

# HONING THE EDGE: AN INTEGRATED MODEL FOR SUPPORTING ERESEARCH

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## ABSTRACT

Like many academic libraries, the University of Wollongong Library became involved in eResearch with the opportunity of Government funding through Australian National Data Service (ANDS). Contributing to the ANDS Seeding the Commons projects provided the University with the opportunity to resource formative infrastructure development of eResearch services, however, without a resourced institution-wide framework in place, the UOW Library's involvement in these initial activities failed to achieve the traction needed to enable these services to grow.

As libraries and information professionals look to secure their place in emerging research-focused industries, it is becoming increasingly important to identify our relevant strengths and unique skills when defining the role we will play. With motivators such as the emergence of citation information for research data, and changes to funding body requirements, research data is gaining traction as its own marker of research impact and success. The push for making data open, reusable, and accountable is increasing, with libraries, including those in the non-academic sector, now faced with opportunities to demonstrate the relevance and flexibility of their traditional skills in this space.

There has been much discussion on the re-skilling or redefining the roles of librarians, inevitably leading to the emergence of new Library roles and teams to support eResearch. Working within an academic environment in which research data has not yet achieved the same standing as scholarly publications; UOW Library took a pragmatic approach, integrating support for eResearch within established roles and skillsets. Leveraging existing experience with managing publications, authority control, application of metadata, persistent identifiers, copyright advice, repository management, training, academic outreach, and stakeholder relationships has allowed for the emergence of a sustainable support model that can be adapted by other libraries for their own context and assists with defining scale and service provision for both the organisation and staff.

## **Introduction**

In the Australian Higher Education environment the National Code of Conduct for Responsible Research outlines a number of responsibilities that universities and individuals have in relation to research data management practices. For several years the University of Wollongong (UOW) and the University of Wollongong Library (UOWL) have been involved in activities that respond to the need for eResearch support and data management.

In early 2010 UOW received initial funding from the Australian National Data Service (ANDS) for a "Seeding the Commons" project to deliver entries in Research Data Australia (a national database of research datasets) for legacy datasets from UOW; documentation and

processes used to collect descriptions about these datasets; and guidelines for data management at UOW. Based on existing expertise with metadata and scholarly publishing, a Library staff member was seconded to the Research Services Office (RSO) for 9 months to complete the project. From this exposure to grant projects and research teams emerged an awareness of relatively low level of understanding and engagement with research data management across the institution. To raise awareness of sound research data management and put the Seeding the Commons projects in context, a “DataWise” project was subsequently created and launched through RSO and the Library. Processes for researchers to register a research project centrally to gain access to storage, and basic data management promotion and support were established for the broader university community.

Support for eResearch and data management at UOW has always been a collaborative arrangement between the Library, Information Technology Services (ITS) and RSO. However, the lack of a single “business owner” for eResearch, coupled with it not being identified as a fundable priority, meant that traction gained from the initial Seeding the Commons and DataWise projects was not sustained. A robust institutional framework with dedicated resources envisioned at the time was not established at UOW although the drivers around the need to support research capacity did not diminish, and have in fact grown, particularly in the area of grant compliance.

Whilst the position on support for eResearch at UOW remained unclear the Library is developing an alternative demand-driven approach to providing services in this area. Established experience with managing publications, authority control, application of metadata, persistent identifiers, copyright advice, repository management, training, academic outreach, and stakeholder relationships across the University meant that many aspects of eResearch could be addressed within existing skillsets and resources. Maintaining involvement and knowledge through internal and external stakeholders improves our capacity for planning for future needs and services while continuing a strong advocacy role for the development of institutional scale provisioning of eResearch infrastructure and support.

### **Defining eResearch**

The definition of eResearch is described simply by the University of Wollongong as where Information and Communication Technologies (ICT) acts as a tool for enhancing research (UOW 2014); the core components of which are data management, high performance computing, and collaboration tools. At an institutional level, UOW is aiming to support eResearch across each of these components; however the Library is operating within a space that focuses primarily on Research Data Management (RDM). RDM has come to be understood, particularly by researchers and librarians, to mean the policy, practices, services and job titles in sustaining eResearch (Norman & Stanton 2014). Research data itself can be broadly defined as data in the form of facts, observations, images, computer program results, surveys, recordings measurements or experiences on which an argument, theory, test or hypothesis, or another research output is based.

The sheer volume of data being created across disciplines means that academic libraries can no longer afford to remain inactive. Previously referred to as a ‘data deluge’, ‘big data’, or a ‘tsunami’ of data (Lyon 2012), the volume and ubiquity of data and growth of eResearch has reached a point where a panel discussion at the [2014 eResearch Australasia conference](#) asked whether it is time to drop the “e” from eResearch, and if eResearch has now just become part of mainstream research infrastructure.

Research conducted at Colorado State University defined small data as datasets up to 200 gigabytes (GB), with large data being datasets more than 10 terabytes (McClure et al. 2014). While the size and volume of data continues to expand, Akers (2013, p. 58) suggests that concerns within a university setting should focus on ‘small’ data, that a preoccupation with

'big' data may be unrealistic and unproductive. Instead, Akers argues, universities should be looking to the challenges that come from managing a 'myriad of diverse and undocumented, yet small, datasets'. Where systems and infrastructure may be designed specifically to manage big data, any research project can generate small data, with management of this left to the individual researchers. Ray (2014) agrees that data that result from smaller projects are often more difficult to manage than big data. Without the storage infrastructure at an institutional level, UOWL is best placed to support those working with small datasets (under 200 GB). Acknowledging existing constraints, it is hoped that those projects likely to be generating large amounts of data, or specialist data such as geospatial, already have the technical framework to support data collection and preservation.

In Australia eResearch has been supported by the federal government through initiatives such as the National Collaborative Research Infrastructure Strategy (NCRIS), Australian Research Collaboration Service (ARCS), and the Australian National Data Service (ANDS) (Thomas 2011). As mentioned previously, UOWL initially became involved in the eResearch space through the ANDS Seeding the Commons program. More recently, changes to the Australian Research Council (ARC) rules for funding commencing in 2015 for Discovery Projects, Australian Laureate Fellowships, and Discovery Early Career Researcher Awards, require the inclusion of a plan for managing data (Australian Research Council 2014) have revived eResearch initiatives at institutions such as UOW. Similarly, libraries internationally have taken an active role in managing research data, and assisting researchers with designing data management plans in response to mandates from research funders (Martin 2014). Martin suggests that these services can be seen as a natural extension of library core functions: to collect, preserve, and consult. While academic institutions in Australia such as Monash and Griffith Universities have a level of maturity in offering eResearch services, this doesn't apply across the board to all universities; and impacts such as requirements of ARC funding rules may be what is needed to bring additional attention and resourcing to this area.

A 2012 survey of librarians from over 800 libraries in the United States and Canada found that a minority of them were offering research data services, although with more planning to begin in the next one to two years (Tenopir, Birch & Allard 2012). The study found that the services being offered most commonly were reference support for finding and citing data (44.1%), curating web guides and finding aids for data/sets/repositories (22.3%), and directly participating with researchers on a project (as a team member) (21%). Institutions such as [Columbia](#), [Purdue](#), [University of Glasgow](#), and the [UK Data Service](#), provide a variety of online guides, templates, training, and documentation. Within the Australian context, a 2012 study by Corral, Kennan & Afzal found that 85.7% of institutions had current or planned services around RDM guidance. Universities such as [Monash](#), [Queensland University of Technology \(QUT\)](#), [Melbourne](#), and the [Australian National University \(ANU\)](#) provide their researchers with extensive guides to requirements, best practice, templates, organisation, citation, and sharing, for example.

An increasing awareness of scientific fraud, and academics actually being accused of fraud over false data (Robertson 2014), as well as issues of irreproducibility, lack of reuse, and costs of collecting new data (Altman & Crosas 2013), have seen a push to make data more open and researchers more accountable. The emergence of data journals, providing faster access to findings and underlying data (Ray 2014), and data policies from high-profile publishers such as Public Library of Science (PLoS) and Nature have also added to the need for academic institutions to offer RDM support to their researchers. More recently, the Bill & Melinda Gates Foundation launched their Open Access Policy, requiring that 'Data underlying published research results will be accessible and open immediately' (Bill & Melinda Gates Foundation 2014). In 2009, Savage & Vickers undertook a study to determine how well authors comply with such policies, and found that only one in ten authors of articles in PLoS Medicine or PLoS Clinical Trials submitted an original dataset, despite PLoS data sharing policies specifically requiring this. This suggests a further need for not only the

education of researchers about the need to comply with such policies, but also providing the resources to enable the process of data sharing. Reflecting on these issues and policies, there is a need for data citation to support the attribution and verification of data, and an increased use of persistent identifiers, e.g. Digital Object Identifiers (DOIs) to more readily track data and related citations (Altman & Crosas 2013).

Kim, Warga and Moen (2013) suggest that skill sets used in traditional library work, to help facilitate discovery, access, dissemination, and archiving of information may be beneficial to the curation work involved with digital data. Libraries, particularly in the academic sphere, also need to be involved in the curation of internally created information, across research, teaching, and learning spaces. Far beyond what is currently required by the ARC for planning data management, successful management of research data requires descriptive metadata, as well as evidence of the data provenance, an audit trail, and information on how it has been managed (Ray 2014). In a study by McLure et al. (2014), participants expressed an interest in training focused on the digital collection of data, managing data, new methodologies for recording data, and organisational tools and approaches. Krier & Strasser (2014) suggest that liaison librarians are naturals for introducing data services to their faculties, conducting data interviews, and for identifying the right participants to be involved with pilot data projects.

The pragmatism of the library profession, the balance between a focus on service and empowering users through literacy, and a stress on identifying and promoting tools and resources to users who might not yet realise they need them, are all particularly relevant in the context of RDM (Verbaan & Cox 2014). Where libraries already have strengths in the active engagement of stakeholders, Krier & Strasser (2014) emphasise the need to not build data management services in a vacuum, and to build a suite of data management services with the understanding that it will be a learning experience for staff and users.

### **The UOW approach**

Key skills or services required to support eResearch include metadata guidance (Lyon 2012; Ray 2014; Altman & Crosas 2013; and McLure et al. 2014), data citation (Ray 2014; Altman & Crosas 2013), communication and interaction with faculty (Bracke, Newton & Miller 2011), and advice on funding requirements and sources of funding (Auckland 2012). While UOW is currently without an institutional framework for eResearch, the Library has identified its position as a key stakeholder and taken a pragmatic approach to supporting UOW researchers without allocating dedicated resources.

While the changes to ARC funding rules in 2014 have provided a further driver to increase efforts around compliance for eResearch, UOWL and other stakeholders from RSO aim to develop services that make RDM easy for researchers already faced with an increasing number of demands, rather than simply selling the need for compliance.

Having thought honestly about the strengths and capabilities of existing staff (Krier & Strasser 2014), UOWL has determined the current scope of RDM services to be offered. Gall (2011) recommends that librarians take an active role in the process and documentation of funded research and the Library has already been strong in supporting the scholarly research and communication process (Lyon 2012).

The structure of UOWL's existing research lifecycle (Fig. 1) means that staff working across the Library are already operating in spaces that extend easily to encompass eResearch. A library Scholarly Content Team, formed in 2012, provides strong support of access to and preservation of publications, and works alongside Academic Outreach and Learning and Research Services library teams to ensure excellent processes to support researchers in this space. As the Library grows in this area, staff are able to work collaboratively to build on their existing skills and play to their strengths to support eResearch, for example knowledge of publisher and funding body requirements, identifying existing data (as opposed to a

literature scan), identity management, citation management, and the promotion of research outputs.

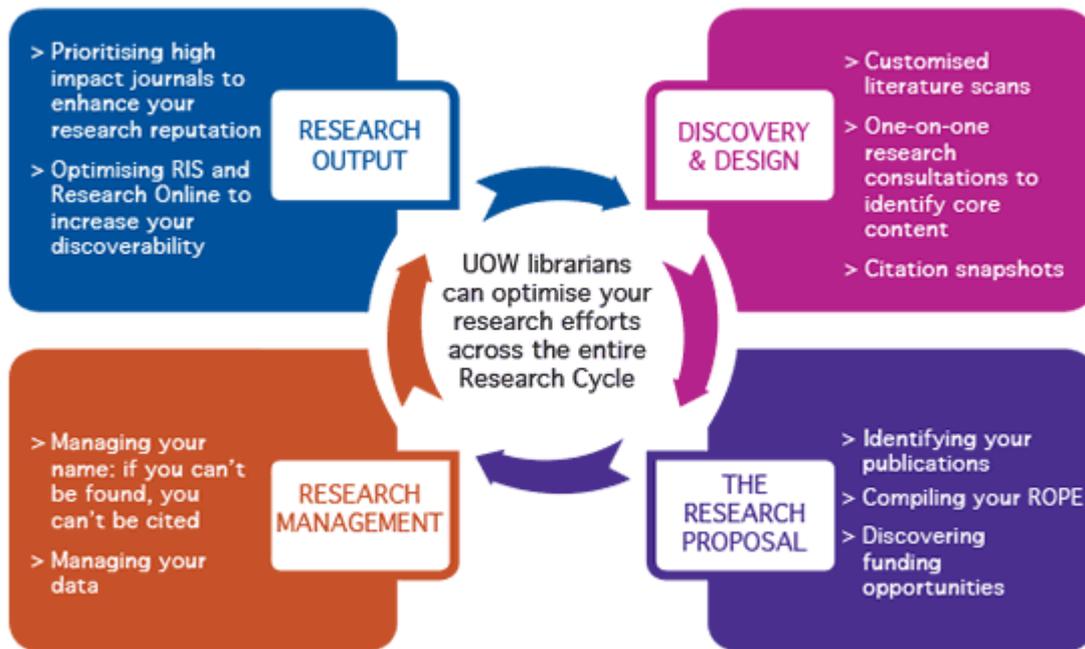


Figure 1. UOW Library Research Lifecycle  
(from <http://www.library.uow.edu.au/researchers/index.html>)

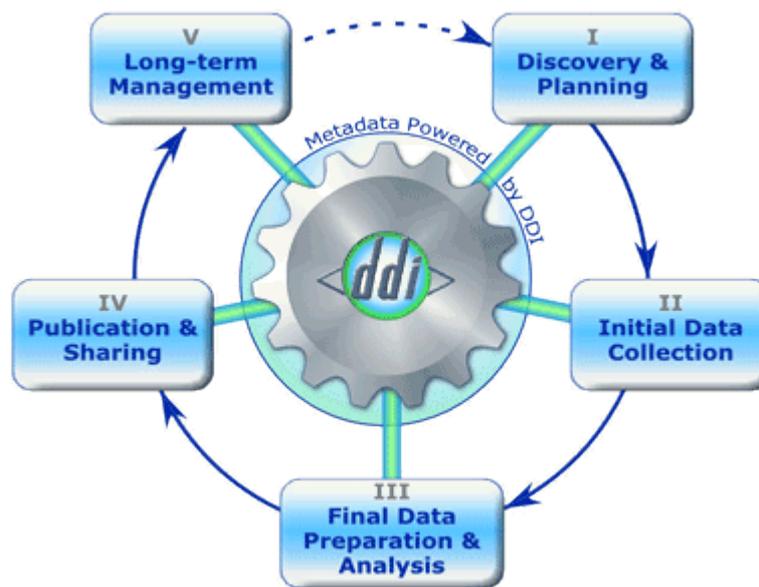


Figure 2. Digital Data Initiative's Data Lifecycle  
(from <http://www.ddialliance.org/>)

A data lifecycle can differ from the research lifecycle, originally designed to fit printed publications and similar research outputs. UOWL has been able to map the capabilities of Library staff against the Digital Data Initiative's (DDI) data lifecycle model (Fig. 2). While the DDI lifecycle was developed more specifically to reflect the DDI's metadata schema, it

matches what UOWL recognises as key stages in the data lifecycle, from discovery and planning of data, through to long-term management.

Data Lifecycle Stages	Library Staff Skills
Discovery & Planning	<ul style="list-style-type: none"> <li>• Awareness of funding opportunities and funding requirements</li> <li>• Data management planning (e.g. type of data, access, ownership, restrictions, storage, re-use)</li> <li>• Training of researchers &amp; support staff</li> <li>• Initial metadata advice</li> <li>• Establish interdisciplinary relationships through existing knowledge of UOW research outputs</li> <li>• Knowledge of data depositories and existing data</li> </ul>
Initial Data Collection	<ul style="list-style-type: none"> <li>• Existing data and advice around licensing and reuse</li> <li>• Knowledge of requirements for collecting sensitive data</li> <li>• Advice for standards, metadata, data dictionaries</li> <li>• Data security advice</li> </ul>
Final Data Preparation & Analysis	<ul style="list-style-type: none"> <li>• Direction towards tools for data preparation and analysis</li> <li>• Metadata advice</li> <li>• Storage and preservation advice</li> </ul>
Publication & Sharing	<ul style="list-style-type: none"> <li>• Identity management</li> <li>• Descriptive metadata</li> <li>• Licensing and intellectual property guidance</li> <li>• Measuring impact</li> <li>• Sharing records with Research Data Australia</li> <li>• Minting DOIs</li> </ul>
Long term management	<ul style="list-style-type: none"> <li>• Preservation metadata</li> <li>• Encouraging use of persistent identifiers (e.g. DOIs)</li> <li>• Understanding requirements for interoperability and long-term preservation</li> <li>• Data security advice</li> </ul>

Table 1: Mapping staff skills to the Data Lifecycle

Table 1 maps the existing knowledge and skills of UOWL staff to the five stages of the DDI Data Lifecycle. While the Library is not yet operating services across all of the lifecycle stages, it does have the capacity to develop these on a demand-driven basis, at reasonable scale, without additional dedicated resources. Verbaan and Cox (2014, p. 211) argue that ‘no one single service has the skills or capacity to take on the whole support role’ for eResearch, and that is where UOWL has looked at developing different tiers of support and an integrated approach.

Reznik-Zellen, Adamick and McGinty (2012) identified three tiers of eResearch support broken into Education, Consultation, and Infrastructure; and Lyon (2012) mapped the responsibilities, requirements and relationships to specific roles across the institution. UOWL has established what it believes to be a scaleable model of eResearch support that can be applied by libraries across the board, depending on their level of resources.

Tier 1: Awareness	Tier 2: Demand-driven	Tier 3: High-level/targeted
<p>Development of library webpages or guides to link to externally created training resources, data depositories, templates, guidelines</p> <p>Very limited promotion of services</p> <p>Basic-level group training</p> <p>Act as an intermediary to organisations such as ANDS</p>	<p>Build on existing role for promoting research outputs</p> <p>Consultation, outreach, and demand-driven training</p> <p>Working with researchers on requirements - service for minting DOIs, services around metadata (including standards and sharing), licensing, and publication</p> <p>Linking of data sets to publications, grants, etc. through platforms such as institutional repositories</p> <p>Advice on identity management</p> <p>Advice around storage/external data depositories, identification of existing data sets, and sharing data externally</p>	<p>Dedicated infrastructure &amp; resources.</p> <p>Large-scale internal storage or data depositories</p> <p>Academic Computing</p> <p>Project development</p> <p>Data manipulation tools</p> <p>Data mining</p> <p>Discipline-specific training</p> <p>Involvement in subject-specific data management practices</p> <p>Appraisal of collections, &amp; assistance with preservation &amp; sustainability</p>

Table 2: Three levels of support for eResearch

UOWL is currently operating with the demand-driven tier (Table 2), with an acknowledgement that existing resources do not extend to setting up services that are not yet required. Libraries in this tier also play an important role in informing infrastructure requirements, communicated through their relationships outside of their own library, and have an increased recognition as a key stakeholder. The types of service offered within each tier are scalable, and if resources permitted UOWL could begin to move into the high-level/targeted tier through actions such as outreach with targeted training to authors who have previously published in Nature or PLoS journals.

Sarah Jones (2014) suggests that institutional effort is more wisely focused on repurposing existing content, given the availability of training materials, rather than spending time replicating content. Certainly in the experience of UOWL, other institutions have been forthcoming in sharing content both directly and through public webpages. This has been invaluable in establishing the resources to mint DOIs, for example. Organisations such as [ANDS](#) and the [Digital Curation Centre](#) provide resources and links to external resources such as training, webinars, toolkits, sample guidelines, case studies, and standards.

Meeting demand-driven requirements for eResearch, in 2014 the Library has provided metadata advice and guidance around a data dictionary for a longitudinal study, [Illawarra Born](#), out of the Global Challenges Program at UOW. UOWL will also be supporting the [PetaJakarta project](#), from UOW's SMART Infrastructure Facility, through minting DOIs, providing links between data and publications, and promoting research outputs. The Library has already provided advice to the PetaJakarta researchers around data licensing, through the Library's Copyright & Digitisation Officer. UOWL continues to establish and foster collaborations with researchers and administrative staff across the University and is open to further developing eResearch services in response to any identified needs.

## **Non-academic libraries and eResearch**

Libraries have expended a great deal of energy on finding ways to define their role into the future (Australian Library and Information Association 2014a; Neal 2014; SLNSW 2009) and have been adapting their service offerings to what their clients need. Special libraries continue to play an important role within their organisations due to the specific knowledge and understanding that they use to work in partnership with their clients (Australian Library and Information Association 2014b; Abram 2010). Public libraries now offer services as diverse as lending tools and people (Berkeley Public Library 2014; Human Library n.d.), privacy awareness and using services such as Tor (Macrina & Glasser 2014), and makerspaces for everything from technology to knitting and sewing (Slatter & Howard 2013; Fayetteville Free Library 2014).

The 'digital revolution has made it far easier to store, share, and reuse data' (Ray 2014, p. 1) and volunteers and community members are now interacting with data at unprecedented levels and increasingly constructive ways. Governments continue to move their services online, as well as making datasets public (e.g. data.gov.au 2014), and events such as GovHack have begun to emerge to find ways to 'mashup, reuse, and remix' this data (GovHack 2014). Institutions provide access to APIs and/or their content for anyone to access, reuse, or redevelop. Community members get involved in citizen science projects such as [Galaxy Zoo](#), Environmental Voluntary Groups (EVGs) such as [Australian Plants Society Victoria](#) (APSV), or contribute their time to text correcting or transcribing, for example [Trove newspapers](#), and ['What's on the Menu'](#) from New York Public Library. Libraries and other organisations are hosting hackdays and wikibombs (Sedghi & Rourke 2014). Emergency services, marketing firms, and government agencies are monitoring social media for research, sentiment analysis, and crime prevention (Marshall 2012), and researchers are turning to local volunteers to contribute data to identify ways to improve local infrastructure and maps in areas such as Jakarta, Nairobi, and Haiti (Holderness 2014; Zook et al. 2010).

In 2014, UOWL has been expanding relationships and engaging with community outside of the University, for example a recent collaboration has been established between UOWL, the Illawarra Historical Society, Illawarra Museum, and the Wollongong City Library. Recognising a need to continue collaborating with the community, and operating within an academic environment that focuses on learning, innovation, and creation of new knowledge, consideration has also been given to how UOWL and other academic institutions can play a role in assisting public and special libraries with support in the eResearch space.

Crowdsourcing, and technologies such as wikis and social networking tools, have helped lead to the development of citizen science (Dickinson et al. 2010). Citizen science involves members of the public in scientific research projects to address real-world problems (Wiggins & Crowston 2011). Citizen scientists can now also make contributions through, for example, photographing or describing plants or animals, uploading content to databases, or transcribing hand-written historical records (Prainsack in press). Similarly, those involved in EVGs are creating and working with data, much of it 'invisible', and therefore difficult for potential users outside of the group to find and use (Kennan, Williamson & Johanson). Public libraries could serve as an ideal service to collaborate with these community members and assist with capturing and preserving their data, and making it available more widely. If their communities are involved in these activities, public libraries can look to providing space, technology, or direction to existing online data resources. For this to happen, staff at public libraries also need to have an awareness of the eResearch space and could foster closer relationships with academic libraries to liaise around training and understanding the needs of their communities.

As data becomes more prevalent in these ways and people become more aware of what is available, libraries can play a role in educating and providing resources to assist their communities to develop. Lankes (2011, p. 159) suggests that we 'need to see the library as a collection of member collections', and in this way we need to support the content being created. The many online guides developed by academic libraries and organisations such as ANDS that fit within the first tier of service (Table 2) mean that rather than expending resources duplicating this work (Jones 2014), public and special libraries can make use of this content to meet the needs of their clients in this increasingly data-driven world.

## **Conclusion**

Libraries need to have an awareness of their local context, and to make use of existing resources and relationships to develop a pragmatic and integrated approach to supporting eResearch. With institutions confined by limited resources, relationships between academic and special or public libraries, community groups and independent researchers, can be further developed to open links and opportunities for further collaboration, for example the archiving of community-created content in an academic institution's repository. Libraries need to be honest about their strengths and capabilities and identify how they are best placed to help their communities, whether this is a focus on supporting 'small' data, education, or infrastructure.

In an academic library context, the current Higher Education climate makes it difficult to anticipate funding and priorities. UOWL has shown that it is possible to develop an integrated sustainable model to support eResearch within a compliance, content and information management framework.

Moving into the future, key issues for institutions and researchers will likely be related to funding and compliance. Where libraries are concerned about best practice, researchers want what works, will assist with funding, and will ensure they're complying with organisational or grant body requirements. For libraries, the challenge will be to be ready to act on opportunities. Being across the activities identified three levels of support for eResearch will help libraries to prepare, whether it's awareness of existing eResearch guides and resources, development of high-level policies, or creation of dedicated eResearch infrastructure. These can be developed into an institutional matrix for organisations to define their role in eResearch.

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