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Virtual Research Environments:

What do libraries have to do with it?

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Introduction

Like many other groups within society, researchers are making use of Web 2.0 technologies for both informal and formal collaboration. Beyond commercially hyped social networks, the development of Virtual Research Environments is taking place around the world. VREs are in part a natural extension of the collaborative nature of research, but also represent a radical shift in the ways that research is carried out, disseminated, and shared.

Much is being said about the need for libraries to remain relevant to the research process in the face of the Google onslaught – often the implication is that libraries are inflexible, hiding behind barricades of dusty tomes in the vain hope of staving off change. Libraries do need to stay abreast of changes in order to remain active partners in the research process, but in many ways, it is the research and academic libraries that have been at the forefront of the developments in online research. Libraries have provided the online resources and repositories that have enabled researchers to collaborate and share ideas, information and publications online.

Now, VREs are being developed as part of research infrastructure and it is likely that the use of VREs and other forms of online collaboration will become commonplace. In order to facilitate research effectively, a VRE needs to be integrated with existing research infrastructure (Fraser, 2005) – this must include library resources and services. Libraries already have the reputation as providers of quality information, (CURL/RIN, 2007) and research has shown that information quality affects the perceived usefulness of virtual research. (Lin 2007, p. 122) We believe libraries are well placed to continue as partners in the modern research process but need to spend time understanding the emerging environment.

VREs and the changing nature of research

The Next Generation of Researchers

The use of VREs represents a serious change in the ways that researchers are working – change that will increase as more technology is developed. Indications are that current researchers are adopting social networking technologies very fast. (CURL/RIN, 2007, p. 8)

Many of the next generation of researchers will have grown up familiar with Facebook and MySpace, and will have been educated, at least in part, using Virtual Learning Environments. There has been a proliferation of studies in the last year looking at the so-called Google Generation with an eye to the future - the technologies the children and young people of today tend to use, and what their competencies are in the areas of Information technology and literacy, will impact on the services they will need from libraries when they become university students and adult researchers. (CIBER, 2008; Educause/NMC, 2008)

Collaboration is the key to research success.

Scientists and researchers have always collaborated – it's long been recognized as key to success in making breakthroughs, getting funding, and having research results published and disseminated. Traditionally this collaboration has taken place both formally within research groups and faculties, and informally through social networking (the old fashioned kind) and interaction within what sociologist Diana Crane identified as "invisible colleges." (Crane, 1969)

Web 2.0 technologies and researchers, are a match made in heaven. In a recent article about the growth and potential of 'networked science' Diana Rhoten describes the advantages of what she has dubbed the "virtual hallway" for scientists, in which the doorways lead to labs and offices containing every discipline under the sun - a space unachievable in the physical world. The benefits to researchers and to the community that arise out of collaboration on this scale are too great to be ignored. Solving tomorrow's problems, says Rhoten, will rely more on our ability to create fluid, responsive networks of scientists and engineers." (2007)

Greater demands on researchers

Ironically, the increase in the use of collaborative technologies is also fed by the demand for researchers to be able to compete more effectively in a global economic and research environment.

In Australia, the political and funding environment has meant that the government and Universities are now demanding that research staff achieve tangible outputs in the form of citations rates, funding, research impact and the ability to attract top students.

In Europe, the need for the local manufacturing industry to remain globally competitive (ie. produce high quality products at low costs, sustainably and quickly) was the impetus for the creation of the Virtual Research Lab for a Knowledge Community in Production (VRL-Kip). The VRL-Kip network enables collaboration between 20 research units involving 150 researchers in the fields of design, production, and innovation to enable the development of competitive manufacturing processes. (<http://www.ist-world.org/>)

The paradox is that In order to compete, researchers *need* to collaborate.

Investment in VREs and e-research infrastructure

Make no mistake – this is going to be big. Universities around the world are already putting resources into developing VREs and, at a national level, Australia, the UK, Europe, the US and Japan, are investing heavily in the development of infrastructure and policy to support virtual research on a grand scale.

E-research, e-science, networked science – whatever name you use, this type of virtual research involves large-scale, distributed, national or global collaborative research enabled by the internet and related technologies. Waaijers (2006) describes e-research as “harnessing the capacity of information and communication technology (ICT) systems, particularly the power of high-capacity distributed computing, and the vast distributed storage capacity fuelled by the reducing cost of memory, to study complex problems across the research landscape.”

In Australia, the National Collaborative Research Infrastructure Strategy (NCRIS), is providing \$542 million from 2005 to 2011 to provide researchers with major research facilities, supporting infrastructure and networks - the emphasis, as the name implies, is on collaboration.

So, the pace is picking up, and research libraries need to be planning for the ways that researchers are now, and will increasingly be working.

What are Virtual Research Environments?

Virtual Research Environment is a term generally used to describe a set of online technology tools, which facilitate the research cycle. The main, defining element of a VRE is peer-to-peer collaboration enhanced by Web 2.0 technology and its derivatives. In a sense, once researchers are using an online collaborative space to conduct their research, that space *is* a Virtual Research Environment. As technology becomes even more ubiquitous, terms such as Virtual Research Environment may become superfluous as it will just be normal research practice to collaborate online, and therefore not require a special label.

As far as VREs are concerned, “One size does not fit all.” (Wilson 2007) What a VRE is comprised of depends on various factors like purpose, funding, discipline and existing infrastructure. Some VREs are informal modes of research comprised of instant messaging, file sharing, blogs, wikis and other online, resource-sharing Web 2.0 technologies.

Other VREs are specifically built for a particular team’s needs using a central collaborative environment like Sakai, which is then customised and its functionality extended to meet a set of requirements defined by the research team for whom the environment is being built.

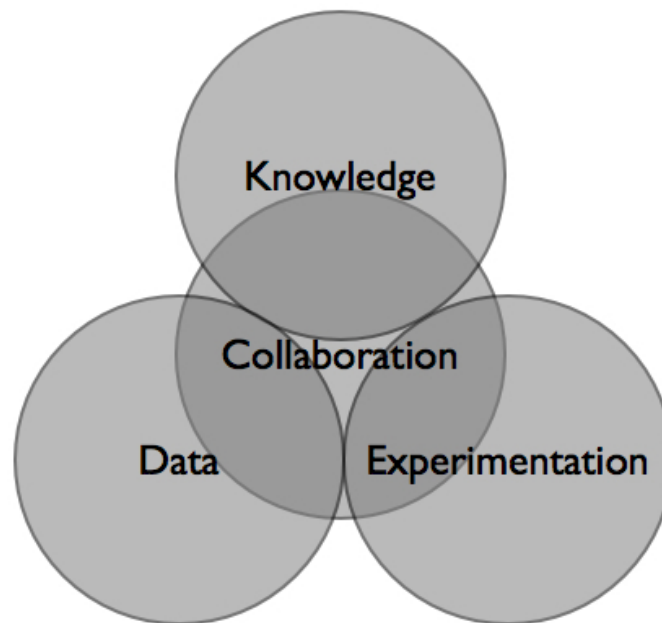
The core elements of a VRE

In developing a VRE environment model, the *University of London Library (ULL)* proposed the following list of components:

- Virtual Research Library Support
- Research-related information
- Online secure research repository (OSRR)
- Online Research Support Mechanisms
- Tracking of Research Activity and Achievement
- Research Output Repository
- Software Evaluation
- Researcher Involvement

While not every VRE will be comprised of the components defined by the ULL model, they will all contain a collaborative tool augmented by additional tools.

In essence, even the most elaborate VREs are composed of four core components: Collaboration, Knowledge, Data, and Experimentation.



Collaboration is the central function which allows users to communicate and network their *communities of enquiry*. Depending on the nature of the VRE, collaboration can be via email, instant messaging, blogging, wiki, podcasting, forums, audio/video conferencing or any other type of technology enabled collaboration. Some VREs even incorporate virtual worlds like *Second Life* as a collaborative space. These collaborative spaces are *enquiry* focused and are rarely used as a social space.

Knowledge is the access to scholarly information. Researchers always need to be able to access academic information from within their research environment, whether that be real or virtual. VREs can provide access to library resources, journals, academic writings, information databases and open-access repositories. Access may be provided via the traditional OPAC search and discover methods, or with new subscribe and deliver methods that make use of Web 2.0 technology.

Data is having access to raw experimental and statistical data sets, and the tools to analyse them. This functionality of a VRE provides researchers with an easy method of discovering existing data which they can use to further their own research. E-research initiatives have set the foundations for these data sets and VREs are simply harnessing these outcomes.

Experimentation is the most discipline specific and unique feature of a VRE. It may be a tool with immense processing power that is used by the particular discipline to conduct simulated experiments. In other instances it may simply be a web site that surveys visitors. What is common to all *Experimentation* tools is that they generate data to support the research *enquiry*.

The model presented here is just that - a model. It is not a rule or set of instructions on how to build a VRE, but a simplified representation of virtual research. To illustrate the model we will use The Dictionary of Australian Artists Online (DAAO) as an example. The DAAO is an online presence which invites art lovers and art researchers to search, discover and create Australian art history. It provides a collaborative space with its focus of *enquiry* to discover all there is to know about Australian artists. Data relating to Australian artists is created and edited by authorised contributors - similarly to a Wiki. The data captured includes birth dates, locations, dreaming, indigenous, languages and ancestry. This data can be analysed to create a rich tapestry of knowledge relating to Australian art history. The entire project itself is a kind of social experiment which is generating the data required for the knowledge to flourish, which in turn attracts further collaboration. Since its launch on the 15th November 2007, 160 new biographies have been contributed and published. The DAAO is not consciously labelled a VRE, but it is a VRE by its very nature and displays all four elements of the VRE model.

What do libraries have to do with it?

Facing the changing world of research

How do libraries prepare for this new web 2.0 world of VREs and e-research? As VREs flourish, there are some fundamental questions for libraries. How do we position our content for use within VREs? What new services do we need to develop in order to retain our position as active partners in the research process? What skills and knowledge will be required?

Content

For research libraries, Web 2.0 is not just about creating or participating in social networking technologies, creating podcasts, blogs and wikis. It is about content. Knowing what types of content researchers need is what libraries are good at – it's been our business for centuries. Researchers come to the physical library, and more recently to the virtual library, to access the most relevant and reliable resources. Now, as the virtual environment evolves, they will expect library content to come to them in the spaces that they work.

Even with the most active outreach and liaison staff, it would be unlikely for any large research library to be aware of all the ways that their users are or will be collaborating online. For research libraries Web 2.0 is, or should be, about letting researchers use our content where and how they need it. (Levine, 2006; Coombes, 2007) We need to make our content easily accessible via a set of open standards so that it can be placed within the networks and environments that people are using. (Educause, NMC 2008, p. 2)

A simple example is the syndication of library content via RSS feeds. At the University of New South Wales we have used RSS feeds to deliver new book alerts to researchers' desktops. The LibX (<http://www.libx.org/>) toolbar has also been implemented to provide users with direct access to our catalogues from their browsers regardless of which website they are viewing. Both of these technologies have proved to be hugely popular and useful tools amongst our users, but really only scratch the surface of what is possible with web 2.0 technology.

"The future is the mass customisation of academic knowledge via services overlayed over repositories." (Waaaijers 2006) Web 2.0 has a set of standards that can provide these services and allow the flexibility to continue innovation in the ways that content is delivered.

Digitisation issues

There is of course still much data and information that resides in printed material and isolated mediums. Digitisation is hugely important to VREs.

In the UK a VRE is being developed for the Study of Documents and Manuscripts to complement research into damaged and illegible documents. It will allow researchers to access image collections in order to view, enhance and annotate images of documents, and share their annotations and findings with colleagues.

(<http://bvreh.humanities.ox.ac.uk/VRE-SDM>)

Much of this sort of valuable material is still sitting in libraries, not available online.

The process of digitising collections is very expensive and timely, and as a result libraries are beginning to enter into digitisation agreements with big companies like Google and Microsoft. Libraries need to carefully consider their options in digitising their collections, with a focus on the ownership of the final digital objects and their copyright restrictions to ensure that they remain openly and freely accessible. Columbia University Library has just signed an agreement with Microsoft to make their collection available through Microsoft's Live Search Books. The agreement allows the library to "provide worldwide access through its own digital library," and to "share the content with non-commercial academic initiatives and non-profit organizations." (LJ: Academic Newswire, 2008)

The US Association of Research Libraries has developed extensive guidelines to assist libraries negotiating digitising agreements.

Digital Repositories

Digital repositories are a growing area of business for libraries and are increasingly becoming part of the established research infrastructure that is so important to the success of any VRE project.

As many VRE enabled research projects involve collaborators from different institutions, reciprocal access to resources is essential. The Australian Access Federation is working towards enabling access between member institutions to resources, including commercial publications. (AAF website) However, publishers will need to 'sign up' to this and agree to make their content accessible – and obviously this impinges on their profits and licensing agreements. Open access digital repositories by-pass these issues.

The DSpace Organisation is forging ahead in this area, providing the software and support required to easily build open access repositories. It claims to have the largest user base and most widely recognised standards for data interoperability. (www.dspace.org)

Interoperability with VREs to facilitate the deposit of and access to scholarly communication (Fraser, 2005) is of course key to how useful digital repositories will be, but the distinctions between repositories and VREs may become less pronounced as technology and interoperability is developed.

What is clear is that digital repositories and libraries will increasingly have a role to play in the management and preservation of the large volume and new genres of scholarly output that we are now seeing emerge.

Data sets and data management

This brings us to the looming issue of data, data, and more data. The data management needs that are emerging as a result of virtual research, particularly large-scale e-research, are immense and very complex. VREs will increasingly be spaces for both the re-use and production of data. Data sets of unprecedented size are already being produced which need to be preserved, and made available for use by collaborating researchers. (Lougee et. al, 2007)

The National Virtual Observatory (NVO) in the United States grew out of the astronomy community's need to cope with ever increasing data sets and the need for storage, management and access methods. The NVO is a dynamic, distributed, open research environment for astronomy, with massive and complex data sets. The NVO offers a means to access stored data, but it also supplies researchers with computational services and tools with which to mine and analyze data and is networked with other virtual observatories around the world. (Goldenberg-Hart, 2004)

Is it possible that libraries could offer services much like those of the NVO? There is definitely an opportunity here for libraries to step in, although admittedly a project along the lines of the NVO would be a huge undertaking for any single library. Many VREs and research projects do

not operate on the same scale as the NVO - but nevertheless produce valuable data and information that needs to be preserved and shared. (Curl/RIN, 2007, p. 8)

When asked about their data discovery, management, and organization needs, most researchers reveal that they are lambs lost in the data sets wilderness. Most are unsure of how or even whether to share data, and lack the knowledge and time to organise, describe and archive data sets. (Brandt, 2007; CURL/RIN, 2007)

And why should they? Managing, collecting, organizing, describing, curating, archiving, and disseminating information is the business of libraries. (CURL/RIN, 2007) If libraries do not step in to provide curation and preservation services, much of this vulnerable information may be lost.

Some libraries are already taking up this challenge - Purdue University Library has established the Distributed Data Curation Centre (D2C2), to develop solutions for curating research data and data sets. The Director of D2C2, D. Scott Brandt, suggests that library involvement in organizing and describing digital objects at the very early end of the e-research spectrum will facilitate data mining in the future, which could truly facilitate new paradigms of research. (Brandt, 2007)

Libraries as Collaborators

Obviously there are huge changes happening, which are already affecting researcher needs and expectations of library services. It is essential that libraries maintain good communication lines with faculties and researchers so that research needs, and library services and content remain aligned. Purdue University Library's involvement in the curation of data sets began with the Library Dean getting out there and telling researchers and academics what library science and librarians could do for them. (Brandt, 2007)

The Dictionary of Australian Artists Online demonstrates what can be achieved with libraries as collaborators – the project needed to be a collaborative one in order to succeed, and libraries and librarians have been key players in its development. (Wells 2005) Librarians with knowledge about the research needs of the art community were able to identify the usefulness and potential of the resource, 8 of the 18 members of the DAAO advising committee are librarians, librarians have identified user needs, and written and tested user case scenarios, digital librarians help maintain the system, and librarians are involved in the indexing of data. The project's home is at the University of New South Wales Library, and the DAAO is accessed via the Library's website.

Where to from here?

What will happen in the next five years?? If developments continue at their current pace, we can safely conclude that there will be a rapid rise in researchers using Virtual Research Environments.

It is easy to create a blog or a wiki, and usage of these technologies is generally on the rise so, as we have mentioned throughout this paper, you would expect an increasing trend in the use of these technologies by researchers as well. Customisable collaborative environments like *Sakai* are also facilitating the growth and uptake of VREs. Large scale e-research and virtual environments are set to become common research practice.

It is also worth repeating that current students, who have grown accustomed to collaborating in an online mode, will become the researchers of tomorrow.

So, where to from here? In the spirit of *23 Things*, we would like to leave you with some suggestions.

- Talk to researchers at your institution - find out what they are doing and how they are working.
- Look at VREs, talk to the developers and the users. A quick google search on SAKAI Demonstrator will bring up some good information. The UK Joint Information Systems Committee website is also a great resource. www.jisc.ac.uk
- Talk to your IT staff – find out what they're doing, and what infrastructure is in place or being developed.
- Visit www.dspace.org and read about it.
- Read the Australian National Data Service Working Paper on data management issues and find out what is happening in regards policy.
<http://www.pfc.org.au/twiki/pub/Main/Data/TowardstheAustralianDataCommons.pdf>

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