Persistent Identifier-Driven Infrastructure for National Research Discovery

Behind the Scenes of Research Link Australia and Research Data Australia

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PRESENTED BY

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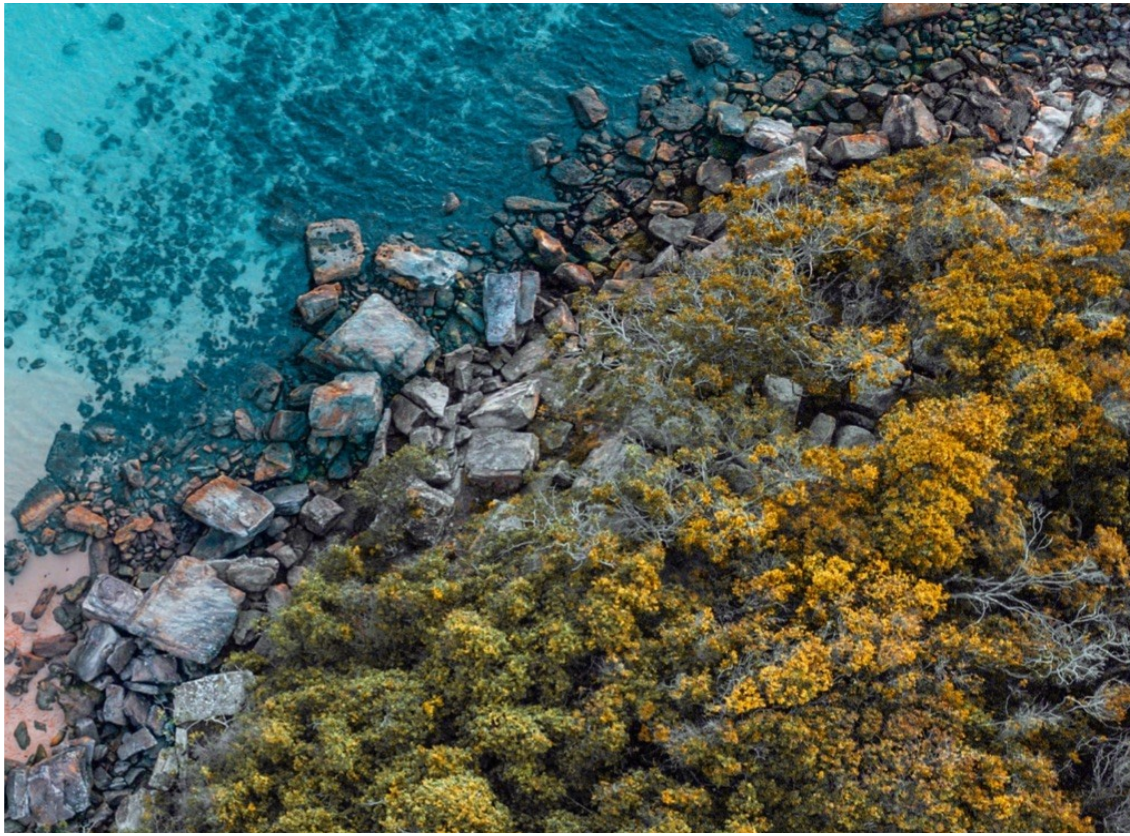
ACKNOWLEDGEMENT OF COUNTRY

We acknowledge and celebrate the First Australians on whose traditional lands we meet, and we pay our respect to their elders past, present and emerging.



Product Overview

Image — Photo by Surface on Unsplash

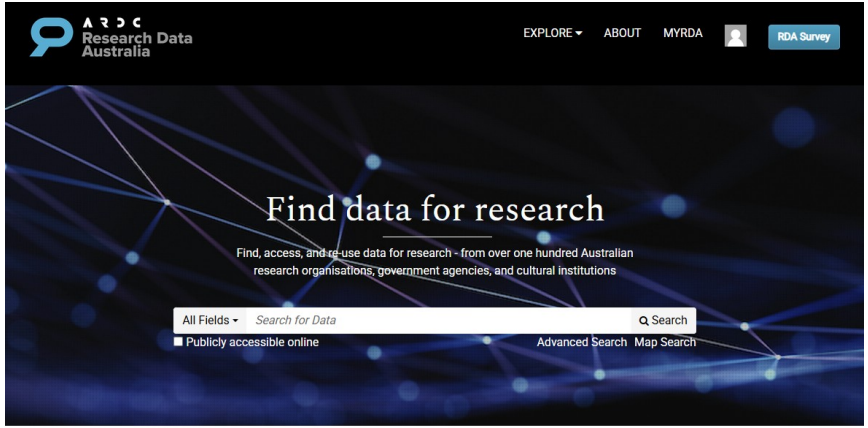
Australian Research Data Commons

What is Research Data Australia?

National Research Data Catalog

An online platform providing metadata and access links to datasets from universities, government agencies, and cultural institutions across the nation.

Over *247,000 data collections* searchable across diverse fields including health, environment, business, and humanities.



2024 - 2025

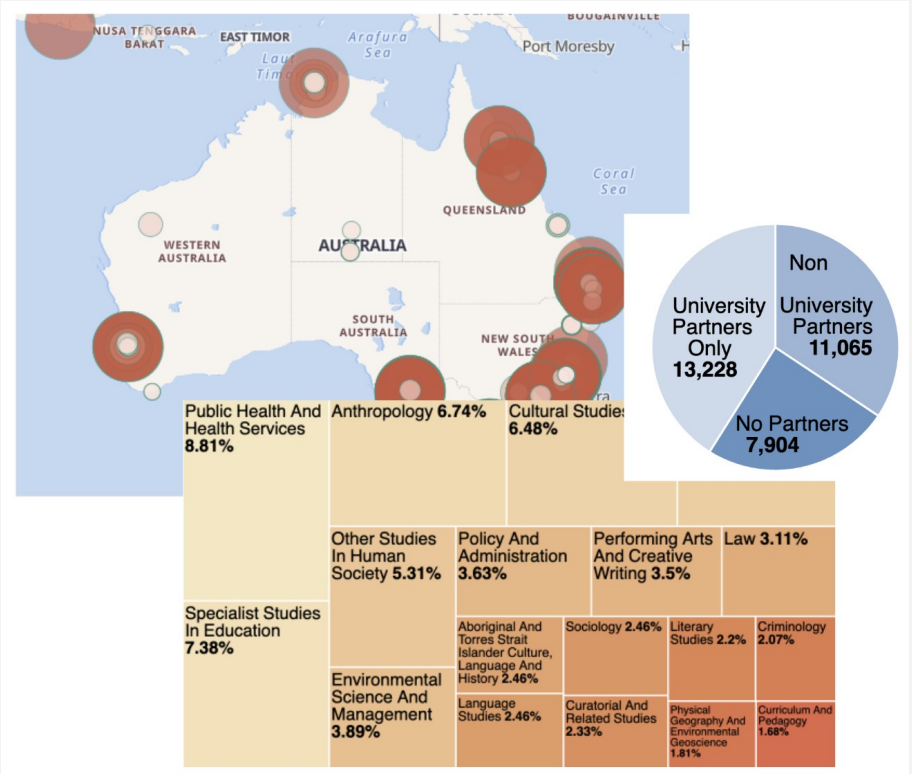
247,965
data collections

869
data services and tools listed

717,892
page views

Research Link Australia (RLA)

- Platform designed to connect publicly funded researchers with industry collaborators, facilitating the translation of discoveries into products and services.
- Discover information about research collaboration and research capabilities.
- Provide dynamic visualisations of research connections and impact through interactive dashboards.



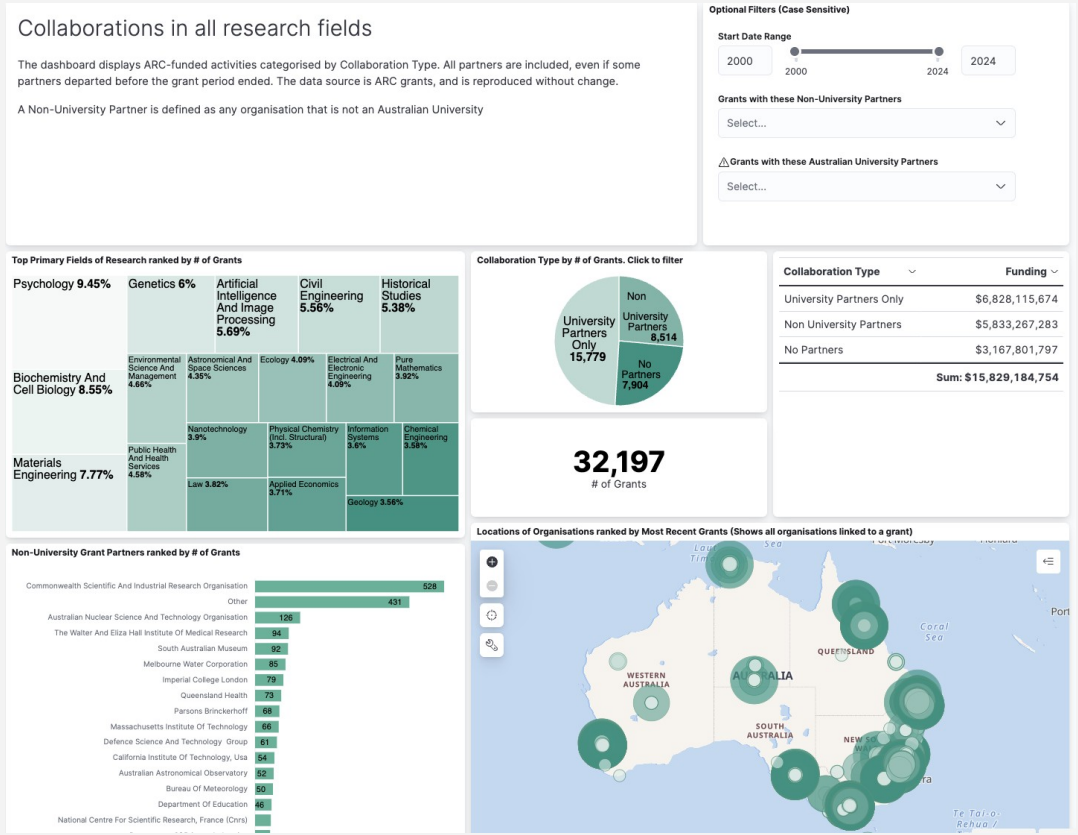
Records in RLA:

805,500+
Researchers

310,000+
Organisations

88,000+
Funded Activities

1,800,000+
Linked Publications



Australian Research Data Commons

NCRIS National Research Infrastructure for Australia
An Australian Government Initiative

ARDC is enabled by NCRIS

Australian Research Data Commons

Our Core Mission: Building Connections

Making research outcomes findable through contextual relationships

Showing how funded activities, publications, researchers, and organisations connect

Bring metadata discovery to life using visualisation and interaction

Australian Research Data Commons

Key Challenges

Implicit Relationships

Many linkages are inferred via shared PIDs rather than explicit relationships. These linkages are crucial but remain hidden from standard discovery methods

Change Detection and Management

Full metadata refreshes strain bandwidth, while complex reindexing, record removal, and on-time synchronisation across systems are difficult to coordinate.

Duplicates

Inconsistent identifiers and manual errors create duplicate records across sources

> "Everyone is becoming an aggregator, but no one tracks changes"

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Our Approaches

PID-based Graph Database

Link indirectly related entities based on PIDs in a graph database.

Visualise relationship paths and context to enhance FAIRness across records.

DELTA Updates

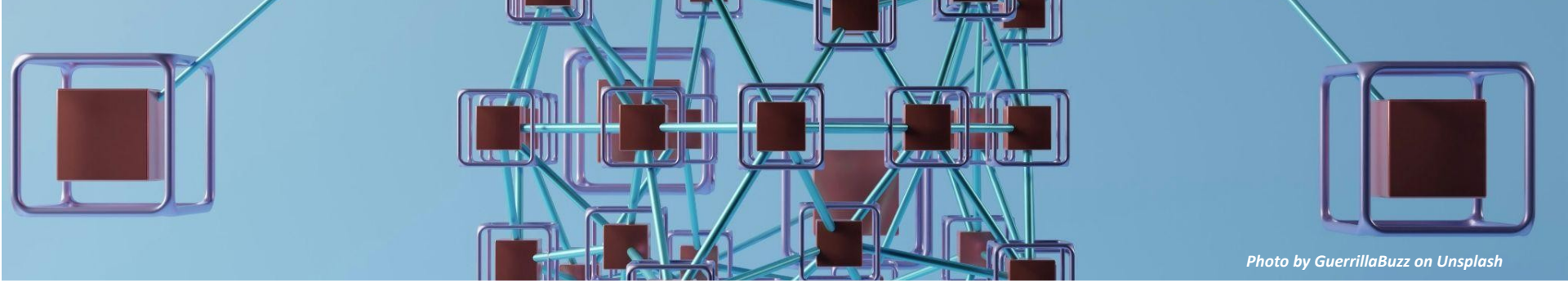
Ingest only changes via provider-supplied deltas or differential change modeling.

Coordinate incremental reindexing and safe record removals to keep indexes current without full re-harvests.

De-Duplication and Normalisation

Apply entity resolution across different entities to merge true duplicates.

Normalise identifiers, casing, and formats while preserving source provenance.



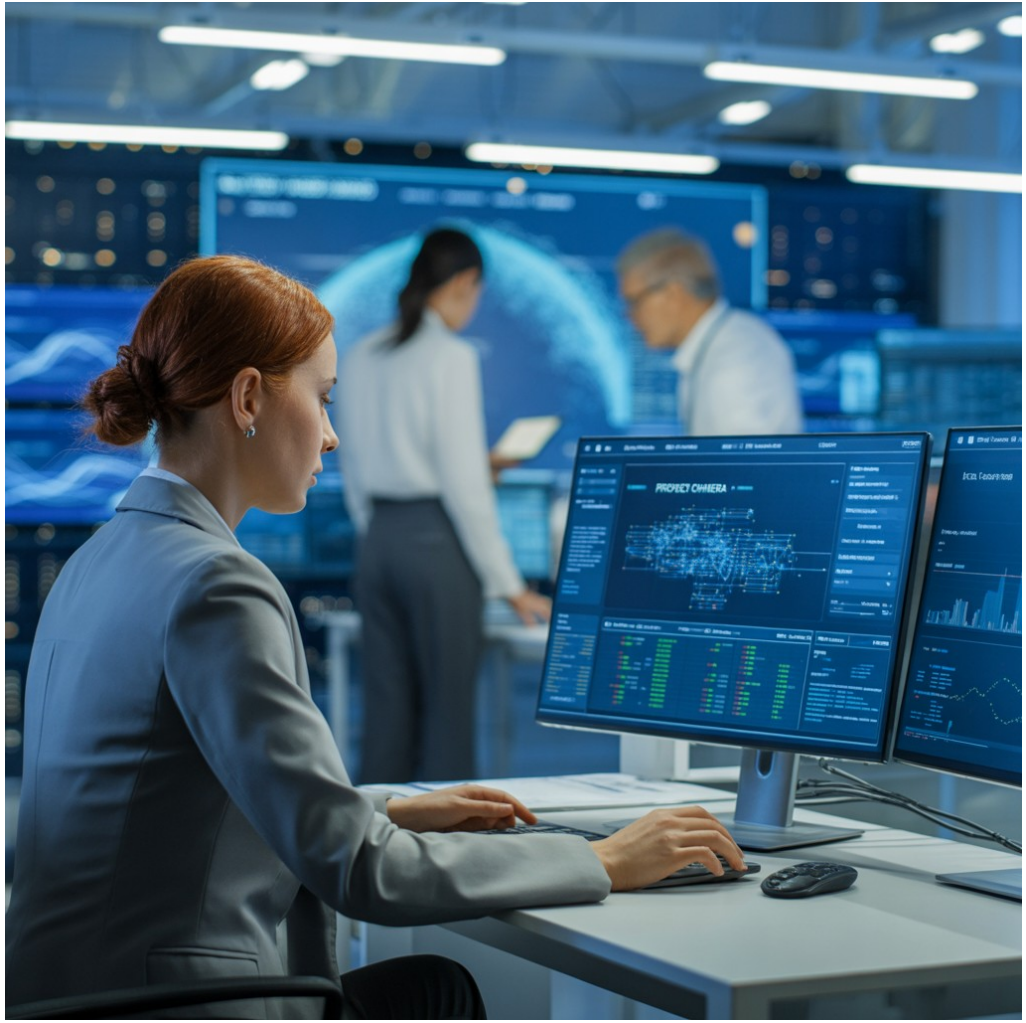
Identifier Normalisation

- Goal: Make entities resolvable and findable across sources via persistent identifiers (PIDs).
- Normalisation rules:
  - Lower casing
  - Trimming
  - Format normalisation per scheme
  - De-duplication: Cluster by normalised IDs to merge true duplicates and keep provenance.
- Outcomes: Higher match rates, fewer duplicates, and consistent linking across the graph.

Records with the following identifiers:

- https://doi.org/10.1234/12345
- doi.org/10.1234/12345
- DOI: 10.1234/12345

Will be merged together after normalisation



Infrastructures Behind the Scenes

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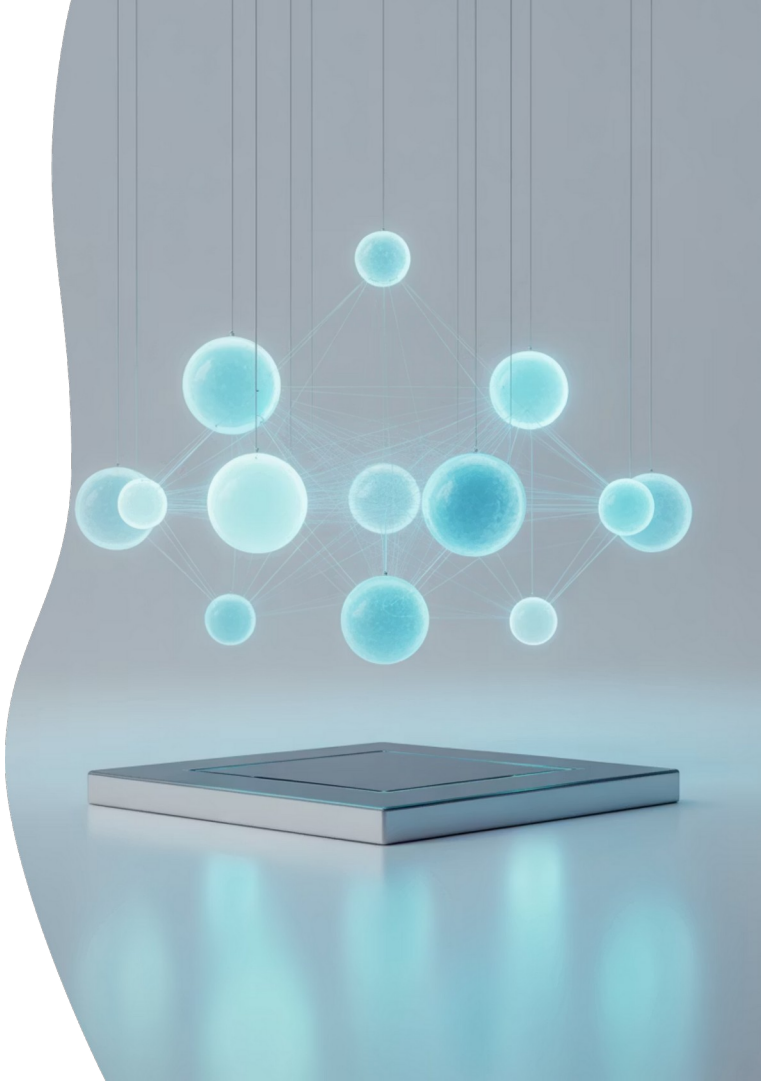
Technical Infrastructure Evolution

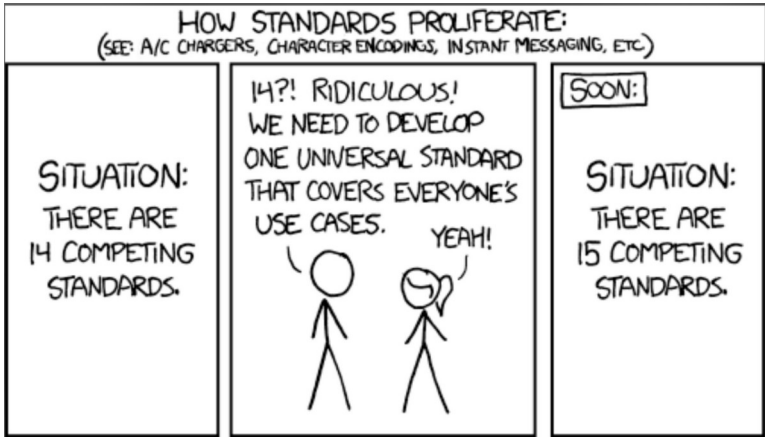
> *In the digital world, everything can be thought of as an object.*

Every entity: publication, researcher, grant, organisation, Patent and Instruments is an object with relationships.

Challenge: Model the **entire Australian research ecosystem** with millions of complex relationships.



The Technical Challenge



Scalable Solution

Software that handles objects, relationships, and metadata efficiently

Data Diversity

Each source describes entities differently—needed flexible system

Standards Problem

15 years with RIF-CS taught us: unwinnable battle

Solution: Support **all standards** that our data providers use.

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Our Three-Pillar Approach

01

Data Registry

Store all metadata as source of truth

02

Neo4j PID Graph

Strong model relationships, enable fast traversal

03

ElasticSearch

Fast, scalable architecture supporting nested documents and queries and AI-ready data structures

ElasticSearch contains **everything we know** about any researcher as one complex document.

Technical Infrastructure Evolution

Smart Services & Indexing

The evolution of our technical infrastructure has focused on implementing robust smart services and efficient indexing mechanisms to enhance performance and data retrieval capabilities.

Real-time Reindexing

- Instant data updates
- Zero downtime operations
- Always current search results

Structured Queries

- Complex nested search capabilities
- Precision-based search
- Advanced filters & facets
- Context-aware discovery

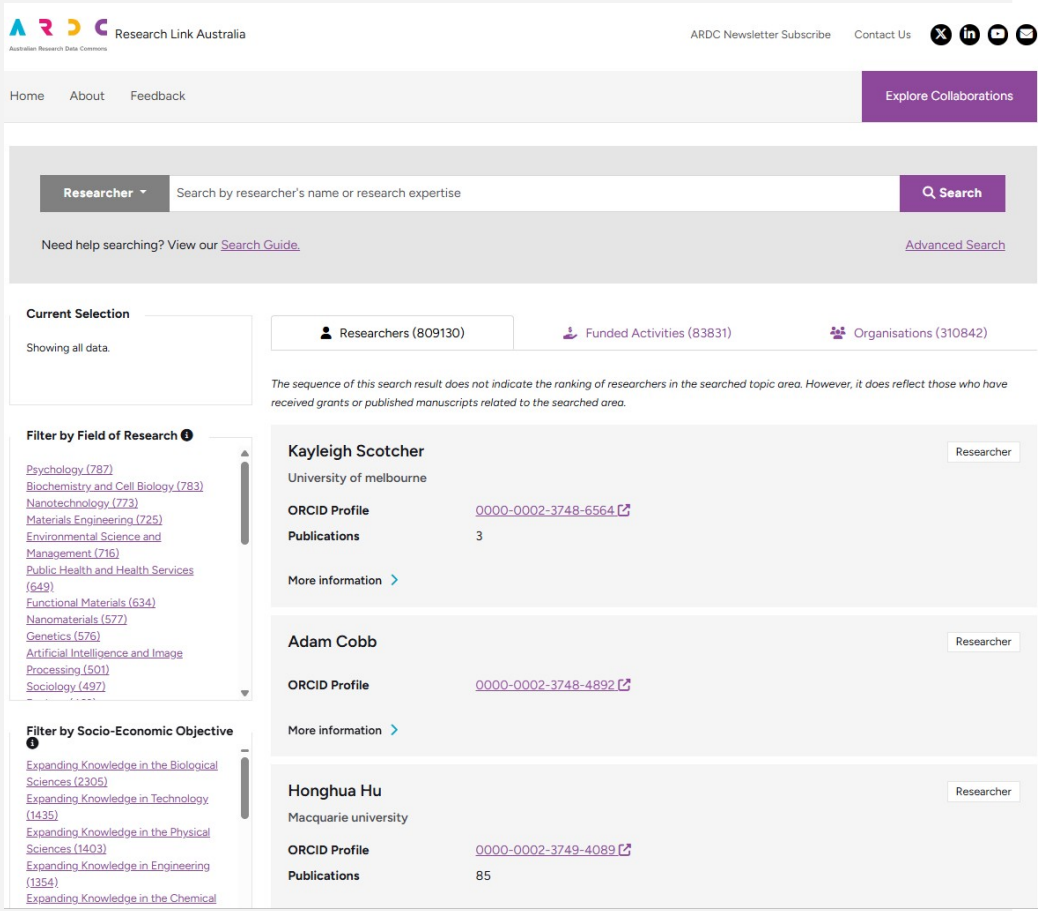
Version Support

- Track metadata changes
- Compare record versions
- Ensure data integrity

Lesson Learned: Choose widely supported technology, not just the "best" – community adoption matters more than technical superiority

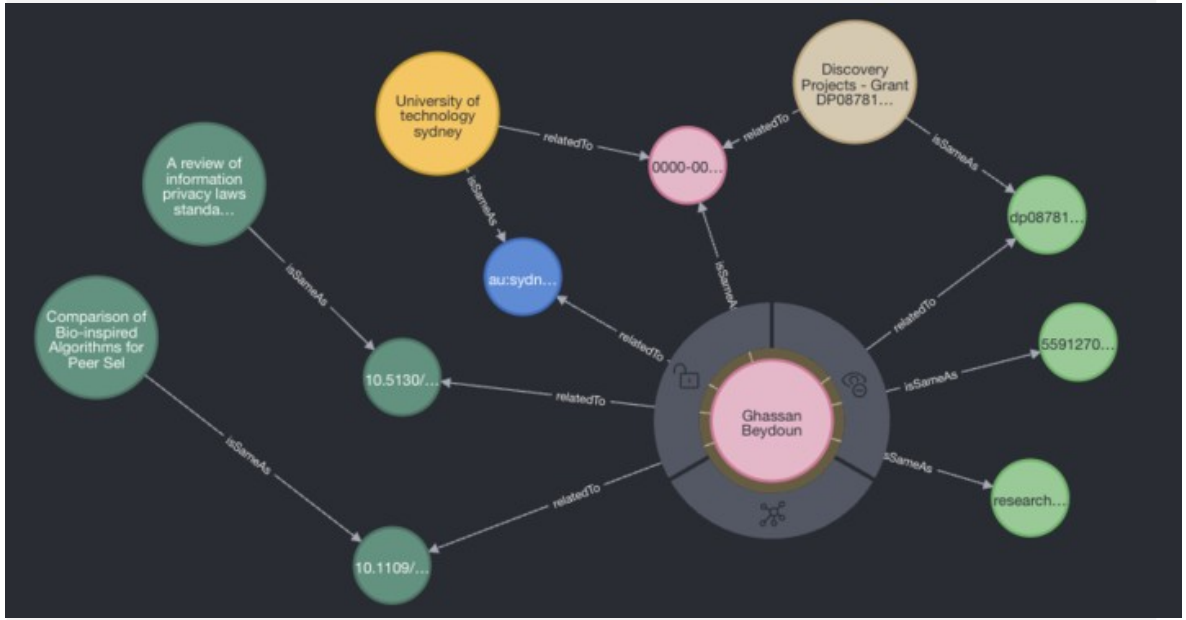
Elastic Search Index

- Powers RLA searches and dashboards
- High-speed, scalable search engine
- Supports complex and nested queries
- Enables faceted and contextual exploration
- Fuels dynamic, data-driven dashboards



PID graph

- Relationship engine connecting research objects
- Built on persistent identifiers (PIDs)
- Links datasets, publications, researchers, grants, and Organisations
- Supports RLA search enhancement & analytics
- Provides contextual and trustworthy connections



The Role of Persistent Identifiers (PIDs)

System Backbone

DOI, ORCID, ROR, ABR, RAiD, etc serve as the foundational linking mechanisms across the entire research ecosystem

Linking Benefits

Seamless connections between datasets, publications, researchers, grants, and institutional affiliations

Current Problems

Duplication

Metadata Standards: sources providing metadata in different data formats

Incomplete/ inaccurate metadata capture

Goal: Widely adopted and internationally recognised identifiers with strict uniqueness enforcement

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Schema-Agnostic Registry

Flexible Ingestion

Accepts data from any source without losing information

- Multiple identifiers
- Names and descriptions
- Spatial/temporal data
- Subject codes (ANZSRC, SEO)
- Object relationships

Nested Index Power

Researcher records contain:

- All publications
- All grants
- All affiliations

Everything relevant in one place

Connecting the

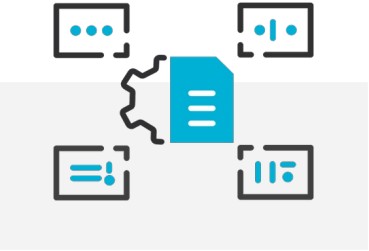
1. **Raw Metadata**
   Multiple sources ingested
2. **Schema-Agnostic Registry**
   Flexible storage solution
3. **Neo4j Relationships**
   Graph database mapping
4. **ElasticSearch Discovery**
   Searchable, discoverable data

> Research Link Australia is about connecting the dots in research data, so knowledge can accelerate faster than ever before.

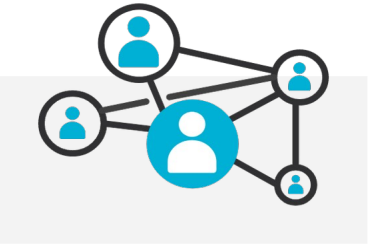
Impact and Outcomes

Dynamic PID resolution and relationship building

Continuous metadata enrichment from multiple sources



Robust performance with low latency in searching.



Future-proof solution with the potential to scale up, evolve, and adapt to more robust tech stack.

Where to From Here?

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Future Directions & Collaboration

1. **AI-Assisted Normalisation**

   Advanced algorithms for handling typos, spelling variations, classify and catalogue metadata with incomplete and inconsistent data

2. **Enhanced PID Governance**

   Improved adoption strategies and standardisation across research institutions

3. **Real-time Supernode Management**

   Dynamic solutions for handling large-scale data clusters efficiently

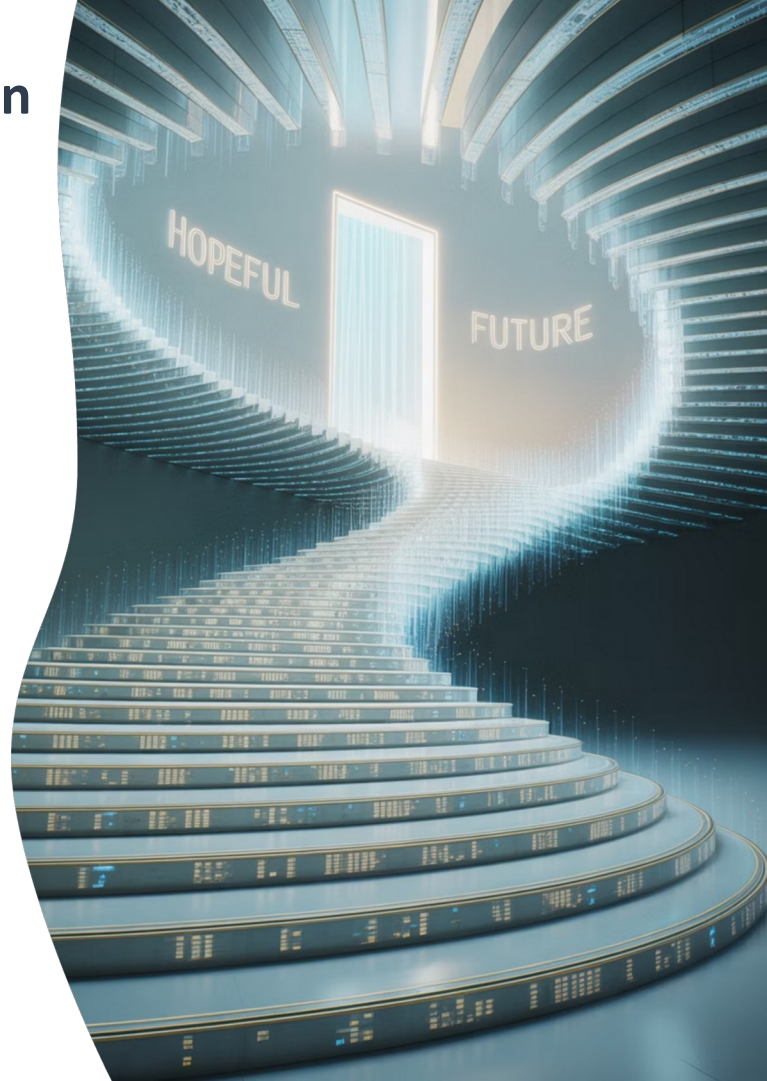
4. **Community Standards**

   Collaborative engagement on data quality and interoperability standards

The Path Forward

RDA and RLA continue evolving through persistent identifiers, delta updates, and sophisticated normalisation techniques. Success depends on sustained collaboration and widespread adoption across Australia's research community.

> Collaboration and adoption remain the key drivers for transforming research data discovery in Australia



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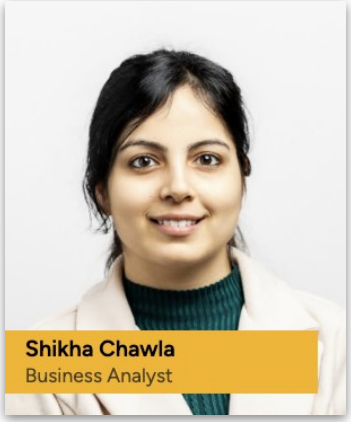
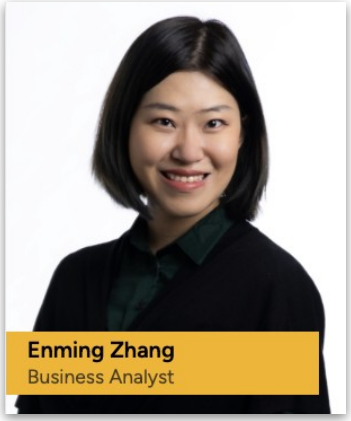
Our Team





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