

# **AN AUSTRALIAN DYNAMIC: REFLECTIONS ON THE ROLE OF PARTNERSHIPS IN THE TRANSFORMATION OF AUSTRALIAN RESEARCH, AND RESEARCH INFRASTRUCTURE AND CAPABILITY DEVELOPMENT**

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## **Abstract**

Australian academic libraries first became partners in the transformation of Australian data and technology enabled research in 2008 through their involvement with the Australian National Data Service (ANDS) program to advance research data management capacity and capability. The partnership of academic libraries with ANDS enabled the development of new research support services and helped to shift the knowledge base of the academic community in research data management, in Australia. Recent training initiatives like the ANDS 23 Things was directed toward academic librarians to increase their knowledge of and capacity to help researchers use national research infrastructure and to manage their data well. The academic libraries have also partnered with ANDS, now part of the Australian Research Data Commons (ARDC) and the Australian Access Federation (AAF) on persistent identifier implementation, DOI (Digital Object Identifier) and ORCID (Open Researcher and Contributor Identifier). In this next phase, AARNet is a partner in supporting academic librarian and researcher skills development. The three organisations are working together; to build on foundational knowledge and infrastructure. Academic librarians and researchers are being introduced to the principles of FAIR (Findable, Accessible, Interoperable, Reusable) data, infrastructure, and platforms, and taught data processing and movement techniques, through ARDC and AARNet (Australian Advanced Research Network) skills offerings. The focus of this presentation is on the changing role of academic libraries in supporting research data management and associated research infrastructures, and on the challenges. Australian national research infrastructures and academic libraries are co-evolving; together we are establishing pathways for the future, to foster new capabilities and advance our world-class research infrastructure. This transformation is enabled through our strategic alliance, an openness to dialogue and change, and by leveraging national and international partnerships.

Keywords: national research infrastructure, collaboration, third space, partnerships

## **Australian National Research Infrastructure**

Pragmatism and collaboration feature heavily in Australia's national strategy for research infrastructure, known as the National Collaborative Research Infrastructure Strategy (NCRIS). This characteristic of the national strategy drives the transformation of research, through investment in research infrastructure and capability development. Australian university libraries became partners in this transformation of research and research infrastructure in 2008 through their involvement with the Australian National Data Service (ANDS) program in their development of research data management support and services, and ongoing via the newly formed Australian Research Data Commons (ARDC).

The 2016 NCRIS roadmap (Department of Education, 2017) defines national research infrastructure as terrain that is shared by critical and enabling stakeholders that transform, enable, and maintain national research infrastructure, i.e. the ARDC, the National Computational Infrastructure (NCI), the Pawsey Centre, the Australian Access Federation (AAF), and the Australian Academic and Research Network (AARNet). The Australian national research infrastructure community and Australian university libraries are coevolving; through their mutual openness to change, their strategic alliances around the NCRIS agenda, and, through national and international partnerships. Sustainable services and practices have emerged through collaboration and they are enabling the transformation of research undertaken through Australian universities.

This paper discusses the national context in which these collaborations are occurring with Australia's university libraries and the work undertaken together with the ARDC, AAF and AARNet, to advance technical infrastructure (persistent identifiers (PIDs) and digital capabilities (research data management and infrastructure literacy) and align these with international best practice. The partnerships reflected in Australian national strategy and with Australian university libraries provide a particular view on the knowledge and infrastructure building in the Australian national research infrastructure landscape.

### **The Australian Context for Change**

The National Collaborative Research Infrastructure Strategy contains the collaborative settings that operate at the heart of Australia's national strategy for research infrastructure advancement. The NCRIS roadmap and investment plan provide direction and funding for new technical infrastructure and capability development in the Australian research sector, the policy settings place a strong emphasis on *collaboration as a definitive approach*. Pragmatism, a resourcefulness, and a cooperative ethos is in a sense inbuilt to the Australian approach to augmenting or establishing new research infrastructure, stimulating changes in practice, and advancing data science and management skills in the Australian research sector.

This ethos also operates at the heart of the Council of Australian University Librarians (CAUL). The CAUL community is well-practised in the art of collaboration, through decades of resource and system sharing and their leadership in building information and digital literacies into research and learning support. Looking back over the last decade of work within the CAUL community the increasing support provided for data driven and intensive research and the treatment of research data as a first class output of research is apparent in academic library practice, that impacted and changed the technical infrastructure and digital capability in Australian university libraries. The partnership with ANDS began early in 2008 with CAUL representatives on the ANDS board providing oversight and guidance on digital scholarly infrastructure, academic library practices and services in support of research. With NCRIS funding from ANDS, university libraries in Australia stepped concertedly into a deeper set of collaborations with partners that operate in the national research infrastructure landscape. These steps into deeper cross-community engagement and practical collaboration are evident in the yearly reviews of CAUL activities.

In the *CAUL 2010 Year in Review* (CAUL, 2010) the relationship between Australian university libraries and national research infrastructure development is reflected in the CAUL submissions on higher education policy relating to federal research infrastructure investment in virtual

research environments and research data storage. In the year following CAUL representatives contributed their expertise and sat on the allocation committee of an NCRIS research data storage program and on an eResearch expert working group convened by the Department of Industry, Innovation, Science and Research (DIISR) (now Department of Industry, Innovation and Science) (CAUL, 2011). Liaison around research infrastructure that year was focused on the national roadmap (with DIISR) and on library engagement in the ANDS program. By 2012 CAUL restructured its committees, and the Research Advisory Committee (CRAC) was established; and a year later a working group on access to Australian research outputs recommended “continuous improvement in the discovery, access and resource sharing” and the AusGOAL (Australian Governments Open Access and Licensing) framework for licensing research data was endorsed (CAUL, 2013). Community liaison in 2014 (at an ORCID roundtable hosted by ANDS and CAUL) enabled engagement to commence around building PIDs for researchers into overlapping scholarly and research technical infrastructures, and afforded institutional and national benefits of new practices and collaboration to be explored (CAUL, 2014).

The momentum for change accelerated and CAUL and ANDS had representatives on the national ORCID working group, and the wider community went on to develop the Australian ORCID Consortium model (with AAF operating as the ORCID consortium lead) and another national roundtable on researcher identifiers was held. Following on from the work on a consortium model, a discussion on open research data and cross-community conversation ensued on open scholarship with a CAUL/ANDS workshop hosted in Auckland for CAUL and CONZUL (Council of New Zealand University Librarians) members. Activity in 2015 with CAUL intensified at a national level, and the AAF entered into the picture as a new partner for CAUL (and other agencies involved in supporting advanced research) in the ORCID consortium (ANDS, n.d.). The CAUL community recognised the associated practice change and put in place a framework for professional development, in response to the digital transformation of research in higher education.

*CAUL has developed a contemporary set of good practice principles and guidelines to provide a quality framework for Australian higher education libraries. This framework was developed to acknowledge the continuing evolution of university libraries and the unique professional skills and capabilities held within libraries that contribute to institutional and national higher education performance outcomes. (CAUL, 2015)*

Work in concert with the CAUL community then arose around open scholarship and research data management with the Australian Research Council, the National Medical and Health Research Council, ANDS, and the Australian Open Access Support Group. The 23 (research data) things program offered by ANDS was endorsed by CAUL for Australian academic librarians, keen to learn about research data. This approach to professional development was taken up in other library communities around the world – the CAUL-ANDS program met with widespread success and held up as an international exemplar in RDM skills development for librarians with links into the global Research Data Alliance (RDA).

Between 2010 and 2017 Australian university libraries were influencing federal policy and involved in federally funded research technical infrastructure and capability developments. With funding from ANDS and in strategic alliances with a wide range of partners another significant shift in intensity occurred, following the cross-community collaboration in 2015. Two new strategic priorities were endorsed by CAUL in 2017 (CAUL, 2019c) that drew from existing strengths within the CAUL community in open access publishing, digital research repository management, and new skills and literacies established in the preceding decade:

- Fair, affordable and open access to knowledge
- Digital dexterity - the new skills for learning and research excellence

Over the past two years ANDS joined with NeCTAR (National eResearch Collaboration Tools and Resources) and RDS (Research Data Storage) national research infrastructure programs, to become the ARDC. The ARDC and the AAF have consolidated their work with CAUL in the uptake of persistent identifiers (ORCID and DOI) and working towards improved discovery and access to research data and integrating the principles of FAIR (Findable, Accessible,

Interoperable, Reusable) into research data management practices and data management planning. From 2016 and onward CAUL representatives have had roles on the Australian ORCID Consortium governance committee, the Australian ORCID Advisory Group (currently chaired by a CAUL representative) and the ORCID International Board of Directors (CAUL, 2019b). Over the past year (2018-2019) the collaborations at a national level and scale in the national research infrastructure landscape have become closer. Then another party (AARNet) entered the scene to work on digital capability with CAUL and the ARDC on infrastructure literacy.

AARNet and the ARDC had commenced collaborating in 2018 and to build “infrastructure literacy” (research data movement, network know-how and research computation with Jupyter notebooks, and PIDs) into the ARDC Skilled Workforce program. In late 2018 AARNet approached CAUL to feed “infrastructure literacy” into their Digital Dexterity program and to work (with the AAF) and on the technical innovations that will affect how electronic resources are managed and accessed in university libraries (and how researchers access platforms, tools and equipment, operating within the national research infrastructure landscape). The CAUL Digital Dexterity digital champions program is underway, and a partnership with CAVAL has been forged to support the growth of a community of practice (CAUL, 2019a), and more recently AARNet. Infrastructure literacy and infrastructure interoperability are a nexus for the partnerships between CAUL, AAF, ARDC and AARNet. All four organisations have an important role at a national level to play in exploring and determining where we are able to augment community skills and the interoperability layers in scholarly and national research infrastructures, and in effect to bridge those infrastructures. So we seize opportunities to work in concert (share expertise, to be resourceful, and future focused).

The cross-community collaboration in higher education in Australia around technical infrastructure and capability development to support data intensive research is maturing and co-evolving. Our shared efforts are continuing to reward us (and the research community we work to enable). A stable foundation has been laid in Australia through partnerships with CAUL and with the ethos of collaboration over the past decade. We are forging a world-class research infrastructure and fostering new capabilities in Australia’s universities in an increasingly diverse set of national partnerships – and as a *collective*.

### **Technical Infrastructure**

Federal funding through the Australian Partnership for Sustainable Repositories (APSR) in 2006-2008 enabled the development of open access digital research repositories in university libraries. This federal investment laid the foundations of digital scholarly infrastructure in Australia and provided a useful foundation, to build new organisational and national research data infrastructures upon. The goals for advancing the digital research infrastructure that enable data driven and intensive research and the discovery of research outputs (like research data) from 2008 onwards, has been guided by a national strategy and investment (NCRIS). The change and advancement of underlying technical infrastructure, i.e. the technologies, policies, standards, procedures, and guidelines around description, PIDs and web services, and metadata aggregation, was largely led by ANDS through a series of projects and national and institutional co-investments in supporting uptake of DOI and ORCID, in partnership with the university library community.

The technical infrastructure created as a shared enterprise forms an important interoperability layer bridging scholarly and national research infrastructures. Persistent identifiers within this interoperability layer are sustained by the ARDC and the AAF in partnership with Australian university libraries. The interoperability enabled at national level through this collaboration is a feat that requires an exchange between all these parties of technical expertise, goodwill, and a vision shared on all sides, of the practical outcomes of this collective work. This interoperability layer provides access to information about Australian researchers and their research partners, linked to their research institutions, grants, datasets and publications arising from research activity. Persistent identifiers and capacity to manage them well constitutes *critical technical infrastructure* in the interoperability layer that connects organisational scholarly and national research infrastructures in Australia.

## Persistent identifiers as information infrastructure

It is easy to think of technical infrastructure as networks of cables, data centres and shared services. But as important to the creation of a digitally enabled community of organisations as these more tangible elements are, their value is limited if without a corresponding information infrastructure. Collaboration on the development of a global network of PIDs for research publications and data, Digital Object Identifiers (DOI), and people, Open Researcher and Contributor Identifiers (ORCID), are providing solutions to real problems faced by researchers and the organisations they work in (and academic libraries). Significantly, the establishment of that information infrastructure in Australia is providing new tools and resources for university libraries to fulfil their knowledge curation, discovery and research impact tracking functions. Australian university libraries have built PIDs into their digital research repositories. More broadly within universities, PIDs have been built into research management and research data storage systems. This is a digital research ecosystem operating institutionally, that is also interoperating nationally and internationally through the use of PIDs such as ORCID (via the partnership with the AAF) and DOI (via the partnership with ANDS and now the ARDC).

Currently the evolution of a common information infrastructure is focused on the inclusion of standards for describing funding bodies, and other elements of the digital research ecosystem. Work on persistent infrastructure is centred on creating a stable and integrated platform of PIDs, known as a "PID graph". The PID graph, is persistent identifier infrastructure upon which platform services for research in the digital age can be built. The digital scholarly infrastructure maintained by university libraries over time is increasingly connected to and coupled with research platforms through institutional PIDs connected into PID graphs. For example, the Data Description Registry Interoperability (DDRI) Working Group in RDA community is leveraging the infrastructure created by organisations such as the ORCID consortium to build cross platform and cross organisational discovery services for research datasets - and - open access research outputs published in digital research repositories. The DDRI is one of the many initiatives building on the value of PIDs in which Australian organisations, such as ARDC, NCI, and the University of Sydney and RMIT University (and their libraries) are making active contributions. The "Research graph" dataset connecting research data repositories, developed through the RDA, with key input from ANDS, (Aryani et al, 2018) is another new persistent identifier component being explored by the AAF.

Technical innovations (such as the PID and Research graphs) have emerged to advance interoperability between scholarly and research infrastructures nationally and globally. These innovations are being explored, tested and built into ARDC and the AAF services where that can aid Australian research platform providers, and university libraries, in augmenting persistent identifier infrastructure at organisational and national levels. A critical challenge for the evolving global infrastructure of PIDs maintained by organisations like the AAF, ARDC, and CAUL, will be identifying when participation (by users as much as by organisations) has reached the point where integrating identity and access services at the organisational level becomes viable and practical. In its role as the ORCID consortium lead in Australia the AAF is participating in the REFED (Research and Education Federations) working group to establish the feasibility of using ORCID as an identity provider service in the global network of academic federations (within which university libraries operate). The AAF are also working with the Research graph, to tackle the problem of integrating different PIDs into a coherent graph, and with the European Commissions' FREYA project to continue evolving the capabilities of the PID infrastructure and services.

With technical innovation comes practice change and new opportunities have arisen for academic librarians to extend their ability to manage more complex PID infrastructure. An example of this is the community of practice forming around the PID graph being developed through the FREYA project. The global partnerships involving the AAF and ARDC have sparked the formation of a new PID graph interest group in the RDA, that university library repository and technology managers in the CAUL community have been able to join meeting both practical and professional purposes. The direct benefit of the AAF in tackling persistent identifier infrastructure, by extending their know-how and technologies to address this technical challenge, and in partnership with the ARDC, is that the CAUL community (already engaged with the AAF in the ORCID consortium) are able to tap into this expertise directly. The AAF

provide expertise and services that the CAUL community (as managers of discovery and access to scholarly outputs produced by the researchers in Australian universities). The CAUL community are able to leverage new persistent identifier services to increasingly play their part in augmenting scholarly and bridging with research infrastructures.

## **Digital Capabilities**

Mapping and building the digital capabilities needed in research, teaching and learning in the academic community is a monumental “people and infrastructure” challenge and change agenda. Of necessity this challenge and change agenda requires resources to be found, community effort to be coordinated, and the development of a shared understanding of the knowledge and skills required. Natasha Simons (ARDC) has phrased the attempt to design a digital capabilities framework for the Australian eResearch community to operate in, as an attempt to generalise the London Underground, i.e. to map, plan, and then build the capabilities and to make those capabilities understandable and useful to the academic community. It is hard to generalise the range of skills, competency levels. There has been merit in tackling this common challenge together as a community exercise in agility instead, by viewing the landscape as an ecosystem with a mix of players, personas, and encounters, and by identifying some core competencies, and marking progress. In Australia we are a “work in progress” with digital capability development in support of research data management. There has been significant work undertaken through the ANDS program to invest in and build research data management and data management planning into Australian academic practice. The CAUL community have played an important translation role as ANDS partners in enabling practice change by integrating RDM into university library research support programs and services. Key success factors in this partnership have been the ability for academic librarians to extend their professional skills in scholarly information management to research data management, and the leadership shown by the CAUL community.

## **Research data management**

To meet the challenges required for Australia to excel in the new digital economy, a focus on the policy environment and social infrastructure is needed to realise a vibrant research data commons. In order to create effective and sustainable digital infrastructure, social, organisational, and cultural issues must be addressed, in addition to technical solutions. Cultural change, workforce development programs and policy frameworks, supported by sustainable communities, are needed to create an environment that support and capitalise on the key elements of an Australian research data commons. The ARDC is working to establish partnerships with key stakeholders, like CAUL, to facilitate collaboration and coordination (within the People and Policy theme). The ARDC has a particular focus on: advancement of cultural change through policy and funding frameworks; skilled workforce planning for the sector; and development of key communities of practice (ARDC, 2019) including connections with international communities and initiatives.

As part of its Skilled Workforce program, the ARDC has an interest in the role of data stewards and academic librarians, the professionals that provide frontline support for researchers in managing data. The program includes working with international initiatives in RDM, particularly around FAIR data, such as:

- The CODATA (Committee on Data for Science and Technology) efforts to identify and document FAIR data core competencies that can be mapped to training and training materials
- Partnering with Library Carpentry in lesson development and sprints (ARDC is represented on the global Library Carpentry Advisory Board).
- Participation and promotion of global RDM skills development events such as the FORCE11 (the Future of Research Communication and e-Scholarship) Scholarly Communications Institute (ARDC teach the FAIR data course).

Within Australia the ARDC runs workshops and webinars that help librarians skill up in RDM and FAIR in addition to providing guides and supporting materials (such as the 23 research data things which are available to be repurposed and reused). More recently, ARDC has focussed on

partnering to develop a series of Top 10 FAIR things that are online learning materials for specific research disciplines. The Library Carpentry community and AARNet have been key partners in this, in addition to a wide range of international organisations on this work program. ARDC also works with institutions to develop RDM policy and guidelines and has made a FAIR data assessment tool available for use by the sector. ARDC continues to facilitate a wide range of communities of practice to enable discussion and collaboration in solving research data management challenges, such as the Data Management Plans community of practice. All of these activities are potentially beneficial to CAUL and its membership as part of their own library practice and infrastructure change agenda.

### **Infrastructure literacy**

In order for students and academics in Australia to develop the data science, technology and computational competencies for working with today's increasingly rich and complex datasets, they must first have an understanding of the underlying enabling technical infrastructures. This infrastructure literacy is critical, and includes awareness of the change in research practices and national research infrastructures such as the Australian Research and Education Network; and how to move, store, analyse and process data, and access and exploit tools, technologies, and the supporting network capabilities. University libraries are well placed to impart this knowledge and foster this new literacy, to enable more efficient research, teaching, and learning practices within the academic community. There is a considerable history and body of work (and evident professional practice) to base this assertion on confidently. Academic libraries have a long history in supporting information seeking and literacy and digital literacy. In Australia, as with other countries (JISC, 2018) there has been a concerted strategic move over the last five years to raise digital capabilities by university libraries. This capability building work is ongoing and intensifying around data literacy, data science, and can readily be extended to encompass infrastructure literacy.

In 2018 AARNet began collaborating with the ARDC in community train-the-trainer events, to feed into the program information and lessons on: what the high speed research network, the Advanced Research and Education Network (AREN) is and does; and, how the academic community can best exploit the fast research network, or learn to work with slow or no networks (e.g. when out in the field work) effectively; especially when faced with data movement and packaging challenges. We have phrased the new area of infrastructure knowledge as "network know-how" and "data handling" and exposed some of the challenges that researchers (and the wider academic community) face as work becomes increasingly data driven and intensive, and the scale of data grows. Through the ARDC Skilled Workforce program, AARNet is able to join in on community development. It is common for research support and data librarians, within the CAUL community attend the train-the-trainer events hosted by the ARDC.

The collective enterprise for the ARDC, AARNet and the CAUL community is mutually beneficial. AARNet has knowledge to transfer and a contribution to make to national capability building; ARDC has a program for capability building; and, the CAUL community are focused on their own capability development (to enable the wider academic community's capability development). This work is a Win-Win-Win for AARNet, the ARDC and CAUL. We are currently exploring how and where Jupyter notebooks and The Carpentries (n.d.) may fit as a technique for this collective effort to be channelled into – as a community. The international liaison undertaken by the ARDC to support software, data and library carpentry is an important means of knowledge transfer and skill change for the research community, and academic librarians, and their partners in the national research infrastructure landscape.

In an Australian context we are in a positive position to build on the digital capability established in research data management by the CAUL community; and advance digital capability for data driven and intensive research; and, increase the community's knowledge of and capacity to use national research infrastructure more effectively.

### **Conclusion**

It is true to say that in the Australian eResearch and academic library communities we are being resourceful and collaborating to aid the transformation of Australian research, research

infrastructure, and researcher capabilities. To collaborate in a digital world as a collective however we work most effectively through trust built over time, or by establishing new working partnerships and building trust, and, by applying ourselves to filling gaps and solving problems in the national research infrastructure landscape together. Trust and collaboration operating at national scale enables this collective to build research infrastructure and platforms of technology, research data and services, and research support and skills. By doing so in concert we liberate collaborators in an academic context, especially researchers, from the constraints of distance, skills and information, and the friction of organisational boundaries.

In effect CAUL, ARDC, AARNet and the AAF are working in and building capability and infrastructure in that “third space” (Whitchurch, 2013; Veles and Carter, 2016) in academia. The third space operates in between institutions and organisational boundaries, and work on common infrastructure across those boundaries demands high levels of trust, understanding and consensus. In this paper there are reflections on this transformation in relation to the partnerships between these four organisations. We are removing the barriers together and creating a common space between organisations, platforms and skills, so that researchers can pursue their endeavours to explore and raise questions and solve problems, and build research communities, through their own collaborations.

There is an advantage to resisting the temptation (in the realms of eResearch) to taking a “build it and they will come” approach; and instead tackling this national research infrastructure challenge and change agenda in partnership and built *with and within* the academic community and with university libraries. The partnerships reflected here with the CAUL community provide a particular view on the transformation in the Australian national research infrastructure landscape with university libraries. It would be remiss however not to acknowledge the many other parties and partners we are all working in this national research infrastructure context, including: the AeRO (Australasian eResearch Organisations), CAUDIT (Council of Australasian University Directors of Information Technology), the Australian research councils and learned academies.

However there is something unique (for those of us working in eResearch) about working with Australian university libraries as partners, in such tricky areas of change (new technical infrastructure and capability development). The CAUL community brings to these challenges and the change agenda, a much valued focus on sustainability, community outcomes, user experience, mass uptake and benefit, that lifts spirits and raises the bar in applying all of our professional efforts. Their contribution in the national research infrastructure landscape is reflected in the CAUL community’s work this year to align their efforts with Sustainable Development Goals, and in their own words.

*“Our libraries transform lives” said Margie Jantti, Chair of the Council of Australian University Librarians. “Every day our students and academics use Australian university library services to grow their knowledge and capabilities. These are our future leaders and agents of positive global change in the quest to end poverty, protect the planet and ensure that all people enjoy peace and prosperity”. (CAUL, 2019d)*

Australian university libraries have risen to the challenge of transforming Australian research, research infrastructure and capabilities, and they also guide thinking within the national research infrastructure landscape, on how we approach that change and contribute to global change through research. The CAUL community have proved true the value of sharing a strong vision and deep collaboration, of being mindful of institutional requirements and working at a national scale, across organisational boundaries with the AAF, ARDC, and AARNet as their partners.

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