIR Data

Drones, Data & Software

Collaborators

Earth Imaging & Monitoring Equipment *(Ocean Floor)*

Mobile Analytical Laboratory

High Precision Analytical Laboratories

Drill Core Analysis

Education & Outreach

Positioning Telescopes

Earth Imaging & Monitoring Equipment

Geohazards *(Earthquake)*

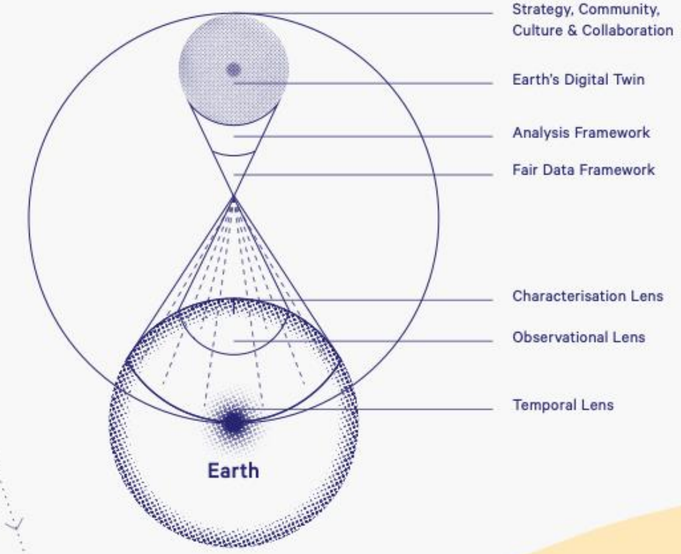
Mineral Resource

Mineral Resource

Groundwater Resource

Energy Resource

Downward-Looking Telescope



Key AuScope Locations & Sustainable Development Goals (SDGs)

- SDG 6 — Clean Water & Sanitation
- SDG 7 — Affordable & Clean Energy
- SDG 8 — Decent Work & Economic Growth
- SDG 13 — Climate Action
- SDG 9 — Industry, Innovation & Infrastructure
- SDG 15 — Life on Land

AuScope | NCRIS National Research Infrastructure for Australia

AuScope acknowledges Aboriginal and Torres Strait Islander people as Traditional Custodians and the first geoscientists of the Australian continent where our scientific community and infrastructure are located. We pay our respects to their Elders past and present. | | Note: This schematic is not to scale.

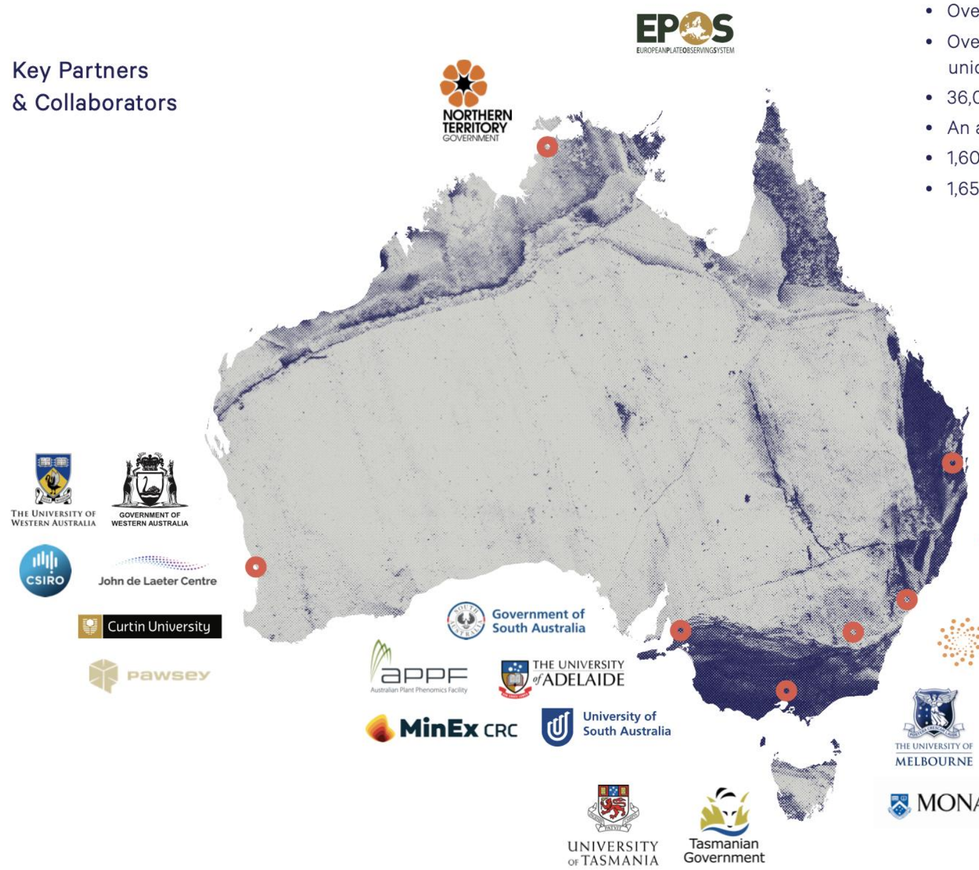
auscope.org.au

A framework for evaluation

- Stepping back…
- How can we progress with complexity?
  - Geographical, Institutional
  - Timescales, Funding source
  - Research domain,
- ‘We stopped ticking boxes years ago’,
  Paul Gruba, Linguist and PCI Academic Convenor, University of Melbourne (2018).
- Tools used to scope, define and progress in complex environments
  - Degrees of complexity
  - Argument-based validity
  - Capability Maturity Model

AuScope | NCRIS National Research Infrastructure for Australia — An Australian Government Initiative

Key Partners & Collaborators



Key Facts

- Total funding ~$113M via NCRIS and ~$23M via EIF (up to 22 FY)
- Total in-kind and cash ~$195M (up to FY20)
- Over 550 unique users in 2020
- Over 173,000 software downloads with 256,000 unique uses per year
- 36,000 secondary school students engaged per year
- An average of 750 academic papers per year
- 1,600,000 total drillcore meters scanned nationally
- 1,652 instrument deployments nationally

Complex, complicated and Simple

- Developmental approach with evaluation based on level of complexity
  - (not based on achievement of end goals, or box-ticking, or descriptive statistics!)
  - evaluation that encourages improvement
  - key stakeholders determine the utility of ongoing work
  - Patton (2011, 2018), Gruba (2016, 2022)

	Level of complexity	Characteristics	Evaluation (+ scope and planning)
AuScope	Complex Initiate	Nonlinear inputs, outputs and timescales	Adherence to principles
Research Data Systems Portfolio	Complicated program	Single output known, many inputs	Strength of claims-based argument validity
Projects	Simple (haha, really?)	inputs \equiv outputs	SMART goals

Complex, complicated and Simple

AuScope principles	AuScope adhere's to the principles of sustainable, collaborative, innovative, inclusive and integrated. See 'AuScope 10-Year Strategy 2020 – 2030' doi: 10.5281/zenodo.7018298
Research Data Systems Portfolio Claims	AuScope's Research Data Systems are guided by three **claims** to scope, prioritise and evaluate the portfolio. AuScope's Research Data Systems are: 1. Designed, developed, and managed to ensure data and data products align with the *FAIR principles* 2. Operated and governed at *international best practices* and *agreed discipline standards* 3. Recognised by external stakeholders through *leadership*, *development* and *collaborative problem-solving*
Projects	Specific, Measurable, Attainable, Relevant, Time Based (SMART) - contracted work packages, field campaigns, instrument acquisition, …

Argument-based validity

How do we (scope, plan and) evaluate the claim that…

AuScope's Research Data Systems are:

Designed, developed, and managed to ensure data and data products align with the *FAIR principles*?

We can present an argued case!

And use a Capability Maturity Model to articulate developmental stage and track progress.

Argument-based validity

How do we (scope, p

AuScope's Research

Designed, developed
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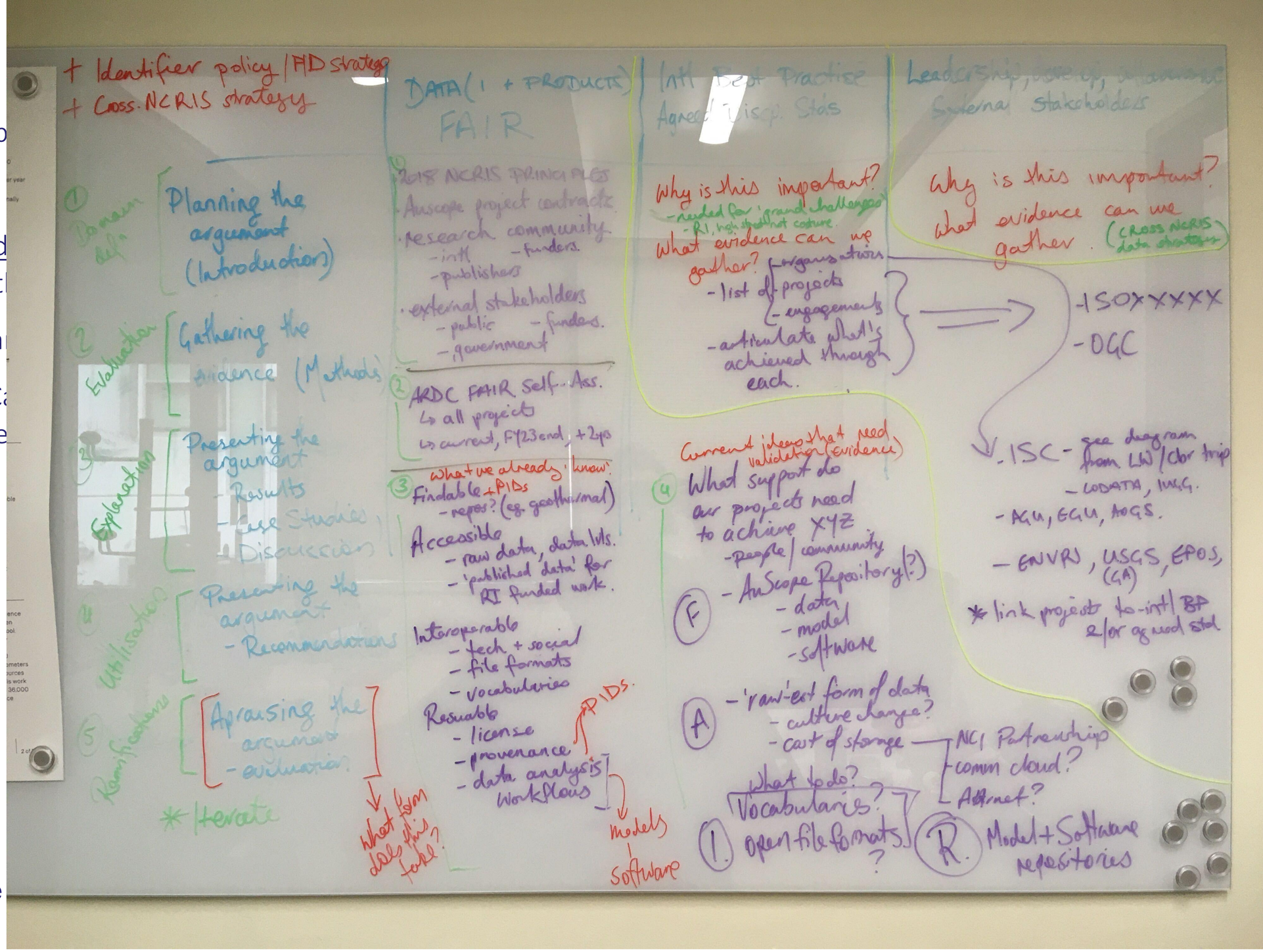
We can then use a C
developmental stage



Argument-based validity

I can develop an argued case that we are 'developing' research data systems that are…

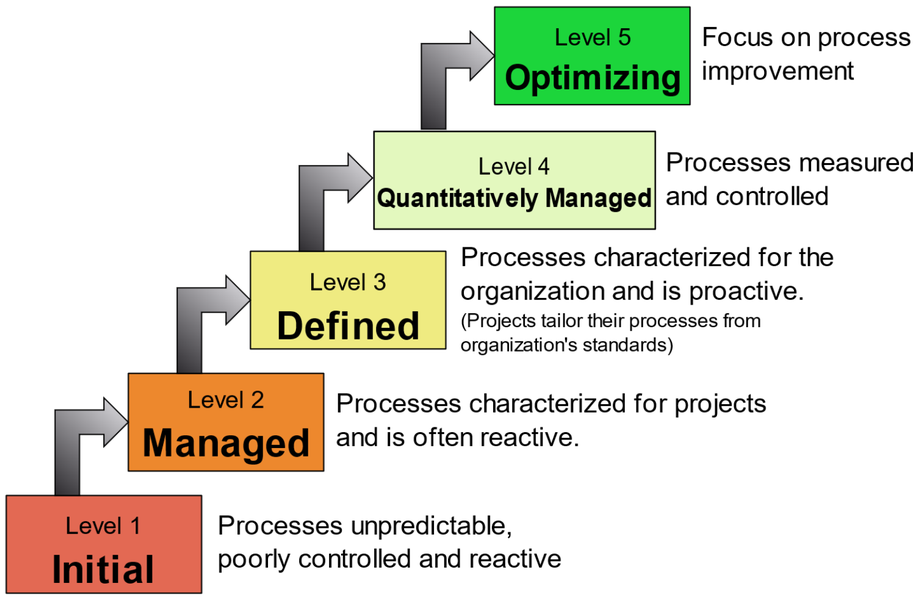
Designed, developed, and managed to ensure data and data products align with the *FAIR principles*?

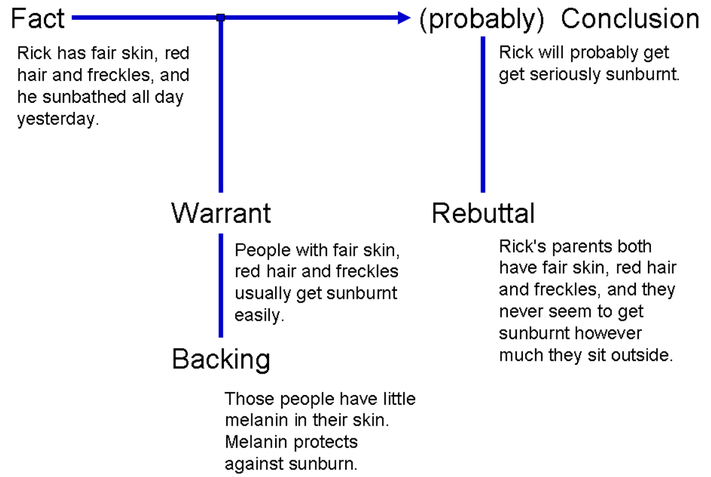
We can present an argued case!

We can then use a Capability Maturity Model to articulate the developmental stage and track progress.

And iterate!

Characteristics of the Maturity levels





Example of graphical representation of argumentation (a rationale model) using the terminology and style of English philosopher Stephen Toulmin (1922-2009)

What's an (interpretive) argued case?

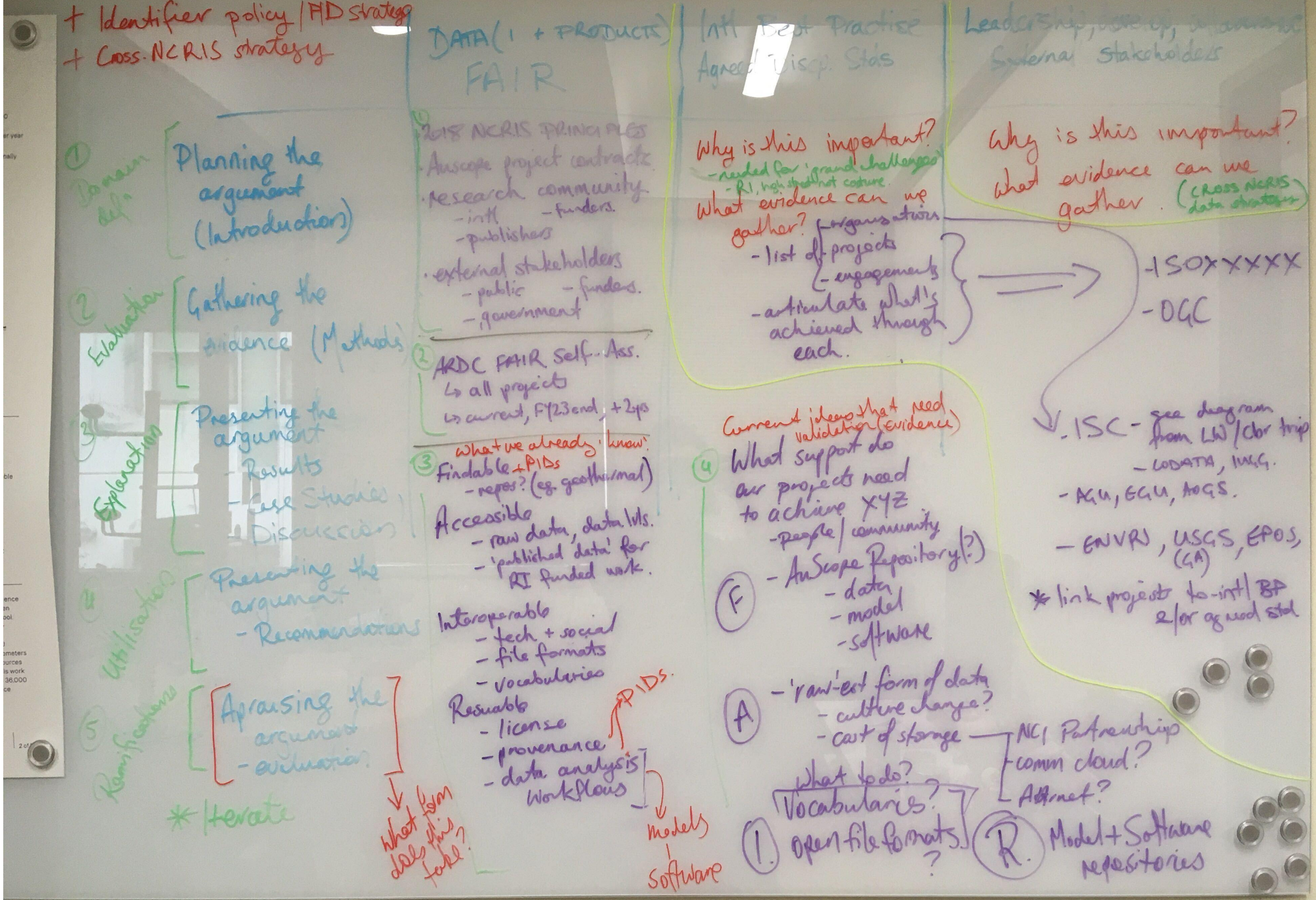
'Interpretive argumentation is a dialogical process in which participants explore and/or resolve interpretations often of a text of any medium containing significant ambiguity in meaning.'

https://en.wikipedia.org/wiki/Argumentation_theory

Argument-based validity

1. Domain definition	*Planning the argument*	Introduction	2018 NCRIS principles, AuScope funding contracts, Research community (intl. activity, funders, publishers), External stakeholders (public, government, social lic.),
2. Evaluation	*Gathering the evidence*	Methods	Ask all projects to complete ARDC FAIR data self-assessment over 4-week period, including current and projected state (FY22 end).
3. Explanation	*Presenting the argument (i)*	Results, case studies, discussion	Collate results (colour map, etc.) Hold discussions and identify trends
4. Utilisation	*Presenting the argument (ii)*	Recommendations	Articulate support needed by projects to achieve target Current and future Capability Maturity Model level Policy and processes to be addresses
5. Ramifications ● ●	*Appraising the argument* ● ●	Evaluation ● ●	Have we presented a strong argument that AuScope currently has a ‘developing’ FAIR data capability? Is a ‘maturing’ capability achievable?

Where are we? Excellent question!



References

Gruba, P. (2022). *Petascale Campus Initiative (PCI) | PCI Evaluation 2018-2022: A basis for future planning*

Patton, M. Q. (2011). Developmental evaluation. The Guilford Press.

Patton, M. Q. (2018). *A historical perspective on the evolution of evaluative thinking*. In A. T. Vo & T. Archibald (Eds.), Evaluative Thinking; New Directions for Evaluation. 158, 11–28. doi: 10.1002/ev.20325

Rawling, T. (2020) *AuScope 10-Year Strategy 2020 – 2030* doi: 10.5281/zenodo.7018298

Turpin, A. & Gruba, P. (2021). *Principles of Melbourne Connect*. doi: 10.31219/osf.io/wfbyq

Paulk, M. C., Curtis, B., Chrissis M. B., Weber, C. V., *Capability maturity model, version 1.1,* in IEEE Software, vol. 10, no. 4, pp. 18-27, July 1993, doi: 10.1109/52.219617.

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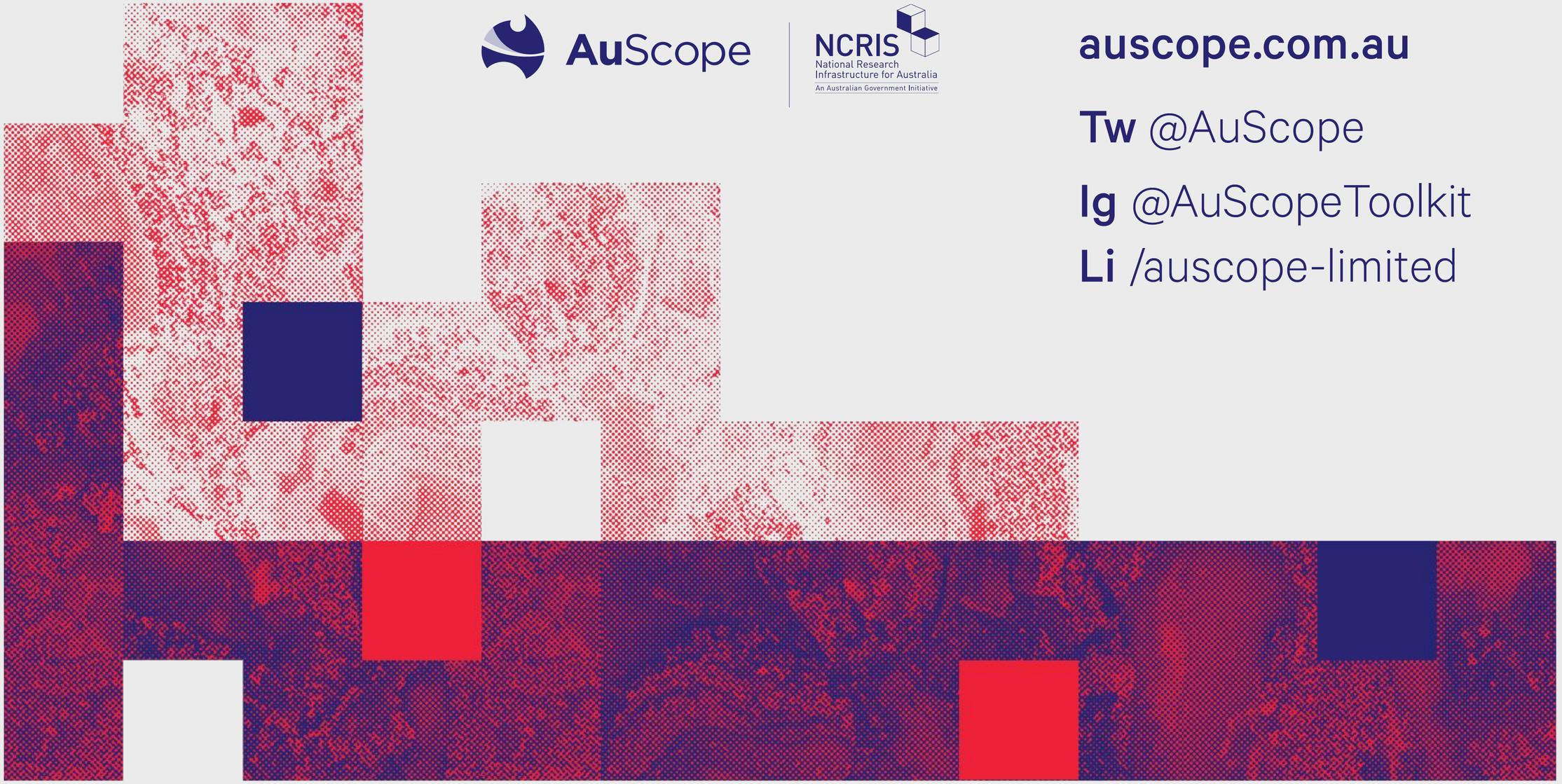

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