DIGITAL REPOSITORIES:

ISSUES AND CHALLENGES

A
LITERATURE REVIEW

PREPARED

BY

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2006

TABLE OF CONTENTS
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ABOUT THIS PROJECT

Digital Repositories was the topic I chosen for my Information Research Project [BUSM2393] as apart of my Bachelor of Business information & Knowledge Management degree at RMIT.

I become interested in digital repositories a while ago when I attended a presentation by the team behind the implementation of a Digital Repository at the University of Melbourne.

I didn't know that such repositories existed and where in most cases available for everyone that knew about their existence.

It was interested in learning more about digital repositories and why they came into place.

Through this project I learnt that digital repositories are not a new invention and they have been around for a while now, I also learnt that many academic libraries are taking the lead role by implementing them.

Some of the reasons they have for setting up a repository have to do with promoting their own community scholarly output and showcasing it to the world, the journey to achieve this at times was not that easy, not because repositories were hard to implement, but because promoting and convincing researchers about the benefits of participating and submitting material onto the repository were not an easy sell, so a great deal of promoting and advocating institutional repositories was crucial for their success.

The limitations and constrains of doing this research were related to the fact that I was not really sure how to give a direction to my research, most of the initial research that I have done took me to articles related to archiving and preservation, these topics were closely related to my topic, but I was not intending to research them.

Our lecturer suggested that I could review some articles and give my paper a start, but again the problem of not being sure about the direction of my paper resulted in getting sidetracked on my topic.

Once I found my way into it I began collecting enough research to start my review.
This was probably the longest part, as I could not avoid furthering reviewing other articles mentioned in my original research.

My lecturer suggested some of the questions that I devised during this part of my project and they proved very helpful, I began asking myself what is a repository, when they began to emerge and the reason for that, and finally how to set up a repository.

Soon after this process some sections of my research began to emerge, my lecturer helped me again to re-organise my paper and my table of contents.

Finally I would like to thank my lecturer Frans Koomen to help me with this research and for giving me directions and ideas to complete this project and gain a better understanding of what digital repositories are, and the benefits they provide for the learning community.

———————————

INTRODUCTION.

In 2002 the MIT [Massachusetts Institute of Technology] launched the Dspace Institutional repository program, since then a large number of academic libraries embraced this system and created their own digital repository.

This paper examines the issues and challenges of setting up a digital repository in an academic library, including the technical and administrative requirements to consider prior setting up a repository. This document also explores the benefits of implementing such system.

This paper also illustrates examples of institutional repositories in academic libraries in Australia, with an overview of the end result, including policies, interfaces and major achievements.

What is a Digital Repository?

To better understand the term *Digital Repository* we must start defining what an *e-print* is. E-prints are a collection of electronic documents organised in a specific way, according to their purpose. These e-prints may or not, been referred before, and can be as varied as journals articles, conference papers, chapters of books or any form of research output produced by an scholar (Pinfield 2004).

In contrast to e-prints archives or digital libraries, institutional repositories capture the research output generated by an institution; this concept is further developed in this paper.

According to Bergman [2001] e-prints are hard to find through a search engine because they may be 'hidden in the deep web' and therefore they cannot be found, Bergman estimates that public information on the deep Web is currently 400 to 550 times larger than the commonly defined world wide web. *See* Figure 1 & 2, institutional repositories have the ability to raise the hidden contents of the deep to the surface web.

Some of the common characteristics of repositories are that their content is defined and generated by their own institutional community, including, researchers and scholars. By norm repositories are available free online, and they are *interoperable* and cross-searchable

Repositories are not really a new technology in fact, in some areas or disciplines repositories have been providing free access to users for many years. Bellow some examples and definitions of repositories types.

DIGITAL REPOSITORIES.

Institutional repositories [IR]

The term institutional refers to the educational or research parent body that controls the repository that usually is the university library.
IR according to Lynch [2003] is a set of services that a university provides to the members of its community with the purpose of management and dissemination of digital materials created for the members of the university community.
This service also implies the safekeeping of this material through long-term preservation if appropriate including the organisation, access and distribution of the collected material.
The definition given by Crow [2002] applies better in the context of this paper; he said that "an institutional repository is a digital archive of the intellectual product created by the faculty, research staff, and students of an institution and accessible for end users both within and outside of the institution with few if any barriers to access".

Discipline-Based Repositories

This type of repository also known as Subject or Research repository are based around a specific discipline, the first and best known is the arXiv http://www.arxiv.org a repository of research papers in the fields of physics, mathematics, non-linear science, computer science and quantitative biology.

ArXiv began in 1991 and was originally based at Los Alamos National and now based at Cornell University Library; arxiv is widely used by physicists across the world (Jones, 2006).

Other examples of discipline- based repository are the EconPapers, working papers in economics [www.econpapers.repec.org] and CogPrints [www.cogprints.com] a repository that captures literature on Psychology, Neuroscience and Linguistics and other areas of Computer Science.

Consortia Repositories

The Massachusetts Institute of Technology [MIT] in partnership with the Hewlett-Packard Corporation created a repository with the idea of capturing, distributing and preserve the intellectual output of MIT. The Dspace software was later adopted by other institutions to launch their own repositories. https://dspace.mit.edu/index.jsp

Another example of Consortia repository is SHERPA LEAP http://www.sherpa-leap.ac.uk/ [London E-Prints Access Project] began in 2004 and provides an open access to e-prints for seven universities in London; the LEAP Consortium is led by the University College London.

Learning Objects

A Learning object refers to a repository of electronic learning materials use for support teaching and learning, this material is often created in small chunks of information and is re-usable, examples of learning objects include files such a video clip, a text or a URL, a power point presentation etc. [Wiley, 2002].

Because learning objects vary in format and metadata requirements it is difficult to capture them into a single repository, and less likely to be considered as having a useful showcase for their institution, despite this, the value of learning objects is their capacity to be re-used many times. [Jones, 2006]. Learning objects emerged as a response to the need of provide high-quality reusable instructional material for teaching, that is well organised and easy to search.

Examples of Learning Objects repositories are: The LOR (Learning Objects Repository) a project undertaken by VCILT - University of Mauritius [*See http://vcampus.uom.ac.mu*]

And RMIT where objects can be use in online learning through the Blackboard and the DLS [See http://www.rmit.edu.au]

ARROW PROJECT

ARROW project started in 2004 with 'the objective of developing best of breed solutions for open access institutional repositories and electronic publishing in Australian universities over three years' [VALA, 2006].

Because ARROW is still a development project it will identify and test appropriate software to support best practice institutional repositories and will comprise e-prints, digital theses and electronic publishing.

ARROW is funded by the Australian Commonwealth Department of Education, Science and Training, under the Research Information Infrastructure framework, for Australian Higher Education.

The ARROW consortium consists of Monash University as the lead institution, Swinburne University, the University of New South Wales and the National Library of Australia.

ARROW uses 'Fedora platform software because is a robust, and well structure software architecture that supports flexible object oriented data model, using persistent identifiers down to the level of individual datastreams accommodating its compound content model'
[VALA, 2006]

ARROW primary project for 2006 is the embedding of the ARROW repositories into the information management practice of their participating universities; this will be done through the ARROW Discovery Service that expects to provide the following:

A) Provide an appropriate search interface that is simple search, advance search and browse options

B) Contributing to other networks such as OAIster, Yahoo and Google

C) Ensuring appropriate local institutional and national 'branding' of the service

D) Provide appropriate subject- based access.

For further information on ARROW *See* http://arrow.edu.au/

MAKING A CASE FOR A REPOSITORY

Outlining the benefits

Traditionally institutional repositories and research libraries role is to capture, preserve and disseminate their university collective intellectual output, thus becoming an indicator of the institution's academic quality output [Crow, 2002].

In the past research produced by academic scholars was managed within faculty departments and kept between university intranets and hubs facilities, making impossible to access this information freely from the outside or from popular search engines [Young, 2003], thus becoming simply '*grey literature'* hidden and lost from view.

Research advance

Today, with the arrival of the Web there is an increase pressure for institutional repositories to release their output why? Because for research to advance in medical advances, in engineering and other scientific areas it have to be available sooner than later, not only to satisfy researchers own career ambitions, but to speed up progress in humankind [Jones, 2006].

Increase visibility and raising profile of institution

Institutional Repositories are then a metric control for the institution's own productivity, increasing visibility and prestige of quality scholarship research, potentially translating into benefits for the institution such as increase funding for research and technology and possibly attract high quality staff and students into their institution, this view is shared by Johnson [2002] Jones [2006] and Cervone [2004]

Possible cost reduction of scholarly published journals

Smith [2004], Jones [2006] and Crow [2002] agree that IR have the potential of reducing the costs associated with accessing scholarly published journals through licensed publishers website and commercial databases.

Increasing costs of journals and reduction of library budget to purchase these resources may lead academic libraries to seek alternative access to research material by creating a new form of *scholarly publishing* through e-prints repositories.

This could have the potential of transforming the existing system of publishing, this view is supported by Pinfield, who also said that repositories do not necessarily should replace the existing peer-reviewed journals but might rather complement them. He said journals and repositories can exist side by side, and authors should also be encouraged to self-archive their e-prints as well as publishing them in the peer-reviewed literature.

Lynch [2003] added that institutional repositories can enhance access to traditional scholarly content by 'empowering faculty to effectively use the new dissemination capabilities offered by the network', if researchers participate actively by submitting material in repositories they would open up new forms of scholarly communications as referred by Pinfield earlier, thus enhancing access of research material both short and long term.

Benefits for Authors

Some of the benefits for authors to submit their intellectual work into repositories are according to Pickford [2006] the opportunity to increase dissemination of their research, citing the work of Antelman and Kurtz [2004, p. 373] to illustrate that an open access material gets cited more often than of restricted access work.

This correlation is also mentioned by Lawrence [2001], where more highly cited articles in the Internet are more likely to be also open access and online. **See Appendix 1**

For researcher digital repositories are more flexible archives in terms of use, offering greater security and long terms access to researcher's own material.

Another benefit for authors is the ability to access a wide range of materials in different format through repositories compared with traditional print-based publications.

Pickford also mentions the ability of some digital repositories to allow the deposit of pre-prints which helps authors to get feedback and commentary for their work from peers, as well as adding some personal services to authors such as hit counts on papers, personalised publications lists and analysis of citations [Pinfield, 2002].

COSTS INVOLVED

Here are two types of costs that should be closely examined before setting up a repository, firstly, the cost associated with acquiring the software and the hardware, these costs according to Crow [2002], are relatively modest compared with the costs in staff time, in terms of organising, promoting and maintaining the repository, these costs are according to Jones [2006] Pickford [2006] and Calan [2004] should not be underestimated.

Secondly, balancing the costs of an e-print repository compared to purchasing a large bundle of e-journals from publishers should also be examined.

Pinfield [2004] and Jones [2006] believes that e-prints repositories have the ability to change the current system of scholarly communication by reducing costs of purchasing prints and electronic serials, [Cost of serials] *See Appendix 2*, this is unlikely to translate in the cancellations of journals subscriptions anytime soon, but for researchers and end users it will means the chance to access material that otherwise would be unavailable, repositories should complement existing publishing arrangements.

Crow [2002] also said that future costs of preserving and archiving the repository should also be added and budgeted, especially if the institution plans to migrate and convert the media and format of the repository content into a new version, this 'migration' he said could also be outsourced to a third party to balance future archiving costs.

TECHNICAL ISSUES

Interoperability:

For a repository to provide access to users outside the university, so they are able to find and retrieve information from it, it should be able to support interoperability in order to provide access via search engines and other searching tools, to do exactly that persistent naming, and standardized metadata formats and a proper metadata harvesting protocol should be in place. [Crow, 2002].

Metadata:

Metadata describes the nature of the digital data that is stored in the repository, and also describes the contents, structure and access of this data; this enables other services to harvest and search the content, such is the case of the OAI [Open Archive Initiative] exists to develops and promotes interoperability to facilitate the efficient dissemination of content' [from Open Archives FAQ]. This Protocol for Metadata Harvesting or OAI-PMH enables the sharing of metadata between services. OAI standards have been adopted by a large number of institutional repositories, including OAIster [see http://oaister.umdl.umich.edu/o/oaister/] and Goggle Scholar [see http://scholar.google.com/][Pickton,2006].

Documents Formats and Types:

A very important element of the repository is the document type, in other words what sort of document will be accepted and in which format, considering the file format in terms of suitability and usability might translate into easy conversion or 'migration' of files into a new version as well as ensuring the preservation of the original document. For instance the use of Adobe PDF as preferred format is likely to guarantee the preservation of the document as is widely used in many repositories, this view is supported by [Penfield, 2002] and Cervone [2004].

And according to Jones [2006], the best sort of files are those where the contents and format are human readable [stored in plan text], and as well as Pinfield, Jones believes that storing the converted files along with originals will ensure that risks involving migration are minimised.

For example the default file format on the E-prints org. software is to accept: Postscript, PDF, ASCII and HTML. Pinfield also advises that because HTML format is a very fluid standard it is difficult to validate easily, and probably not recommended to accept documents into this format.

SOFTWARE

Some of the open source software products available are: Dspace, GNU Eprints and Fedora. There are some commercial options like BioMed Central, but open source software are the best option as they are free.

Dspace
http://www.dspace.org/:

This software as mentioned earlier was originally created as a collaborative research project between the Hewlett Packard labs and the Massachusetts Institute of Technology Libraries over a period of two years from 2000 to 2002.

DSpace software is easy to install and was created as a platform to build an institutional repository. DSpace allows deposit of digital content and metadata [Dublin Core] into the repository by users [researchers or librarians on their behalf]; this is done by following an approved workflow indicating the policies for reviewing, and approval of the material to be lodged for submission. Unlike E-Prints Dspace allows a wide range of digital material types.
Dspace have been adopted by many institutions including Victoria University *See* http://eprints.vu.edu.au.

GNU E-Prints
http://www.eprints.org/software/:

E- prints also was developed to provide greater access to research material, but can also be used for many purposes such as teaching resources, museum exhibits and administrative materials] and can also be configured to act as an archive of published research material such as journals, books, theses, pre-prints and technical reports. E prints provides a free web interface for managing, submitting and downloading documents, and the mayor advantage of this software is that is OAI-compliant.

E-Prints have been adopted a number of Australian academics libraries including the University of Melbourne, *See* http://eprints.unimelb.edu.au and by Queensland University of Technology [QUT] *See* http://eprints.qut.edu.au.

Fedora [Flexible Extensible Digital Object and Repository Architecture]
http://fedora.redhat.com/

Fedora began in 1997 as part of a funded research at Cornell University and further developed in collaboration with the University of Virginia Library Research Group. Fedora is as described in their website 'a powerful digital object that supports multiple views of each digital object and the relationships among digital objects'.

Fedora is different software because the model is abstract; making no difference what kind of data is represented by the digital object including text, images, video, sound etc, making this software is a flexible tool for archival and institutional repositories as well as a good resource option for education and teaching.

IDENTIFIERS

Repositories need identifiers to make persistent reference to the digital objects so they can be searchable by users. Sale [2004] and [DiLauro, 2004] points that if objects are worth of preservation they should have a proper identifier that is also useful over the time that the object is preserved [long term archiving]

DSpace for instance uses the Handle System, a mechanism that helps to achieve this. Fedora instead allows any identifier that complies with the Uniform Resource Name [URN], and does not impose any *semantics*.

Some identifiers allows access additional information about themselves, which can be useful to communicate policies regarding the identifier, for instance how long the identifier guarantees to be resolvable, and other policies associated with the digital object itself.

ADMINISTRATIVE ISSUES

MANAGEMENT POLICY

Before a repository is established a number of decisions should be taken into consideration. Decisions on systems architecture, content, scopes and purposes of the repository should be defined in this policy.

According to Johnson [2002], some of the key issues to consider before setting up a repository also are:

- Access levels, legal aspects including copyright and ownership of the material submitted.
- Standards including metadata, formats and documents types
- Sustainability and long term archiving and preservation
- Funding available to maintain the repository.

SUBMISSIONS

In order to establish how the repository will be managed it is important to have administrative guidelines regarding the submission of material into the repository, repositories do this by using a workflow to indicate the necessary steps to achieve it.
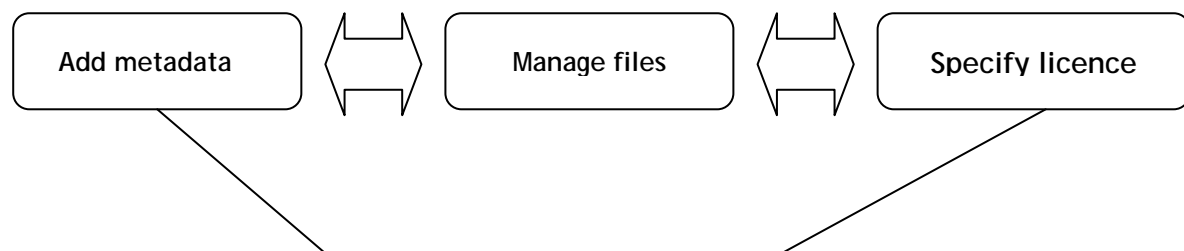Workflows can easily describe who that what, when it get done and how [Thomas, 2005].

Submission is a workflow that is often entered by one person; therefore the stages of the workflow are essentially very close together, so the process can be completed successfully very quickly.

According to Jones [2006] any item submitted into an institutional repository is defined by its content, in other words the files and the metadata attached to it, but they are also other important elements that should also be considered, such as licensing agreements, so a record of what was agreed with the depositor remains with the item perpetually, as well as the structural information about the item.

The basic three components steps of a repository submission *workflow* are:

a. Capture of metadata
b. File Management
c. Licence handling

```
┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│  Add metadata   │ ⟺   │   Manage files  │ ⟺   │ Specify licence │
└─────────────────┘      └─────────────────┘      └─────────────────┘
```

Example of simple three-stage submission workflow.

See also Figure 3 to 6 in Appendix.

Submission: Mandatory or Not?

The issue of mandatory submission to the repository should also de discussed, at the moment only QUT Queensland University of Technology have a formal requirement for authors to deposit all research output in their repository, the rest of the Australian universities have a voluntary deposit policies.

And according to data collected by the Australian Department of Education, Science and Technology [DEST], "no Australian university with a voluntary policy collects significantly more than 15% of the DEST reportable content and most much less" [Sale, 2004].

QUT stands out 4 times higher than its nearest competitor, *See* Figure 7, and the data available up to March 2005 suggest that QUT expected a success deposit ratio of nearly 60% and 80% for 2006.

For QUT the policy have been very helpful to help populate the repository according to Paula Callan, but it was also the result of considerable amount of work put into promoting the repository through brochures, emailing Deans and Faculties and contacting researchers.

RESTRICTIONS

Institutional repositories do not normally allow permission to remove material from the repository once submitted. Only in exceptional circumstances these restrictions should be lifted, for instance if there is a problem with copyright restrictions imposed in the item.

Other restrictions may refer to the access of the content of the material to a specific set of users, for example where is an embargo by some department regarding the access of the file for political, commercial or industrial reasons [Johnson, 2002].

Restrictions then should be specified in the repository under the management policies.

COPYRIGHT

Questions regarding the ownership of scholarly materials produced by universities are not always easy to interpret. According to Jones [2006] this vary between countries, in Australia the legislation establishes that an employee creates a work in the course of employment, then and subject to contrary agreements, ownership belongs to the employing institution.

In most cases the right of the intellectual work is given away by authors as part of copyright transfer agreements, routinely signed to publish in academic journals, this creates financial implications for institutions to allocate sufficient funding to cover copyright permissions for journal articles.

This issue is also explored by Garner [2003] that reminds us that is still possible for academic staff to submit their work in journals as well as deposit them in the institution repository. Researcher she said signed away their copyright to publishers in exchange for the opportunity to make their research visible and known by many, and also to gain career advances.

The University of Melbourne, for instance differ compared to other universities, because in most cases academics own their intellectual property rights rather than being required to cede them to the University, and contributors to the repository are required to sign a form allowing the university non-exclusive rights to store copies in the repository, the form also requires authors to attest that they own the intellectual property of the work.

Sometimes the author no longer owns the intellectual property of their research output, and the research was carried out as part of a contract that may own the intellectual property, and the author only retains the right to make the work publicly accessible on the web. *See* http://eprints.unimelb.edu.au

ADVOCACY AND PROMOTION

A digital repository requires a number of technical and administrative steps to develop before implement it. Two very important aspects are advocacy and promoting, as there is not use of having spent money and time planning a repository that is empty. A repository is useful when is used by users and sufficient material is stored in them for users to search.

The participation of users by contributing with content, is primarily important, for instance at Loughborough University in the UK 'early adopters were identified, and individuals who were already uploading their research to their personal web-pages and publishing in e-journals were contacted, this resulted in 250 initial papers being loaded into the repository.

Convincing academics of the benefits of an institutional repository is probably the main task and possible the biggest challenge, many researchers are reluctant to submit a paper in the repository, because this will demand to fill another form and add another task to their already limited time, this view is supported by [Cervone, 2004].

At Loughborough University these process have been done for academics within the Library [Pickton, 2006]

A similar experience happens at Nottingham and Edinburgh university were the easiest way to promote the repository was by including publications that were already in the open access, some of there were in academics own website or in departmental pages, in all of the cases authors were contacted and most of them agreed to collaborated and sent their papers. Important is to present the argument that a researcher is also a contributor and a reader of literature to make them to participate into submit material.

At Queensland University promotion of the repository began immediately after the draft policy was approved by the University Research and Development Committee.

A number of meetings an a formal launch including the distribution of a glossy brochure explaining the repository helped to begin to show to academics that an archive existed, but extra promotion efforts were needed.

At Melbourne University responses to the repository have been varied, from supportive to dismissive. Some academics were satisfied with this new model of scholarly communication as well as pleased by the speed of publication, others expressed support that their intellectual work was being more widely and freely accessible [Garner, 2003].

Melbourne University also gathered information about the number of hits the repository received from the date the repository was registered as compliant with OAI and indexed by ARC. *See* figure 8

CONCLUSIONS

Institutional Repositories have the potential to change the problems of today's scholarly journal system, by transforming the scholarly communication and enhancing access to material that otherwise is lost or hidden from view.

Repositories also have the ability to increase visibility of the institution by showcasing the intellectual research output of their community, this not only means increased dissemination and feedback for authors and contributors, but it also implies advance in research for humankind.

Academic libraries play an important role in developing and managing a digital repository; they are after all, the traditional custodians of cultural memory of organisations.
By setting up a repository academic libraries are extending their commitment to provide access to information.

Researchers and scholars are entrusting libraries to publish and preserve their intellectual work through repositories.
Libraries then, are not longer passive mediators for users to obtain information; they can transform their role from passive transfer agents of information to active partners of information process.

Library and information professionals should have the vision to be leading the way in the implementation of institutional repositories and change the structure if not the nature of scholarly communication.

APPENDIX

EXAMPLES OF INSTITUTIONAL REPOSITORIES
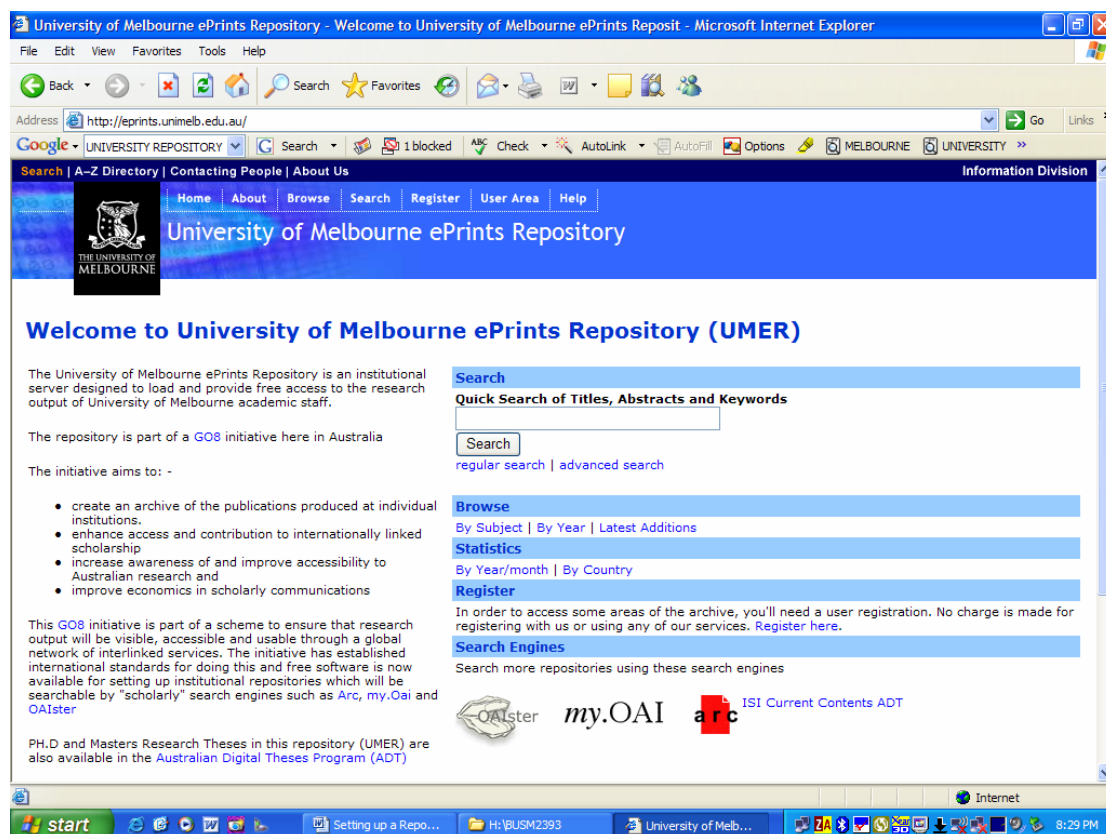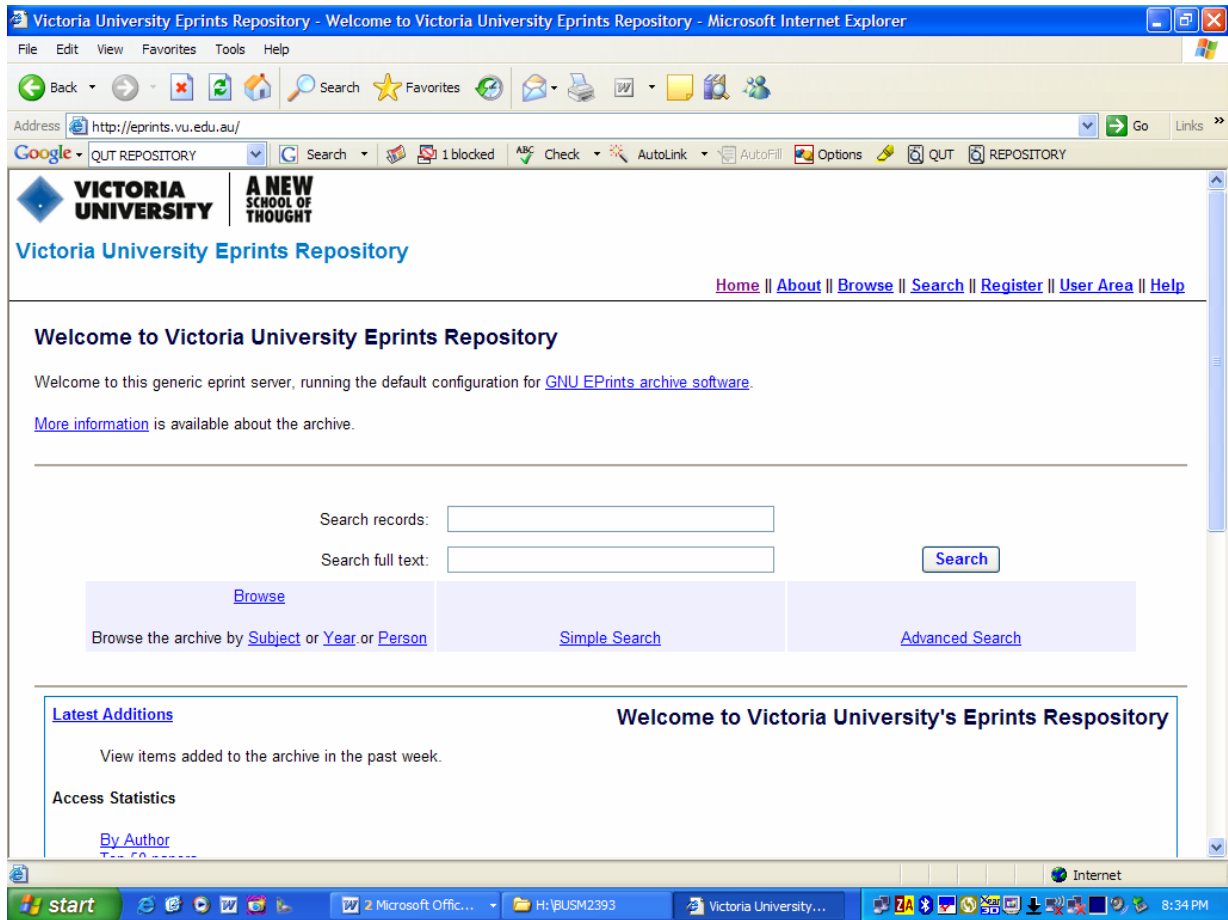

University of Melbourne Repository [UMER]

See: **http://eprints.unimelb.edu.au**

Queensland University of Technology Repository
See: http://eprints.qut.edu.au/

Victoria University Repository

See: **http://eprints.vu.edu.au/**

Australian Research Repositories Online to the World - Microsoft Internet Explorer

File   Edit   View   Favorites   Tools   Help

Back   Search   Favorites   Media

Address   http://arrow.edu.au/

skip to content   Site map | Site search   Find

about arrow   contact us   publications   repositories   project documents   news & events   arrow members

Deposit. Share. Find.

Welcome

The ARROW project will identify and test software or solutions to support best practice institutional digital repositories comprising e-prints, digital theses and electronic publishing.

The ARROW project is funded by the Australian Commonwealth Department of Education, Science and Training, under the Research Information Infrastructure Framework for Australian Higher Education.

The ARROW Project is sponsored as part of the Commonwealth Government's *Backing Australia's Ability*.

Consortium Members

The ARROW Consortium comprises Monash University (lead institution), National Library of Australia, the University of New South Wales, and Swinburne University of Technology.

This Site...

This site provides details on the ARROW Project through the navigation links at the top of this page.

Alternatively, view our list of ARROW repositories at participating institutions, or explore the ARROW Discovery Service, which indexes Australian research repositories, and provides usage statistics.

ARROW Discovery Service

Search: Go
advanced search

Partners

MONASH | UNSW | SWIN BUR

arrow
australian research
repositories online
to the world

Start | Quick Launch   Mill... | Aus... | BU... | Set... | End...   9:44 AM

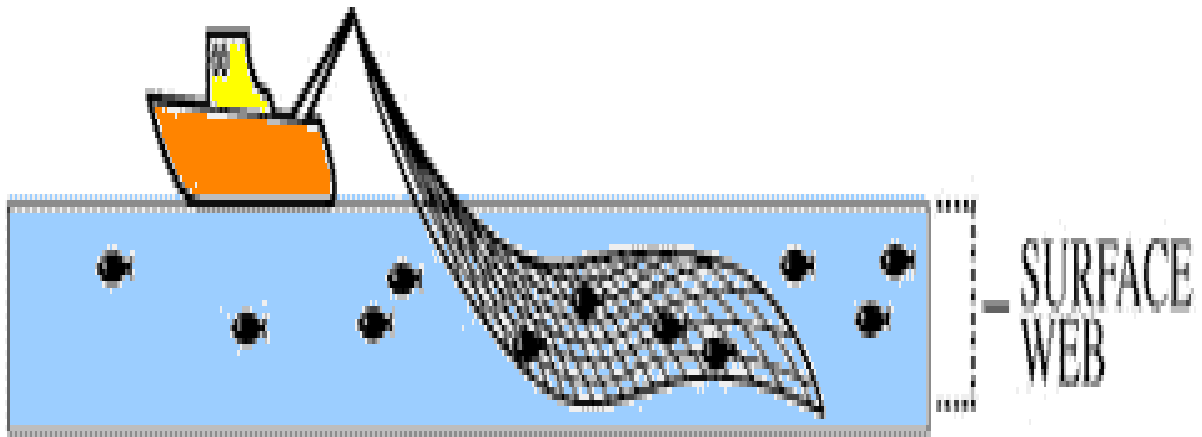*ARROW PROJECT*

See: http://arrow.edu.au

Appendix 1 & 2

Figure 1. Search Engines: Dragging a Net across the Web's Surface
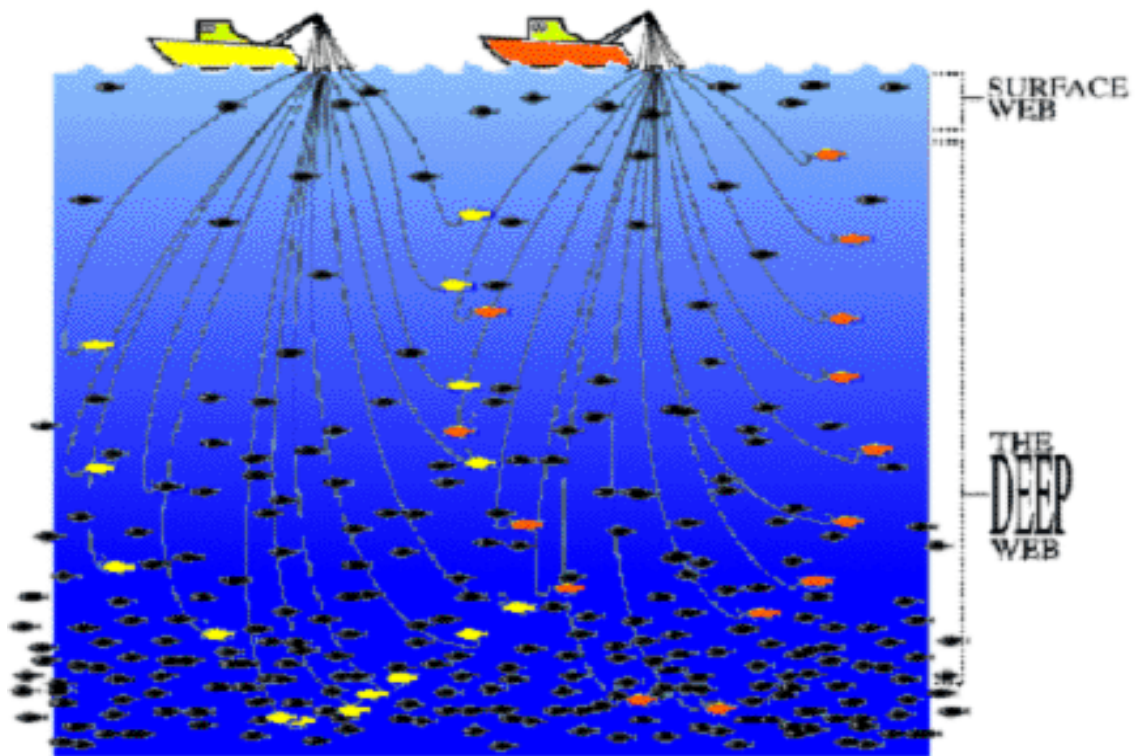

Figure 2. Harvesting the Deep and Surface Web with a Directed Query Engine
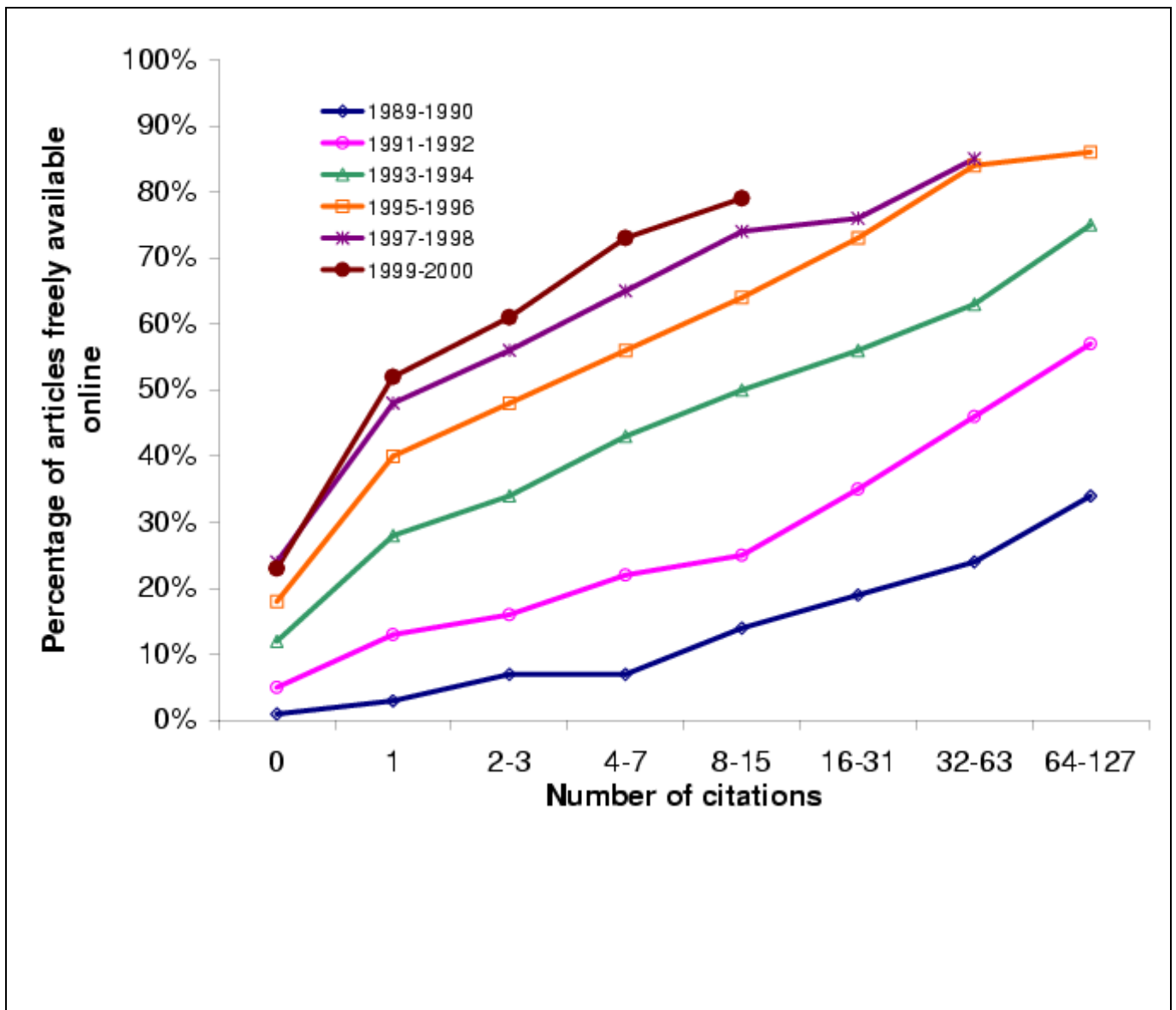
Appendix 3

Figure 3: The number of times and article is cited increases when the article is freely available on the Internet. From journal *Nature* [vol. 411, no.6837 p.521, 2001]
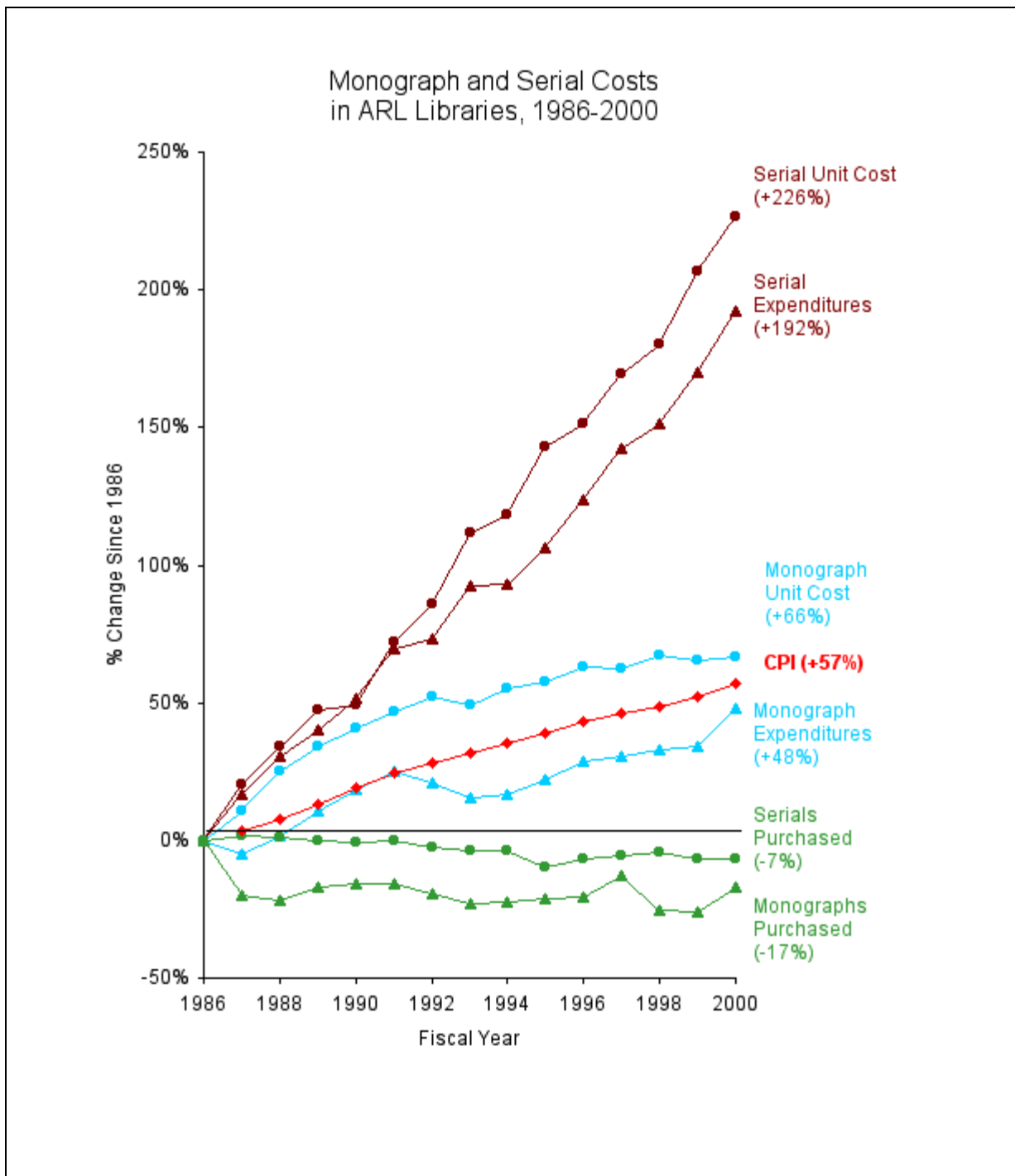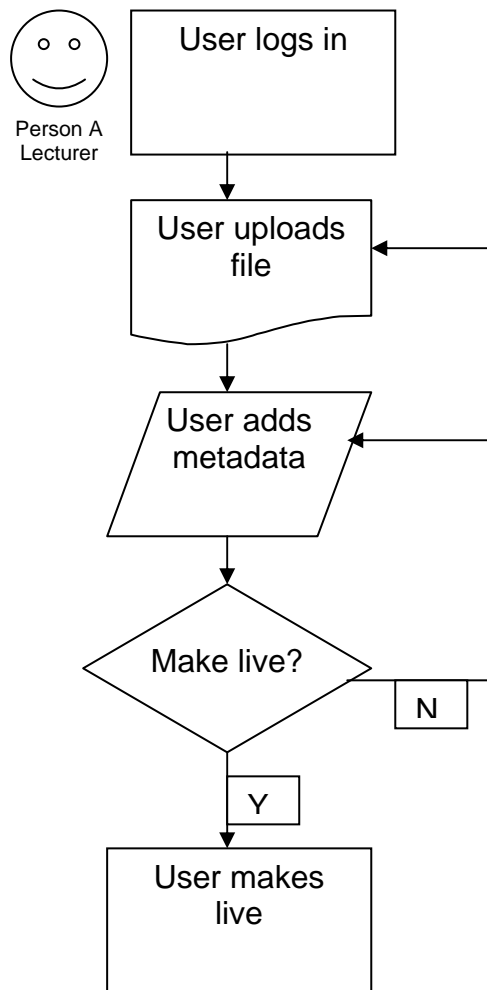
Appendix 4

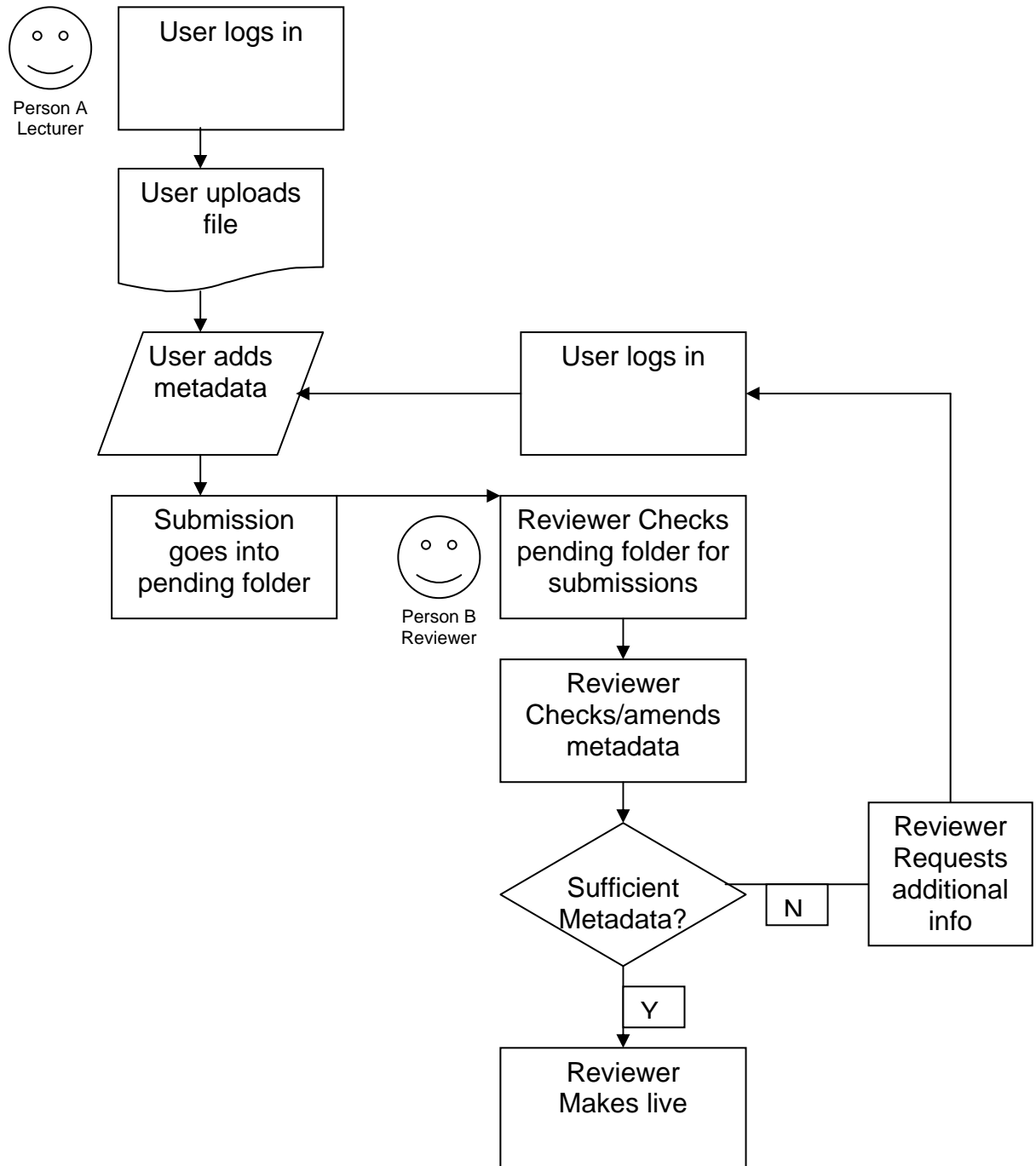**Figure 4:** US Association of Research Libraries [ARL]. SPARC survey analysis of serials costs 1986-2000.

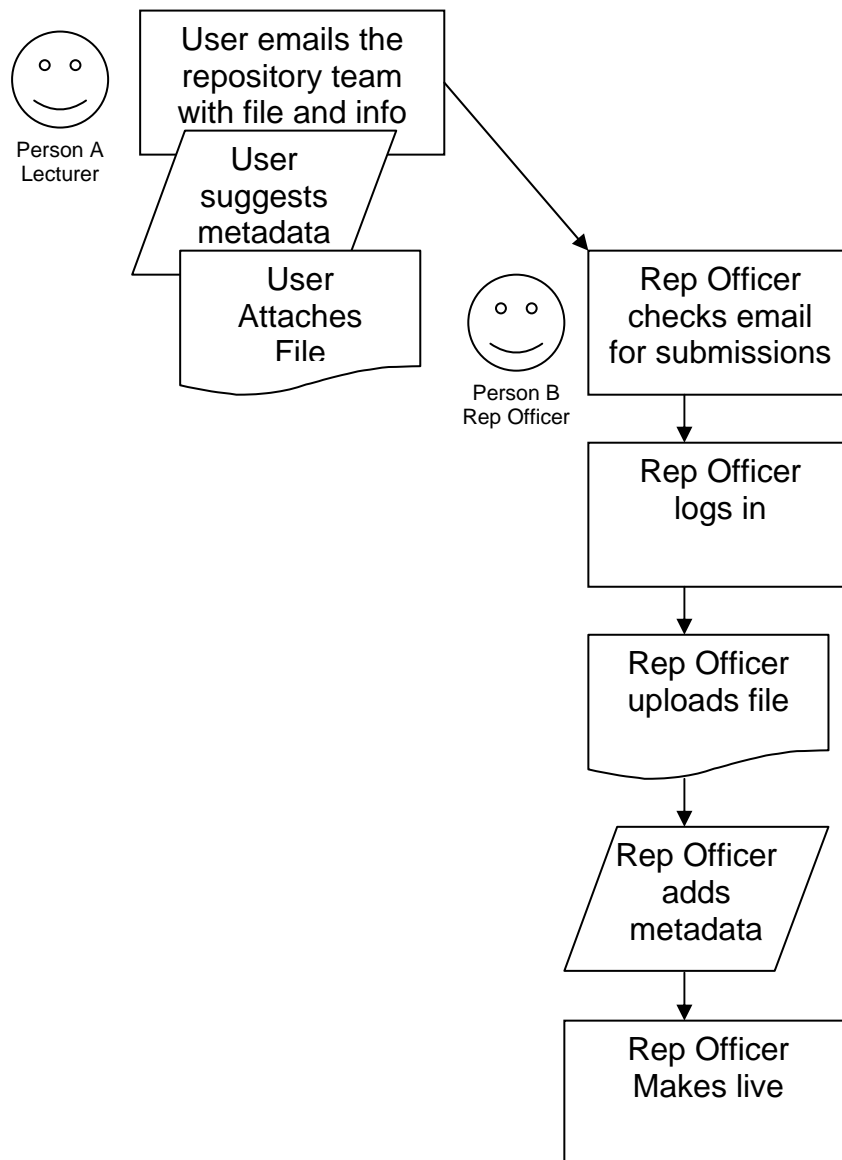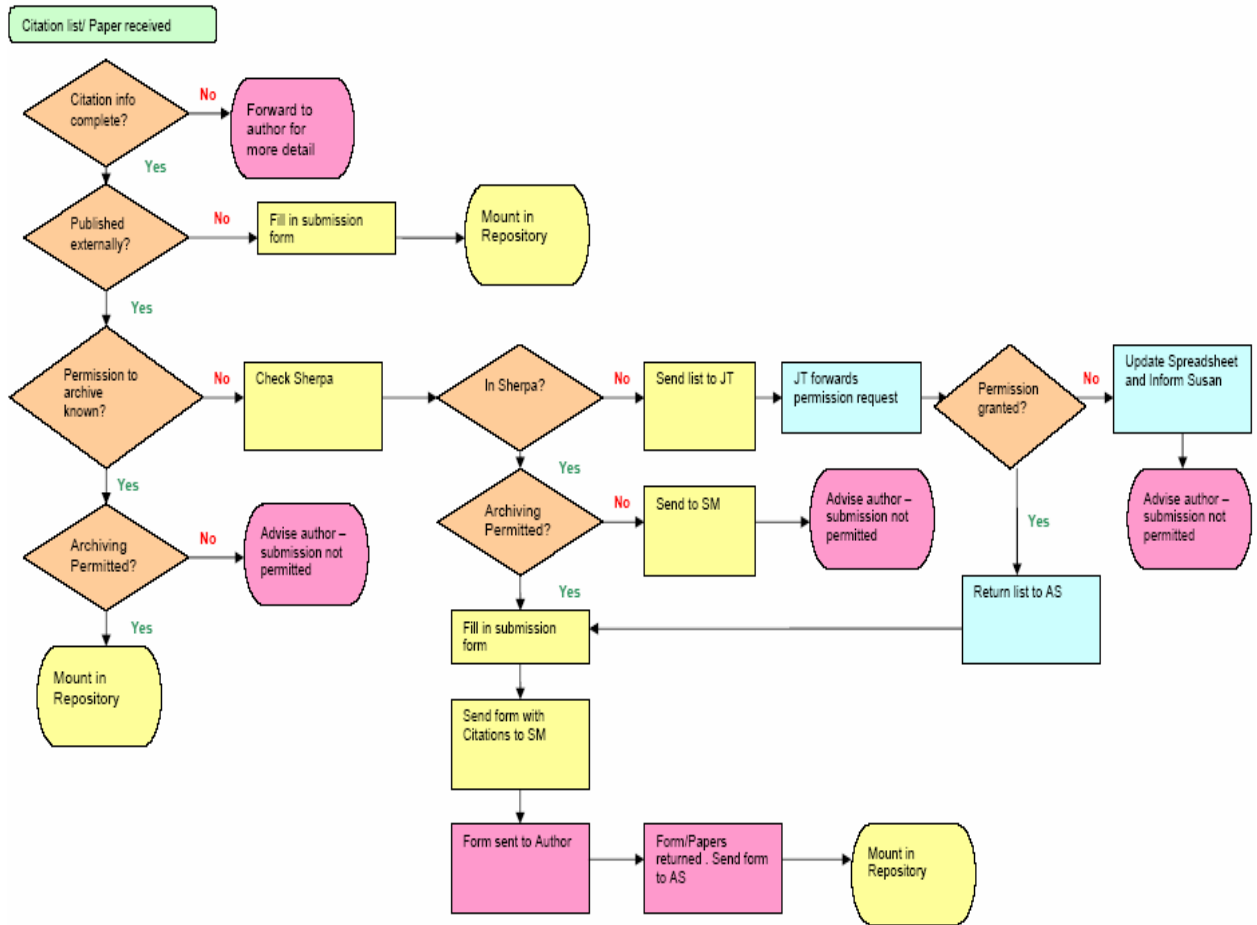**Appendix 5**

Workflow 1: Unmediated Submission

Appendix 6

Workflow 2: Submission with metadata check

Appendix 7

Workflow 3: Supported Submission

EPrints Workflow for checking citations lists

Appendix 8

Figure 8: Victoria University E-Prints Workflow for checking citation lists
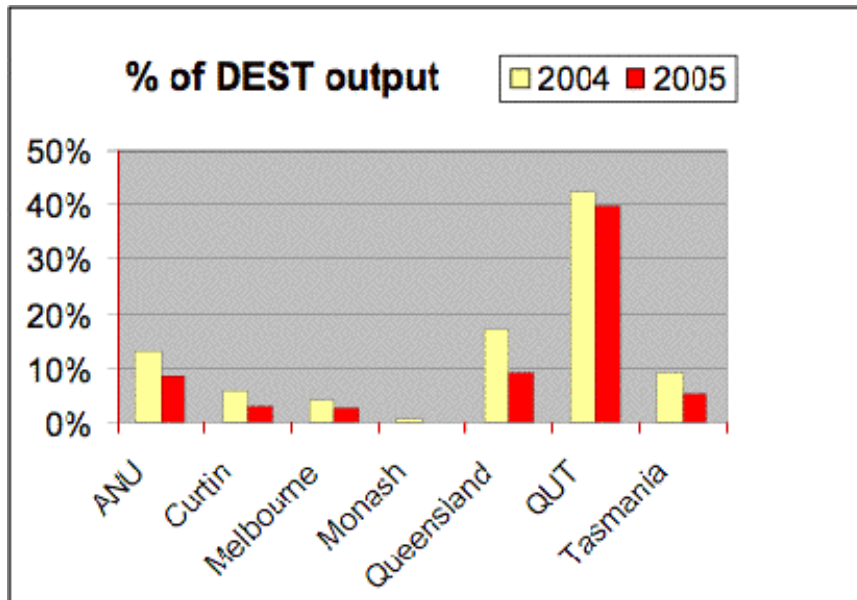
Appendix 9

Figure 9: Illustrates the research output of all Australian universities, as assessed by the Department of Education, Science and Training [DEST]. Note that Queensland University of Technology recorded the highest percentage of research output submitted to their repository through mandatory submission policies.
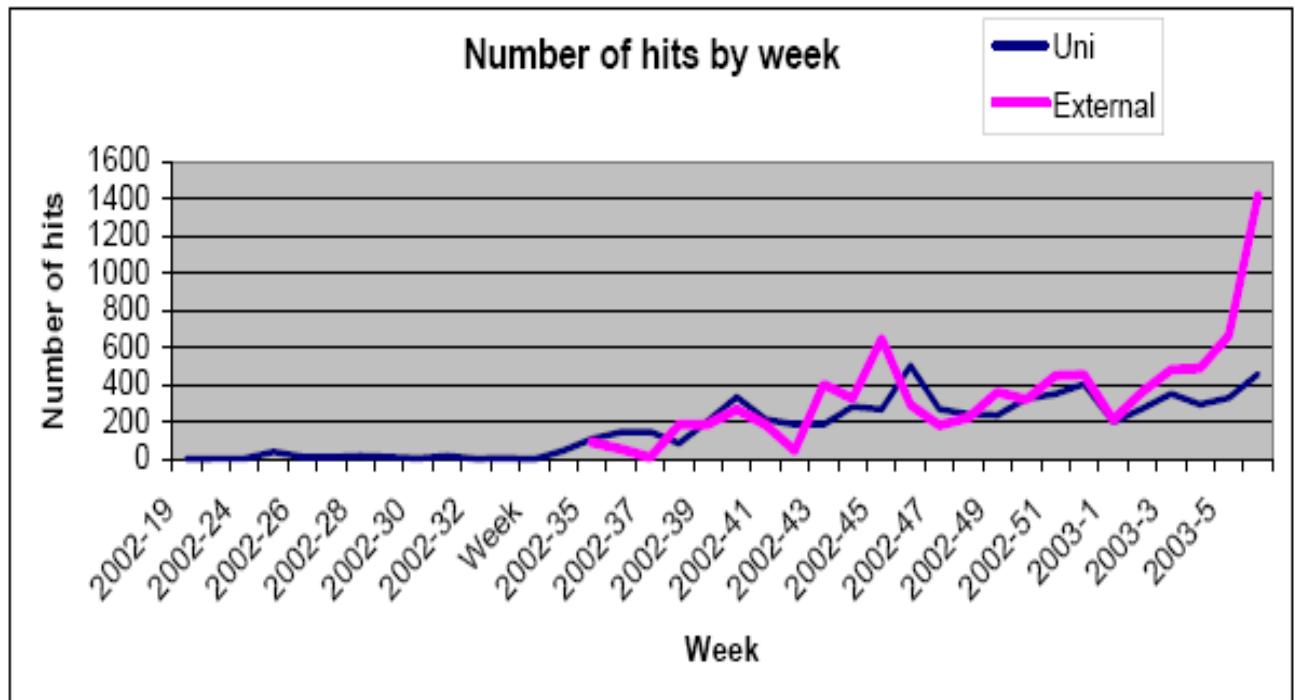
Appendix 10

Figure 10: Number of hits onto MER [Melbourne University Repository from the date it was registered as OAI-compliant and indexed by ARC.

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Glossary

E-print:	An electronic version of an academic own research output. This term also refers to re and post prints of journal articles, conference and working papers [Jones, 2006]
Interoperability:	Is the ability of two or more systems or components to exchange information and use the exchanged information without special effort on either system [Young, 2003]
Grey Literature:	A term used to describe unpublished scholarly material and that is hard to find [Goggle, 2006] Also known as "Gray literature."
Peer-review:	The process through which articles for journals pass for reviewing by academics, ensuring work is checked and corrected prior publication in a journal [Jones, 2006]
Scholarly communication	The process of academics exchanging ideas for mutual benefit, done mainly by peer-review journal system [Jones, 2006]
Semantics	The meaning of a string of characters, which dictates the structure, independent of meaning [Taylor, 2004]
SPARC	Scholarly Publishing and Academic Resources Coalition
URL	Uniform resource locator]. The name given to a web-based resource enabling users to find its location on the World Wide Web [Jones, 2006]
Workflow	A set of tasks held together in a logical network of pathways to achieve some objective. Often the controlled flow of information is supported by a software system [Jones, 2006]