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Becoming the authoritative source: taking repositories to centre stage.

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Abstract

Institutional repositories can be a storehouse of the research of an institution. There are many internal and external needs to find, use and report on the entirety or parts of an institution's research output.

This paper examines how to harness environmental factors to make an institutional repository the central and authoritative source of the research material output of a university. How to take it from "a place" to put research to making it "the place" and moving it from a nice-to-have service to one with a solid, sustainable future, one that the academic community values, supports and uses rather than sees as yet another administrative burden.

A key value of research material is its authoritativeness. Researchers want to be able to say "this is my paper" or "this is the corpus of my research". Research organisations want to be able to say the equivalent for all their researchers. The value of this identification is not just an assertion of authorship. It is also valued because the material can be authoritatively used to feed research discovery services and e-portfolios, fulfil reporting requirements to government and funders, substantiate promotions and back-up grant applications, and assist with benchmarking academic success in any given field. There are also many other uses for a repository..

The UNSWorks repository at the University of NSW will be used as a case study for this paper. The factors that can support the role of a repository as the authoritative source of research output are evaluated. The implications for interoperability with other institutional and external systems are identified, as are the resource implications and how success can be measured.

Topic: Planning, development and management of digital libraries
Digital library services

Keywords: Digital library services, institutional repositories, scholarly communication,
organisational change

The environment we operate in

Dempsey (2006) writes that the development of the web and greater depth of connectivity has allowed libraries to move from a peripheral role to a central role in the information space that supports research, teaching and learning that Universities engender. Academic libraries must now provide relevant services in an environment where there is a cornucopia of content and information services. Our community members are changing the way they interact and engage in their research, teaching and learning activities. Most importantly, the amount of time our users are prepared to invest in learning about and using our services is reducing and is now almost non-existent. The future of the academic library is challenged by these new dynamics. It means we need to think about how to deliver and integrate services; the future of the academic library lies in how well it meshes with a whole range of related services. (Wainwright 2004)

The term “repository” is being used in reference to some types of digital collections and data stores. Unlike a collection of digital objects housed in a traditional library database, institutional repositories are being used to capture original research and other intellectual property generated by an institution's constituent population (Crow 2002). Clifford Lynch (Lynch 2003) goes further. He sees institutional repositories as ‘a set of services for the management and dissemination of digital materials created by the institution and its community members. It is most essentially an organisational commitment to the stewardship of these digital materials, including long-term preservation where appropriate, as well as organisation and access or distribution.’

Repositories are about facilitating the use and re-use of material in many contexts. The value of storing and managing the research dataset will become more widely recognised as it is demonstrated that repositories, as both knowledge stores and data stores, facilitate the creation of new knowledge by allowing for non-anticipated use of research datasets. Repositories are about facilitating the use of materials in many contexts – this is a core function of libraries that librarians have always provided. The digital librarian must therefore build skills in data management, access control policies as well as building and exposing metadata to ensure maximum discoverability. Digital library services do not, in themselves, ensure that information is discoverable to users outside of the Library's immediate user base and its integrated library management system. The Scholar's Box (Yee 2005) gives users "gather/create/share" functionality, enabling them to gather resources from multiple digital repositories in order to create personal and themed collections and other reusable materials that can be shared with others for teaching and research. This gathering and sharing brings together users with the resources and services used from the network.

Van de Sompel and others (2004 2005) see repositories growing exponentially as their role in the scholarly communication value chain become more widely recognised. He sees this value chain as beginning with the registration of new knowledge from research outputs that are ingested into the repository. As this research is discoverable through such standards as the

OAI-PMH harvesting protocol it is accessed and validated by different parties. This validation builds awareness and leads to new research outputs. The end of the chain occurs with the archiving/preservation of the knowledge. Libraries and the repositories they service will become content nodes on the network, capturing the intellectual output and exposing it to the wider community.

The digital librarian will assist with the ingestion of research outputs such as datasets and research papers, so they are described for maximum discoverability and so they can be preserved. These research outputs will be discovered using protocols such as OAI-PMH and new services for object reuse and exchange (ORE) (obtain/harvest/put) (Van de Sompel et al 2006). Research outputs and digital objects will be used to allow the re-use of datasets hosted by various repositories for the creation and publication of a new dataset and will contribute to the development of new knowledge and new research outputs – which will be stored in other institutional repositories. And the cycle will continue.

It is in the management of research data and data sets, held inside the repository alongside the published findings that will challenge us. There are two aspects of research data that relate to academic libraries:

- Data as *primary source material* available for further research and experimentation, using particular datasets or groups of datasets; and
- Data as part of *enhanced publications* that form the basis of modern, digital scholarly communication. (Smith 2006)

For “enhanced publications” that include datasets as a useful part of the research output, academic librarians can contribute to emerging standards, including:

- Ontologies for these complex/compound publications that include data
- Identifiers for publication parts that work across disciplines
- Consistent description practices for enhanced publications and their parts
- Data structuring conventions
- Interoperability protocols for searching and retrieving data.

Broadening the scope of libraries and archives to include stewardship of digital scientific research data brings the bigger challenges. There are unanswered questions about:

- The required technical infrastructure, and who will develop and manage it
- Collection practices involving decisions about what data will be kept, when, in what form, with what tools, and with what description
- Digital preservation practices, which are still being formulated
- The legal framework that is necessary to allow any of this to happen at all.

- Collection policies and practices (appraisal, selection, weeding, destruction, etc.)
- Data clean-up, normalization, description, and submission to archives
- Collaboration with researchers around scholarly communication practices

We need to start thinking about how we will do this now. The funding rules for the Australian Research Council Discovery & Linkage Projects commencing in 2008 encourages researchers to consider the benefits of depositing their data as well as any publication arising from a research project in an appropriate repository. We will need to have flexible modular systems (and the skills to administer them) that can respond to change quickly and easily.

'It is expected that repositories will continue to focus primarily on serving particular communities, for example subject-based or institutional communities; or be responsible for a particular content type, for example images or learning materials. However, the repositories of the future will be much more interoperable with systems used to support learning and teaching, Virtual/Managed/Personal Learning Environments, assessment systems, ePortfolios, etc., as well as with authoring tools, other repositories, portals and library systems.

By 2010, simple metadata will no longer be created 'manually' to the extent that it is now. Techniques such as text and data mining, topic mapping and so on will be used to create metadata and extract information. However, it is still unclear as to who will be responsible for this 'knowledge extraction' and what level of aggregation will be required for it to be effective.' (Heery and Powell 2006)

Libraries will contribute to defining needs and requirements for this knowledge extraction, but it is unlikely that they will be the primary providers of the large-scale storage infrastructure required. Nor will they provide the specialized tools to work with the data (sometime at the level of individual datasets). It is certainly within the mission of academic libraries to preserve the scholarly record, but the technical challenges and costs involved are large, and libraries will need to invest seriously in this area if they wish to help find solutions.

We will also need the ability to create and exchange data models so that heterogeneous repositories can expose themselves to the rest of world. This will require standard data models for representing digital objects, a common format for serializing digital objects into surrogates compliant with that data model, and repository services for requesting access to and deposit of those surrogates. Work has begun on the ORE specifications (Lagoze and Van de Sompel 2007) on defining a framework and identifying where standards are needed to provide services across distributed repositories, so that digital objects in these repositories can function as units of scholarly communication in cross repository work flows.

Librarians will assist researchers in providing detailed information about the data to maximise discoverability. And they will assist and support the legal and behaviour framework (similar to the support provided for creative commons licensing) to enable "open research" based on "open

data". However, the greatest contribution libraries can provide is their expertise in collection management and the management of descriptive consistency to achieve economies of scale *across all research domains* and not just perpetuate the creation of data silos within particular fields of study or sub-disciplines. To illustrate, the discipline of systems biology is dependent on the existence of well annotated data sets defining and describing the components of these systems, especially genes and the proteins they encode. Information on these compounds is accessed through structured bioinformatics databases and from the scientific literature such as Medline and PubMed (Kersey and Apweiler 2006).

Like all academic and research libraries UNSW Library has been exposed, and reacted to, changes in the scholarly communication cycle and how people use libraries to access information. At UNSW, our services need to focus on the priorities established and re-affirmed by the new Vice-Chancellor. These priorities are to continue to build a research intensive professional and scientific university, with an emphasis on applied research. The University's priorities are to strengthen research and support the academic mission in producing "job ready" graduates. UNSW Library services are being developed to confirm UNSW's distinctiveness and support the academic mission. In 2003 the Australian Government allocated funding to identify and test solutions to establish institutional repositories. The ARROW project (Australian Research Repositories Online to the World) was established to develop an integrated institutional digital repository and associated information infrastructure components linked by common or interoperable software and management procedures. The ARROW platform is open-standards based and facilitates interoperability within and between participating institutions. (Payne 2005). The ARROW project has resulted in a repository platform established in 15 Australian Universities that support a wide range of digital content types housed in these repositories.

As contributing partners to the ARROW project UNSW Library is building repository services to serve the needs of our University. The UNSW ARROW team have worked closely with a number of schools and research centres to:

- Test the storage and distribution of various forms of research material
- Understand where researchers will get the most value from their material being seen
Consider and address copyright issues and concerns
- Design and implement effective work flow processes for ingestion management and use of the repository

"ARROW@UNSW" was developed as part of the UNSW contribution to the project. The production service, UNSWorks is using the outcomes from the ARROW project to meet two separate business drivers – to provide information management facilities including discovery to delivery services for UNSW research outputs and to support the research assessment process at UNSW. In the context of the UNSW information space, UNSWorks plays a major role in managing the research outputs of the University. As such, it was also designed to contribute to

the UNSW response to the Research Quality Framework (RQF), the previous Australian Government's initiative, to formulate a world's best practice framework for evaluating research quality and impact.

As an information management facility UNSWorks relieves academics and their faculty of the need to maintain an access and dissemination service (perhaps a web server on one of the faculty's systems), as well as requiring them to manage their own content. An audit of 3 schools at UNSW in 2005 showed that there were a number of discovery/delivery problems, including circular references and broken links resulting in inaccessible documents. None of these resources were discoverable using protocols such as OAI-PMH (Open Archives Interface Protocol for Metadata Harvesting (www.openarchives.org))

Factors for successful repositories

There is much discussion and examination of the factors that help build and sustain a successful repository. Apart from the institution mandating deposit, the key factors usually identified are that the repository is community-driven and community-focussed; facilitates scholarly communication; is easy to use and administer; provides a safe, long-term home for material; and has institutional support. Much has been written on the first four of these factors and this paper will only dwell on them briefly.

Community members will deposit material and use the service if it meets their needs, and engagement with the community is a key component to drive the development of the repository. Some examples of meeting community needs include:

- become a showcase for the member's work
- extend and expand exposure
- offer safe stewardship of the member's material
- replace or improve other similar services such as reporting of publications and listings of publications of websites
- provide value-added services such as statistics on use, pushing to services that the community member uses or finds useful, and annotation features

The ability to facilitate the changes in scholarly communication through support for open access, housing datasets, enabling new genres of scholarly work, and assisting with digital collaboration are seen as success factors.

The third success factor is that the repository needs to be easy to use and administer. This encourages the deposit of material and lowers the cost of providing the service. Examples for the community members include making the deposit interface intuitive and like other services they use; pre-populating the repository with data; and centralising tasks that may be difficult or confusing tasks such as checking copyright clearance. On the administrative side, there are

examples of providing easy-to-learn systems; having policies that result in low intervention in the checking of material; using standards to easily share data and development with other repositories and services; and leveraging institutional IT infrastructure including mass storage, authentication services and platform compatibility for easier systems administration.

An early goal for repositories has been providing a safe, long-term home for material. A successful repository maintains the integrity of material and ongoing access through successive changes in technology.

The final factor is institutional support. It is usually seen as a key factor, particularly organisational commitment to the long-term funding of the repository. However, success factors for institutional support are rarely expanded upon. The experience of UNSWorks, described in the case study, identified the following six key areas to gain institutional support.

- Improve the University's profile by exposing the research depth of the institution in a consistent way that is easily found and shared. The benefit is that senior institutional management can demonstrate the dynamism of the institution to potential funders; prospective research students can gain with in-depth knowledge of the research being undertaken in the department or school they are considering joining; and academics thinking of joining the institution can easily examine the research output of possible future colleagues and research teams.
- Support the institution's core research activities. The repository manager can provide expertise and advice in data management, data description, and standards to areas in the institution operating local repositories or managing research data. Beyond this, the repository can become an active partner of a research project to provide an open, semi-open or closed repository that is focussed completely on their needs. Working with the strategic research activities and projects of the institution raises the profile of the repository within the institution's senior management hierarchy.
- Improve reporting and accountability. Obtaining a complete picture of the research output of an institution and being able to measure its usefulness have not been simple tasks prior to repositories. As well as reporting on the content, the repository can contribute to external reporting requirements, bibliometric analysis and impact of the research. Standardised descriptions within the repository and tools to extract data in various formats enable analysis and reporting to be improved.
- Provide institutional-wide efficiencies. Descriptions of research material, and sometimes the material itself, are collected and used by many parts of an institution. Offering "slices" of the data to other services of the institution removes duplication of effort. Examples of this capture-once-use-often approach can be taken with publications data that is used in Find-An-Expert services; listings of publications on faculty, school and personal websites; and external reporting requirements based on

research outputs. In addition it reduces the burden on community members to supply the same information to multiple services within the institution.

- Become embedded in other core functions of the institution. Particular services within the institution are core to its overall administrative operations. By becoming part of another core service makes it seen as a core function as well. An example is providing access to publications that help substantiate academic promotions.
- Maximise interoperability with other systems. Most of the factors above involve working with other systems in the institution. This may be taking data from other systems such as names from a central human resources service. However, the repository feeding information to other services is seen to be of more value to the institution, particularly those services with high profiles in institution administration such as the Research Office, Reporting Office, and Grants Office. These other systems are not necessarily standards based and customised interoperability may be required. An example is providing data to a Find-an-Expert service where material included in the repository can be linked to each expert and keywords and abstracts used in repository material may be used in search indexes for the service.

The value of institutional support is critical to sustained funding for the repository, and hence its long-term viability. To encourage depositing of material, the academic and research staff need to value the repository and its services highly. However, this high value does not necessarily translate into sustained funding. Providing value to institutional management and becoming a core, central function for the institution will be the basis of the sustained funding. In other words, the repository needs to be good for the researcher AND good for the institution.

Case Study

UNSWorks, the institutional repository at the University of New South Wales

Development phase

UNSWorks had its genesis in the ARROW project, the aim of which was to identify and test software or solutions to support best practice institutional digital repositories. The ARROW Project was funded by the Australian Commonwealth Department of Education, Science and Training, under the Research Information Infrastructure Framework for Australian Higher Education. The platform chosen by the ARROW Project was the VITAL product from VTLS, Inc that leverages off the open source FEDORA platform. The other initial partners in the ARROW Project were Monash University, Swinburne University and the National Library of Australia.

The development phase of UNSWorks was characterised by visits to researchers, academics, and heads of schools to gather information to help develop and test repository solutions. The information was used to examine standards, design workflows, and test software solutions in conjunction with the other ARROW partners. The conversations were wide ranging and

included topics such as the material they would find useful to include in a repository, what they were excited about, where it would fit into their work and communication methods, and the terminology and analogies that would help them understand how to get the best from a repository.

Researchers were very supportive of a repository. Their key concerns were understanding and checking copyright conditions and the extra work of adding material to the repository. Many enthusiastically added material immediately. However, this did not necessarily translate into continuing deposit during the development phase.

The development of the repository with the other ARROW partners covered:

- Trying a wide range of material types including journal articles, conference papers, research reports, working papers, theses, technical reports, and still and moving images.
- Developing metadata standards.
- Prototyping and user-testing workflows and screens for self-submission and submission by an agent.
- Writing conversion programs for bulk ingest from various data sources including Excel spreadsheets and publications data in Research Master.
- Understanding the software configuration options.

Moving to production

Because of the work undertaken in the development phase, the library was in a good position to understand the scale and complexity of the task to develop a production service. A business analyst and a systems developer were employed to provide a rapid, concentrated effort and to work on a series of development projects. The analyst supplemented the information gathered during the development phase with further visits to the research community. In all, sixteen schools and research centres were consulted. All major research areas were included. This information fed the five areas that were identified to become a production service: policy; workflow and screen design; software customisation and development with a stable system; documented processes; and a sales/marketing campaign.

Policy

A light policy framework was adopted covering: the role of the repository, its content and the legal framework for deposits.

“UNSWorks aims to enhance the value and impact of UNSW research by making it more visible and accessible globally, free of charge”. This is the simple, clear role of UNSWorks. It has two functions. Firstly, it explains the usefulness of the repository to researchers, academics,

university administrators and library staff. Secondly, it focuses the development of the service. It was honed over a number of presentations to schools, academic committees and in discussions with individuals. The intent was to use words that have meaning to the research community. The role is supplemented with the following aims that illustrate the meaning of “value and impact”:

- Support researchers to manage their works efficiently;
- Provide a stable and enduring home for research outputs;
- Enable researchers to meet recommendations of funding bodies to deposit research publications in an institutional or subject-based repository;
- Assist with University reporting;
- Meet the Library's purpose to deliver professional services to optimise the University's investment in our digital and print collection that improve outcomes in research.

The research community was interested in adding a wide range of material but wanted clear guidance on what they could and could not add. Consequently, the development of the content policy started from the basis of accepting all research material and then identifying exclusions. This resulted in “UNSWorks holds research publications, objects or collections for authors with an affiliation with UNSW or where the material is associated with or sponsored by UNSW”. Exclusions are listed and include such things as confidential and proprietary material, material intended for teaching and learning (e.g. course notes, reading material), and undergraduate essays. Some researchers asked about removing material from the repository so clear rules were established about the circumstances and process for removal that do not detract from the role of a repository to be a place of permanent storage for access.

Interesting discussions arose around the rights that depositors need to agree to. The UNSW Legal Office particularly wanted to ensure that authors clearly understood and agreed to the conditions under which they were depositing material. It led to the development of four different workflows. One for individual authors depositing their material, another for agents depositing on their behalf, a third for material owned by the university, and the last for material published in UNSW journals and report series.

Workflow and screen design

A high level of customisation was undertaken on the VITAL self-submission screens based on feedback and testing with researchers. The primary driver was to make it easy to add material. Some examples of the work were:

- Only showing the fields needed for the type of material being added, e.g. location only shows when entering a conference paper.

- Drawing on other data sources to minimise data entry requirements such as drop down lists for school names and research area codes, which also benefits consistency when searching.
- Pre-populating the repository with data, though not very successfully. Data sources such as publications lists on school websites were very inconsistent and had high rates of errors, and the lack of a web editing tool meant authors could not change incorrect information

Software configuration and development

Each of the customisations for workflow and screen design changes required software development and system configuration. A rapid application development process was employed with designs going through a number of iterations each informed by user testing. Essential improvements were decided to ensure they were delivered and usability was a key goal.

In addition the platform was improved to provide development, test and production environments with change management, back-up and restore processes in place.

Documented processes

Often overlooked in the development of new systems is the documenting of processes and software. This became an important focus of moving to production. Documenting business processes and workflows was important because the person most involved, the business analyst, was leaving to continue with full-time study. Much of the software customisation, configuration and development was building on open source code or linking into the VITAL software which has had regular releases and documentation helped apply any changes to later releases.

Sales/marketing campaign

An awareness and demonstration campaign ran for almost 12 months focussed on academic and research staff. It began from the time it was agreed to create a production repository as a standard library service. The campaign was led by Outreach Librarians in the Library's Academic Services Unit as part of their role to build relationships with faculty, identify with the community what services may be required, and deliver these services. Closer to the launch of the production repository this changed to a sales campaign to encourage the addition of material to the repository and included the setting of targets to monitor progress.

Moving to the centre stage

In addition to the campaign to academics, effort was also focussed on the academic and administrative areas of the university. Presentations were sought (and given to) high level, university-wide academic committees such as the Academic Board. The thrust of these presentations was to raise awareness of how a repository could work for the university.

Meetings were arranged with other areas of the university interested in publication and research data to examine data exchange, efficiencies in data collection and elimination of duplication. Discussions were held with the Research Office, the Institutional Reporting and Analysis Office, Central IT Services and specific projects such as one looking at identity management. The message being delivered was that the repository should be seen as the authoritative source of publications data for other services.

The value of this approach can be seen in university-wide functions that were given to the repository. For example:

- The repository was immediately seen as the logical place for storing the research outputs for the Research Quality Framework, with the Library responsible for checking and adding the data.
- Discussion with the Research Office resulted in the transfer of the responsibility for collecting publication information for Higher Education Research Data Collection (HERDC) moving to the Library with the clear understanding that data entry would be amalgamated with the repository.
- Online journals produced by two UNSW Faculties (Business and Law) approached the repository to deposit their articles.
- A major research project asked for a customised repository to store research publications and datasets that will be shared between the nine universities in the project.
- One school has stopped development of an interface to allow staff to list publications on their website and will draw the information from the repository using a tool developed by the repository.

Immediate future for the centre stage

The library intends to build on centre stage activities. Plans are underway to:

- Develop a single interface for addition of material to the repository and HERDC for the 2008 publications
- Support a second major research project to demonstrate the value of including the repository as an active partner.
- Lead the revitalisation of the university's find-an-expert online service using the publications data in the repository as one of the authoritative sources that helps discover an expert and check their relevance.

Continue active participation in university-wide projects that improve the repository such as the identity management.

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