eResearch: Faster, Better, and Brighter Research at Institutional, National and Global Scales - An Australian Perspective

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Pro-Vice-Chancellor (Research Infrastructure)
(Prev: Director of eResearch, Monash University)
Acknowledgement of Country

The University of Queensland (UQ) acknowledges the Traditional Owners and their custodianship of the lands on which we meet.

We pay our respects to their Ancestors and their descendants, who continue cultural and spiritual connections to Country.

We recognise their valuable contributions to Australian and global society.

Image: Digital reproduction of *A guidance through time* by Casey Coolwell and Kyra Mancktelow
My Background

Combinatorics, Computational Mathematics and AI

- most recently: AI applications to Medical Imaging, and scientific instrumentation

University of Auckland (15 Years)

- Led the establishment of NZ’s first eResearch Programme (BeSTGRID -> NESI)

Monash University (15 Years)

- Director of eResearch (2008: Established as partnership between ITS, Library, DVC-R)
- Involved in National Collaborative Research Infrastructure Strategy (NCRIS) since 2008
  - Chaired the establishment of the Australian National Data Service which became part of ARDC
  - Board of ACCESS-NRI
  - Led Digital Research aspects of Auscope, Microscopy Australia, National Imaging Facility, Synchrotron/ANSTO

University of Queensland (Globally Top 50 University)

- Pro-Vice-Chancellor (Research Infrastructure)
- Board of Microscopy Australia, National Imaging Facility, Terrestrial Ecosystem Research Network, and Advisory Committee for Phenomics Australia
- Board of Queensland Cyber Infrastructure Foundation
A data-driven research example....
Mission Statement

Transform melanoma early detection using total body surveillance to enhance individual lesion management

Diagnostic Intelligence
Improve early detection and risk stratification using total body images integrated with history, clinical phenotype and genotype.

Health Service Evaluation
Total body imaging will reduce unnecessary biopsies by better ‘hit’ rate, improving cost for patients and the healthcare system.

Informatics
Integrate total body imaging into a telehealth network and EMR through implementation of image standards.

Mission

Research aims

Diagnostic Intelligence
Improve early detection and risk stratification using total body images integrated with history, clinical phenotype and genotype.

Health Service Evaluation
Total body imaging will reduce unnecessary biopsies by better ‘hit’ rate, improving cost for patients and the healthcare system.

Informatics
Integrate total body imaging into a telehealth network and EMR through implementation of image standards.

Critical infrastructure

ACRF funded telemedicine network of 15 total body imaging research nodes

Outcomes

• World’s largest, most comprehensive skin imaging database.
• Reliable solutions for melanoma early detection.
• Facilitate development of artificial intelligence for risk stratification, prognostic and diagnostic support.

• Research-validated ACRF infrastructure underpinning a national targeted screening program
• Establishment of a national teledermatology network for remote care provision
Building the Research Repository

QUEENSLAND

NEW SOUTH WALES

VICTORIA

ADDITIONAL PARTNERS
Monash eResearch Centre

Monash eResearch Programme* is the University-wide transformational programme to digitise research. The Centre uplifts the sophistication and success of Monash researchers by helping them digitise their research to make it Faster, Better, and Different.

**Faster**  Instrument data processing, **high performance computing**, digital research pipelines.

**Better**  Findable, Accessible, Interoperable, **Reusable (FAIR) research data**, data management, “Lego blocks” of reusable advanced digital techniques and technologies, automation for more secure and reproducible research.

**Different**  The application and translation of new research techniques and disruptive technologies such as sensors, AI, drones, data linkage, global-connected data sources and tools.

- Delivered in partnership with e.g. Helix
IN PRACTICE

Monash eResearch Centre

Runs Infrastructure: High Performance Computing, Data Storage, Cloud Computing

Runs and participates in national projects: Large-scale collaborations to digitise research and help researchers become more productive

Expertise and Training: Expertise in applying digital tools, techniques and infrastructure to advance research.
A central theme for eResearch - building microscopes for 21st Century discovery
The 21st Century Microscopy Analogy

- **CAPTURE**
  - Light Source
  - Samples

- **ANALYSIS**
  - Filters

- **INSIGHT**
  - Lens
  - Visualisation techniques and advanced analytics

- **DATA MANAGEMENT**
  - The Instruments
  - High performance computing and cloud Workbenches
Monash eResearch Building 21st Century Microscopes

“Seamless Orchestration” with advanced digital technologies for realtime interaction with all layers

**INSIGHT**
- Lens
- Filters

**ANALYSIS**
- Light Source
- Samples

**RESEARCH**
- Cloud and HPC

**CAPTURE**
- Sensitive, Survey and Commercial Data
- Sensors, IoT, Models, and Born Digital Data

**SCREEN: DIGITAL VIRTUAL LABORATORIES INCL REMOTE DESKTOPS and VISUALISATION**
Interconnected set of Secure Digital Research capabilities

Improved security and privacy throughout the lifecycle of the research data

Data Collection
- Secure Hosting of Research applications
  - Host applications that handle sensitive data
- Clinical Instruments
  - Generating sensitive research data
- Imaging Research Data Management
  - Including Medical Imaging De-identified Images

Data Storage
- Secure Research Data Storage
  - Store petabyte scale sensitive research data
- Secure Analysis Enclave Platforms
  - Data custodians analyse data & create extracts for sharing with other researchers

Data Analysis
- Secure HPC
  - For large scale image, genomic and big data for AI and ML
- Secure Data Custodian Platforms
  - Share and analyse secure data across organisations through the governed environment

Data Sharing
- Secure text analysis
  - Extract data from unstructured text
Research is something that happens *between* organisations (and it is a “*team sport*”). It is not contained within the enterprise boundaries.
Research Infrastructure is about People and Partnerships
Research Infrastructure is about Co-Design
Co-Design of Research Infrastructure

Research Infrastructure Governance and Co-design. Research Techniques, Tools and Technologies are increasingly interlinked and interrelated in their selection, design, deployment, use and operation.

Research Techniques
- e.g. Methods, Workflows, Experiments, Theory

Research Tools
- e.g. Instruments, Algorithms, Devices, Software

Research Technologies
- e.g. Systems, Platforms, Infrastructure

Role of NCRIS and Institutional RI Platforms

Intensive

Light
Co-Design of DIGITAL Research Infrastructure

Digital Research Infrastructure Governance and Co-design. Research Techniques, Tools and Technologies are increasingly interlinked and interrelated in their selection, design, deployment, use and operation.

- **Digital Research Techniques**
  - e.g. Methods, Workflows, Experiments, Theory

- **Digital Research Tools**
  - e.g. Digital Instruments, Algorithms, Sensors, Software

- **Digital Research Technologies**
  - e.g. Systems, Platforms, Infrastructure

Role of NCRIS and Institutional RI Platforms

Light vs. Intensive
Research Infrastructure is about Collaboration and Connection
Building 21st Century Microscopes

“Seamless Orchestration” with advanced digital technologies for real-time interaction with all layers

- **CAPTURE**
  - Light Source, Samples

- **ANALYSIS**
  - Filters

- **INSIGHT**
  - Lens

- **SCIENTIFIC INSTRUMENTS**
  - RESEARCH CLOUD and HPC

- **SCREEN: DIGITAL VIRTUAL LABORATORIES INCL REMOTE DESKTOPS and VISUALISATION**

- **SENSITIVE, SURVEY and COMMERCIAL DATA**

- **SENSORS, IOT, MODELS, and BORN DIGITAL DATA**
National Collaborative Research Infrastructure Strategy (NCRIS)

The only Federal Government funding into collaborative research infrastructure

Provides researchers access to cutting edge infrastructure facilities, equipment and resources

Enables partnerships between the research sector, industry, and government to bring economic, environmental, health and social benefits for Australia

Key contributor to the attraction of research talent and industry partners to Australia

Co-investing enables states to influence and shape NCRIS capabilities to meet State priorities
Our Purpose
To provide Australian researchers with competitive advantage through data.

Our Mission
To accelerate research and innovation by driving excellence in the creation, analysis and retention of high-quality data assets.
**Research Platforms**
We list over 25 research platforms supported by the ARDC ready to use for your...

**Digital Services Hosted On Nectar**
Explore and access digital services hosted on Australia’s national research cloud.

**ARDC Research Vocabularies Australia**
Share and combine your data with confidence using Research Vocabularies Australia.

**Advisory Services**
Supporting your data and digital research challenges.
Find Datasets

Maximise your research impact with quality datasets and collections.

Find Datasets

We’re working with research organisations across Australia and across research disciplines to make their datasets and data collections findable, accessible, interoperable and reusable (FAIR) to all researchers.

Research Data Australia is an online portal for finding research data and associated projects, researchers and data services. Browse data by subject or theme.

Many of our ARDC-supported research platforms also include open datasets.

Explore open datasets – there's something for every discipline.
Find data for research

Find, access, and re-use data for research - from over one hundred Australian research organisations, government agencies, and cultural institutions
Demonstration
Research in the age of Data Privacy

NCRIS Capabilities are increasing handling Human Data
Uplifting Digital Research Infrastructure for Sensitive Data

Principles:

• Bring data & tools together
• Technology + Process + Governance interplay
• Risk management based approach
• Research-led governance
Final Advice for Organisations

Digital research technology must be digitally connected to the rest of the World’s digital research decisions and control span organisations.

Research is the journey of the unknown. It must follow then:

So is the design of digital technology used by research, iterative and perpetual co-design where researchers contribute and lead.

Digital research technology spans ownership and responsibility, workflow and data lifecycles straddles pillars of the organisation.