

Institutional repositories: review and an information systems perspective

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Abstract

Purpose: To review the current literature and discussion on institutional repository (IR) and open access (OA) issues, to provide examples from the Information Systems (IS) literature, and to propose the use of IS literature and further research to inform understanding of institutional repository implementations for library managers.

Methodology/Approach: Recent literature is reviewed to provide the background to, and current issues in, the development of institutional repositories to support open access to refereed research output.

Practical implications: Existing research is identified, as are areas for potential research. Brief examples from IS literature are provided which may provide strategies for libraries and other organisations to speed up their implementation of IR to provide access to, and management of, their own institutions refereed research output.

Value of paper: The paper brings together recent opinion and research on IR and OA to provide librarians and other information managers with a review of the field, and proposes research on IR and OA building on existing IS as well as information management and librarianship research.

Keywords: Open access, institutional repositories, libraries, information systems

Article type: General Review

Introduction

Scholarly peer-reviewed journals are crucial in the work of academics and other researchers. Costs of these have been steadily rising and it is increasingly impossible for any institution to provide access to all, or even most of them. In addition technology has advanced so that the information within scholarly peer reviewed journals is available over the Internet at the individual researcher's desk top. Thus, economic conditions appear to be limiting access to the scholarly corpus while technological advancements appear to be encouraging access. One response to these changes has been that individual researchers are posting their work to their

own web sites and institutions and disciplines have also been developing their own institutional¹ or disciplinary² repositories (IR or DR) to store, preserve and disseminate their research. Authors are either encouraged or mandated to self archive³ their work in these repositories. Most repositories adhere to the principle of open access⁴ (OA) that is Open Archives Initiative⁵ (OAI) compliant.

To begin research, the previous scholarly and scientific literature in the domain must be consulted. This previous research is most commonly published in journals, where the research papers are “refereed” by qualified experts prior to publication for quality control (Harnad, 2003). This process has been described as a “worldwide, collaborative, cumulative and self-corrective cycle of [researching,] publishing, accessing, and using research findings in order to generate further findings, applications and publications” (Bosc and Harnad, 2005)

How researchers locate and retrieve previous research has undergone substantial change over the last thirty years – change that has largely been driven by technology. Academic libraries (in fact often themselves institutional repositories, although not always of the electronic or web based kind) have long filled the role of acting as a research tool by providing researchers with access to previous research in publications of various kinds through various different processes. For centuries libraries operated as gatekeepers, preservation experts and information providers in a paper paradigm, where the library kept paper copies of books and journals containing previous research, and the tools and knowledge with which to access their own resources and resources from other libraries. Changing technologies from the 1970s have seen the dominant form of information provision change to online or electronic provision. The online provision of scholarly publications comes in many formats, for example in individual electronic journals, publisher collections of journals, aggregator collections of articles (often subject based), or OA discipline or institution based repositories.

¹ In this context a web based database or repository of scholarly material which is institutionally defined

² A web based database or repository of scholarly material which is defined by discipline, such as Research Papers in Economics (<http://repec.org/>) or arXiv (<http://arxiv.org/>) catering for the physics, mathematics, nonlinear sciences, computer sciences and quantitative biology communities.

³ Authors posting copies of preprints, postprints or any eprint to institutional or discipline based repositories, or even to personal or institutional web pages without publisher mediation.

⁴ Open access suggests the deposit of material in an open web based archive such as a subject or institutional repository to enable open (free) access.

⁵ <http://www.openarchives.org> is best known for its protocol (OAI-PMH) for metadata harvesting about data files and providing the necessary interoperability for search engines to facilitate dissemination of content.

This changes the paradigm, and with the change in paradigm comes changes in expectations. In the paper paradigm the library was a building holding tangible items such as books and journals. In the new paradigm libraries provide an invisible infrastructure to enable the provision of information to inform research (Borgman, 2003). The costs of acquiring and managing the purchases (or current and future access rights to content) and technological infrastructure is generally unseen by users.

It has been suggested that the establishment of IR should be the role of the library as it complements the already established roles of libraries in providing access to scholarly material and information management (Bosc and Harnad, 2005; Horwood, et al., 2003), and indeed in many organisations this is so. In some cases repositories are restricted to research output, and in others they include other intellectual capital that belongs to the institution, such as teaching and learning materials (Horwood, et al., 2003).

There are growing calls for institutions to collect their research output in institutional archives, where authors are encouraged or required to self archive their output (Harnad, 2003; Houghton, Henty et al., 2003; Bosc and Harnad, 2004; Mark Ware Consulting Ltd, 2004; Poynder, 2004; Pinfield, 2005; Sale, 2005a). The literature refers to institutional archives and repositories synonymously, but some authors differentiate repositories which may contain work other than eprints⁶, such as theses, grey literature⁷, working papers, and so on from archives designed to promote authors and institutions archiving their own scholarly output for the future (Swan, et al., 2005).

Background

Authors of peer reviewed scholarly research published in journals generally receive no royalties or fees for their work that is published in scholarly journals. Scholarly output for which the author may receive direct payment, such as books, films, or patentable work,

⁶ In the paper paradigm when a journal published an author's work, the author was able to obtain copies of reprints (copies of the refereed, published work) from the publisher which could be sent to colleagues or which interested parties could request. The reprint is now usually in electronic format and has come to be known as the eprint. However eprints can be both preprints and postprints and usually refer to work that have been self archived by the author. Postprints are all post publication works including the official published draft. Preprints are unrevised, un-refereed drafts, unaccepted by a journal (Harnad, 2003).

⁷ Scientific and technical reports, patent documents, conference papers, internal reports, government documents, newsletters, factsheets, theses, which are not readily available through commercial channels. Grey literature can be more difficult to search and access than traditional literature. It is typically not as well cataloged, and not collected by libraries as extensively.

remains outside this discussion. Readers and citations bring academic authors the rewards of employment, promotion, tenure, grants, prestige, etc. Scholarly research output is also often used as a performance indicator and criteria for distribution of funding for both individuals and institutions (Houghton et al., 2003). Any financial profit to be made from the journals is made by the publishing companies and their shareholders in return for the services they offer such as peer review, marketing, dissemination etc. While both paper and electronic paradigms are still in existence, publishers' revenue is from subscriptions to the paper titles, and increasingly from site licences (to both institutions and on-sellers or aggregators⁸) to electronic titles, or collections of titles locked behind firewalls. Costs to readers are spiralling increasingly higher and universities and other research organisations can afford to purchase increasingly smaller percentages of available scholarly journals (Houghton, et al., 2003; Suber, 2003) and so what was previously a distribution network, is now in fact acting as a barrier to readers (Pinfield, 2005). In addition to escalating costs, publishers and aggregators concerned about their revenue stream use copyright legislation and licensing agreements (contracts) to limit what libraries may do with the licensed electronic journals they pay for, limiting the access to electronic journals way beyond the limitations that were placed in the print paradigm. For example some licences restrict access to electronic journals for Inter Library Loan/ Document Delivery and/or to walk-in users in libraries. It has been argued that these cost and permission barriers work against the interest of researchers and the organisations to which they belong, which share the rewards of research impact (Houghton et al., 2003; Suber, 2003).

As the OA movement grows it attracts the interest of research funders, such as universities and other research institutions, private funders such as the Wellcome Trust (2003; 2004), governments (the biggest providers of research funds). A U.K. Government Inquiry questioned how the output from publicly funded research could be handed free of charge to commercial organisations that increasingly make it difficult to access the publications resulting from the research (Gibson, 2005; Poynder, 2004). Benefits of OA for authors are clear – it lowers access barriers and disseminates research quickly (peer review can take upwards of six months). For readers access is also quick and easy from their desktop via common search tools or even from some repositories email alerts (Pinfield, 2005). The OA

⁸ Aggregators are usually commercial providers of articles or publications. An aggregator generally purchases or licences material from publishers and other sources and provides access to them via toll charging databases. Well known aggregated databases include ProQuest Information and Learning's ABI Inform and Ebsco's Business Source Premier.

movement through the Open Archives Initiative (OAI) has developed protocols that enable data providers (repositories) to expose structured data to the Internet, so that it can be harvested by service providers (such as specialised repository search engines, and even more general ones such as Google) to expose the information in repositories to people searching for information (Pinfield, 2005). OAI allows service providers to provide more than just search services such as citation analysis. Citebase (<http://www.citebase.org>) provides an early example of this.

Open access literature is free of charge to the user (but someone has to pay the costs for the infrastructure and maintenance) and the copyright holder consents to unrestricted use (Suber, 2003). It is argued that as many disciplines are not in a position to set up repositories such as arXiv, institutions are ideally placed to do so. Institutions have the resources and infrastructure to set up, support and fund repositories. They can mandate or encourage self archiving and they can benefit from the enhanced profile (Pinfield, 2005). If such open access archiving were mandatory, further benefits to institutions would accrue, such as keeping track of research output, research reporting, and eventual online global access to all research. Benefits to researchers include increased readership and citations, and therefore higher research impact (Harnad, 2003). So there are incentives to publish in OA electronic journals⁹ (known as the “gold road” to OA) or to self archive eprints in institutional or discipline-based repositories (known as the “green road”) which utilise free open source or even proprietary software (Swan et al., 2005).

In the past, libraries within research institutions (as the purchasers of journals on behalf of the institutions) have been responsible for the preservation of the content of journals for the future. In the current model, as most electronic journals are only licensed (in effect leased) to libraries, the preservation is up to publishers. There is concern that the imperatives of the commercial world will mean that there is no proper concern for preservation archiving. While some argue that the IR movement is about access not preservation others argue that preservation is one of the key issues that could define an IR (Pinfield, 2005).

There is also opposition to IR and other forms of open access from commercial journal publishers who see that OA might harm their business and therefore their profits. There is

⁹ Journal publication where the journal’s contents are available free to users and where publication is generally paid for by fees collected from authors, sponsors or an agency. There are variants of these types of journals. A list of open access journals is available at <http://www.doaj.org>

further opposition from some of the scientific societies for whom sale of publications can form a significant part of income and subsidise their other activities (Goodman, 2004; Poynder, 2004). It is also recognised that commercial and scholarly society publishers play a key role in scholarly communication, being largely responsible for organising the refereeing and review process among other things. So the outcomes of the OA movement are anything but clear. For the moment the scholarly publishing position includes traditional (electronic AND paper) for-fee (toll access - TA) journals, OA journals and OA repositories. In many cases institutions through their libraries are paying for access to the same article in all three ways.

Research in institutional repositories and open access

There are many articles, papers and reports on IR. Generally the works discuss the pros and cons of IR and the roles they may play in scholarly communication in general or for institutions specifically. They speculate regarding the possible effects on major stakeholders: libraries, authors, publishers, funding agencies, and governments (Crow, 2002; Harnad, 2003; Houghton, et al., 2003; Bosc and Harnad, 2005). Some studies have surveyed authors (Swan and Brown, 1999; Swan et al, 2005; Houghton et al., 2003) regarding their requirements, views and usage of scholarly publishing including their attitudes to IR. Others have examined the major repository projects in Europe and North America and analysed their overall lack of success in attracting content despite seemingly overwhelming views in favour of the idea of IR (Mark Ware Consulting Ltd, 2004).

A number of studies look at what motivates scholars to publish research and to go on and self archive in IR or DR (Swan and Brown, 1999; Houghton et al., 2003; Swan et al, 2005). Most scholarly authors state their motivations for publishing such as communication with peers, enhancing career prospects, building their CVs, gaining prestige and funding for future work. Authors select journals in which to publish after consideration of the journal's reputation, impact factor, coverage by abstracting and indexing services, and increasingly by the journals availability online. A recent study (Foster and Gibbons, 2005) has looked at faculty work practices, their research and their perceptions of IR, and proposes strategies to overcome misperceptions by faculty and to assist faculty with IR self archiving, so that it becomes a clearly useful, and therefore happily performed, task and which will also encourage growth in IR content. Other projects are underway to look at motivational and support issues such as

the “Rights and rewards in blended institutional repositories” project (Oppenheim, 2005) based at Loughborough University and other JISC¹⁰ projects.

More specific research (often comprising citation analysis¹¹) has been conducted to analyse the question: Do articles that are freely available online have a greater research impact? “Access is not a sufficient condition for citation, but it is a necessary one” (Brody et al., 2005). Garfield (2005) cautions the need to distinguish between readership and downloading and actual citations, but acknowledges that web use may be a harbinger of future citation. OA dramatically increases the number of potential users, by providing access to users who individually or institutionally do not subscribe to the journal in which the article appears. The debate was sparked by Lawrence in *Nature* in 2001. Lawrence (2001) analysed 119,924 conference articles in computer science and related disciplines and found that the mean number of citations to offline articles is .274 and those online is 7.03, an increase of 157%. Antelman (2004) examined the mean citation rates as recorded in the *ISI Web of Science* of freely available articles with those that are not for a sample population of journals in four disciplines (without addressing publisher policies or author reasons for posting or not). She found that open-access articles have a greater research impact than articles that are not freely available. *The Open Citation Project - Reference Linking and Citation Analysis for Open Archives* (2005) includes a script which returns the number of articles published in the *Astrophysical Journal* in 2003, and their number of citations. Another script shows the number of those papers which are available in arXiv and their citations. The result is that 75% of the papers are in arXiv and they represent 90% of citations, a 250% OA effect. Not all articles report the same findings; however that is possibly because they are measuring slightly different things, for example OA journals against non-OA or print and online journals (Anderson, et al., 2001) or OA journals rather than OA articles (Testa and McVeigh, 2004) compared with non-OA articles from the same journal which would control for journal

¹⁰ “The Joint Information Systems Committee (JISC) supports further and higher education by providing strategic guidance, advice and opportunities to use Information and Communications Technology (ICT) to support teaching, learning, research and administration. JISC is funded by all the UK post-16 and higher education funding councils.” <http://www.jisc.ac.uk/> accessed 20/1/2006

¹¹ Citation analysis is an aspect of bibliometrics which is a technique which counts and interprets data gathered from and about publications (Wilson, 1999). It is used for a number of purposes including the calculation of impact factors for journals and articles. An impact factor is a measure of importance of scientific journals. It is calculated each year by the Institute for Scientific Information for those journals which it tracks, and are published in the *Journal Citation Report*. Impact Factors have a huge, but controversial, influence on the way published scientific research is perceived and evaluated. The Impact Factor is generally calculated based on a three-year period. For example, the 2003 Impact factor for a journal would be calculated as follows: A=Total cites in 2002; B= 2002 cites to articles published in 2000-2001 (this is a subset of A); C=number of articles published in 2000-2001; D (2002 impact factor) = B/C (Garfield, E. 1994 amended 2004).

quality variables. ISI have a contract with a research team from the Université du Québec à Montréal, Southampton University and the Universität Oldenburg to test the OA advantage across all disciplines in a ten year ISI sample of 14 million articles. The physics analysis up to 2001 has already been completed with OA/non OA citation ratios of 2.5-5.8. A growing number of journals are giving the “green light” (<http://www.sherpa.ac.uk/romeo.php>) to author self archiving partially because journal impact factors benefit from increased article impact factors (Harnad and Brody, 2004).

Further studies have analysed the users of scholarly research. Houghton et al. (2003) summarise the literature on user studies and find that many academic researchers utilise the full range of information resources, but that there is a “disciplinary divide” similar to the “digital divide”. Other studies have focussed on how people use electronic resources or on their feelings about electronic and print resources in the library. Tenopir (2003a) summarised and analysed 200 research publications looking at how users interact with or feel about using electronic resources and found among other things that: electronic resources are perceived as convenient, relevant and time saving; different disciplines have different requirements; print is still important in all disciplines, but particularly in the humanities; print still the preferred option for books; most electronic information users still print out for reading, searching by topic is important; and most journal article readings come from articles in their first year of publication, although a sizable minority are older. Concerns were raised regarding electronic collections included that they may not be complete or long lived. The use of electronic journals increases every year, often accompanied by decreasing visits to the physical library. More recently Tenopir and colleagues have been surveying academic staff at UNSW about their journal reading patterns (Tenopir, et al., 2005). While largely consisted with her earlier reported work a number of interesting results are reported including use of author’s web sites and various kinds of online repositories.

While there has been much discussion in the literature of the pros and cons of IR, there has been little work framing them within a theoretical context. Some feel the introduction of IR and the consequent easy access to scholarly publications will cause the cancellation of subscriptions to journals published by learned societies and commercial publishers and therefore force changes in the whole scholarly publishing paradigm, not just in the ways that people access information. In the words of Oppenheim (2005) “it seems “obvious” to many that the increased use of OA will lead to journal cancellations...An alternative view is that there is no cause and effect relationship between OA and cancellations”. Neither suggestion

is supported or refuted. Also IR may influence change in other newer aspects of scholarly information such as digital theses repositories (Lafferty and Edwards, 2004; Lafferty, 2005). Lafferty and Edwards argue that any of these scenarios are possible and that self archiving in open archives and IR may therefore play the role of a disruptive technology based on Christiansen's (Christensen, 1997; Christensen and Raynor, 2003) theory of disruptive technologies which predicts that existing organizations and industries can be made obsolete (or sustained) by changes in the paradigm within which they operate.

Continuing issues

For institutions or disciplines to set up open access repositories, there are a number of issues to be surmounted. These include technical issues, such as hardware and software selection, IT and human resources costs, preservation policies and also cultural issues. Institutions and authors need to research and understand the possible benefits and barriers and other outcomes. Further, the agreements that authors have with publishers are seen as a barrier to IR, although increasingly publishers are allowing authors to self archive¹². There are the management costs and resources involved (Swan et al., 2005). Other OA issues which remain unresolved are: physical organisation of material, identification of material (i.e. what material is to be deposited in the repository), identification of versions of material, intellectual organisation, copyright and other legal issues, peer review, authenticity, and preservation. Houghton (2003) and Genoni (2004) argue that an important issue is quality control.

Lack of a common view

Genoni (2004) reports an OCLC study from 2003 stating “there is no common view of what an institutional repository is, what it contains and what its governance structure should be”. He mentions a SPARC¹³ study suggesting that all kinds of published and unpublished materials such as preprints, theses and dissertations, research centre newsletters etc. be a part of the content profile of an IR. Other writers in the field believe that IR should concentrate on refereed research output (Harnad, 2005). This lack of a common view has caused much

¹² The RoMEO project has a web site which unofficially list the OA policies of various publishers at <http://www.sherpa.ac.uk/romeo.php>

¹³ **SPARC** – Scholarly Publishing and Academic Resources Coalition – An alliance of academic and research libraries and organisations working to correct market dysfunctions in the scholarly publishing system (<http://www.arl.org/sparc/> or <http://www.sparceurope.org/>).

discussion on the American Scientist Open Access Forum (<http://listserver.sigmaxi.org/sc/wa.exe?A0=american-scientist-open-access-forum&D=1&F=1&O=D>) with disagreement between those who think that IR should focus on making research output (from preprint to peer reviewed) available via open access (Sale, 2005d) to those who think that other “digital library” functions are an important part of IR planning and development and may be pursued concurrently (Rowland, 2005). Poynder (2005) neatly summed up many of the issues in a recent posting by questioning what an institutional repository really is. His suggestions are:

- a) “as a repository for a university's research output, with the aim of increasing access to that research, and so enhancing its impact
- b) as a tool for preserving and curating a university's research output
- c) as a tool to assist a university in its digital publishing ambitions, and
- d) as a tool to enable universities offer digital courseware and online learning services.”

The replies varied from one or all of the above to “and more”.

Looking at IR as an information system

Regardless of the final role of an institutional repository, which may be, as Carr suggests (2005) performing task a), and assisting in tasks b) to d); it may be possible to agree that an IR is an information system, specifically a web based database or repository of scholarly material which is institutionally defined, and which makes that scholarly material widely accessible to the community using open access technologies and protocols. However, it also seems clear that many IR implementations are progressing slowly, or not at all, while those seeking to implement them seek to find answers to the myriad of questions raised above and posed by the questions arising from Poynders’ previously mentioned tasks b)-d) and beyond.

While there are many definitions of an information system (Cecez-Kecmanovic, 2002), simply put an information system is a system that “comprises people, machines, and/or methods organised to collect, process, transmit and disseminate data and information” (Wikipedia Contributors, 2006). Recently it has become associated with information technology and in common use refers to any telecommunications and/or computer related information system. Information Systems (IS) is the academic discipline concerned with the development, use, application and influence of information systems. IS is evolving as information systems permeate more of our work and personal lives to become more like

social systems based on information technology, enabling new ways of interacting, acquiring, capturing, storing and sharing information (Cecez-Kecmanovic, 2002).

What can we learn from research and practice in IS that may assist us in the successful implementation of our IR? Below are examples of areas that may be worthy of further consideration and research.

With regard to the lack of a common view about what an IR really is perhaps we can learn from research around the IS phrase “requirements uncertainty” (Moynihan, 2000). The term “requirements uncertainty” is used to describe a number of situations in IS project management, including lack of agreement about what is needed, the need to satisfy multiple groups of users with differing needs, and where the system must be adaptable enough to cope with unknown future needs, all issues discussed in the IR/OA debate. One approach touted to manage such uncertainty is an adaptive, iterative, incremental IS implementation approach, variations of which are known as “prototyping”, “improvisational” or “results driven incrementalist” approaches (Markus, 2004). Briefly, using these approaches, information systems are implemented incrementally and organisations can achieve benefits from early phases, even if the envisioned end is changed or terminated. Robey et al (2002) for example, conducted a comparative case study of 13 enterprise resource planning (ERP) systems implementations in North American companies and their results indicated that knowledge and use barriers were effectively overcome when change was introduced incrementally, and with accompanying change management measures, for example, by introducing one module at a time.

While IR (at this stage anyway) are not as complex systems as ERP, were this approach adopted more IR could be implemented; especially by organisations with scarce resources, or those which are uncertain of the end role or capacity of their IR, by focusing at the outset on the refereed research literature or research output and utilising existing open source or proprietary software (Sale, 2005e). As discussed earlier in this paper, most seem agreed refereed research output should form at least a part of the content and the benefit of making it OA has clearly been demonstrated. Other institutional intellectual capital and additional functionality could be added as organisational change and learning takes place, or as more resources become available. Indeed, if necessary, data and information held by the early implementation can be mapped and ported to another system, should superior systems become available and affordable.

Those used to “design and then implement” or “rational” approaches argue that incremental implementation is time consuming and expensive, largely due to the requirement of user involvement, and the lack of existing methodologies used. Others report that it can achieve significant results in smaller increments, minimise the risk of failure and provide implementations that are context sensitive as opposed to “cookie cutter” responses (Markus, 2004). Segars’ and Grover’s (1999) research posited that while elements of the rational approach can be important, an adaptive approach, especially in areas characterised by rapid change, rapid technological obsolescence and recognition of the potential of IT (such as that evidenced in IR and OA) is important not just in implementation, but as a part of the overall planning strategy. The approach can also encourage action in situations previously caught in inaction by uncertainty.

With regard to the non-use or lack of content of existing IR discussed earlier in this paper, IS research tells us that non-use is primarily related to behavioural rather than technical issues – so understanding the role of behavioural factors in IT performance is important. Users perceive systems primarily as a means and not as an end; so, understanding what the users want or expect and aligning this with what system provides is important. Systems may not be used if the users are not motivated to do what the system enables them to do. Mandatory use requirements can deliver use, but uncommitted use. Use can be driven by self esteem derived from recognition or by a belief that the system will facilitate their performance (Malhotra and Galletta, 2004).

This is already seen in IR implementations. Sale (2005b) has analysed the impact of mandatory policies on both electronic thesis and other IR content (Sale, 2005c). While the greatest participation and growth in content comes from those institutions which have a mandatory deposit policy, it is acknowledged that mandating alone is probably not successful. Paula Callan (2005) from QUT¹⁴ reported that:

“It was only when we identified and lowered the barriers to participation that our academics started depositing their own papers. That is, we (the Library) relieved them of the burden of responsibility for checking the publisher’s policy on self-archiving and allowed them to upload the file in any format (including MS Word)... Once the perceived benefits outweighed the perceived difficulties and worries, the floodgates were opened.”

¹⁴ QUT has an established IR with a mandatory deposit policy (http://www.p.qut.edu.au/F/F_01_03.html)

Callan's comments appear to indicate that it is not the mandatory policy alone, but also behavioural, social and other factors that contribute to IR success in attracting content and commitment. More research on this is warranted.

Conclusion

Installing the software will just be the first step in establishing an IR, but it is a necessary first step. Different institutions will want different inputs and outcomes from their IR, but most are agreed that at least one of the key content layers of an IR should be the refereed research output of an institution. Implementing IR in an incremental way may allow institutions to speed up their IR implementations and learn from their own (and others) implementations. Similarly conducting research into the needs and requirements of users will assist us in building knowledge to understand and resolve the issues regarding the slow building of content and slow growth of self archiving practice among academics, despite the demonstrable impact effects. The brief examples in this paper indicate that research can build on existing knowledge already gained by IS researchers to enhance our understanding of IR and their users. Research can also lead to learning to create more successful IR implementations and therefore the more successful dissemination of refereed research output and other intellectual and research contributions of institutions such as universities.

References

- Anderson, K., J. Sack, L. Krauss and L. O'Keefe (2001). "Publishing Online-Only Peer-Reviewed Biomedical Literature: Three Years of Citation, Author Perception, and Usage Experience." *Journal of Electronic Publishing* Vol. 6 No. 3, <http://www.press.umich.edu/jep/06-03/anderson.html>
- Antelman, K. (2004). "Do open-access articles have a greater research impact?" *College and Research Libraries* Vol. 65 No. 5: pp. 373-382,
- Borgman, C. (2003). "The invisible library: Paradox of the global information infrastructure." *Library Trends* Vol. 51 No. 4: pp. 652-674,
- Bosc, H. and S. Harnad (2004). "In a paperless world a new role for academic libraries: Providing open access". *Spreading the Word: Who Profits from Scientific Publications. A Symposium within EOSF2004*, Stockholm, <http://eprints.ecs.soton.ac.uk/10502/01/boscharnadLP.htm>.
- Bosc, H. and S. Harnad (2005). "In a paperless world a new role for academic libraries: providing open access." *Learned Publishing* Vol. 18 No. 2: pp. 95-+,
- Brody, T., S. Harnad and L. Carr (2005). "Earlier web usage statistics as predictors of later citation impact." *Journal of the American Association for Information Science and Technology preprint*, <http://eprints.ecs.soton.ac.uk/10713/>
- Callan, P. (2005). "Re: New Zealand IR initiatives". *Ozeprints email list*. (ozeprints@library.uq.edu.au).
- Carr, L. (2005). "Re: Institutional Repositories." *American Scientist Open Access Forum* Retrieved 24/12/2005, 2005, <http://listserver.sigmaxi.org/sc/wa.exe?A2=ind05&L=american-scientist-open-access-forum&D=1&O=A&F=1&P=98351>.
- Cecez-Kecmanovic, D. (2002). "The Discipline of Information Systems: Issues and Challenges". *Eighth Americas Conference on Information Systems*, Dallas, Texas.
- Christensen, C. M. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Boston, Mass, Harvard Business School Press.
- Christensen, C. M. and M. E. Raynor (2003). *The Innovator's Solution: Creating and Sustaining Successful Growth*. Boston, Harvard Business School Press.
- Crow, R. (2002). "The Case for Institutional Repositories: A SPARC Position Paper ". Washington, The Scholarly Publishing & Academic Resources Coalition. <http://www.arl.org/sparc/IR/ir.html>.
- Foster, N. F. and S. Gibbons (2005). "Understanding Faculty to Improve Content Recruitment for Institutional Repositories." *D-Lib Magazine* Vol. 11 No. 1, <http://www.dlib.org/dlib/january05/foster/01foster.html>
- Garfield, E. (2005). "The agony and the ecstasy - the history and the meaning of the journal impact factor". *International Congress on Peer Review and Biomedical Publication*, Chicago, <http://www.garfield.library.upenn.edu/papers/jifchicago2005.pdf>.

- Garfield, E. (1994 (amended 2004)). "The ISI Impact Factor." _ Retrieved 20 January, 2006, <http://scientific.thomson.com/free/essays/journalcitationreports/impactfactor/>.
- Genoni, P. (2004). "Content in institutional repositories: a collection management issue." *Library Management* Vol. 25 No. 6/7: pp. 300-306,
- Gibson, I. (2005). "Overview of the House of Commons Science and Technology Select Committee inquiry into scientific publications." *Serials* Vol. 18 No. 1: pp. 10-12,
- Goodman, D. (2004). "The criteria for open access." *Serials Review* Vol. 30 No. 4: preprint: http://eprints.rclis.org/archive/00003542/02/SR30_4_Goodman.pdf
- Harnad, S. (2003). "Eprints: Electronic preprints and postprints". *Encyclopedia of Library and Information Science*, Marcel Dekker. Vol., <http://eprints.ecs.soton.ac.uk/7721/01/eprints.htm>.
- Harnad, S. (2005). "Maximising research impact by mandating institutional self-archiving". *ETD 2005: Evolution Through Discovery: 8th International Symposium on Electronic Theses and Dissertations*, Sydney, Australia, <http://adt.caul.edu.au/etd2005/papers/harnad-sydney.ppt>.
- Horwood, L., S. Sullivan, E. Young and J. Garner (2003). "OAI compliant institutional repositories and the role of library staff." *Library Management* Vol. 25 No. 4/5: pp. 170-176,
- Houghton, J. W., M. Henty and C. Steel (2003). *Changing Research Practices in the Digital Information and Communication Environment*. Australian Department of Education, Science and Training. http://eprints.anu.edu.au/archive/00002196/01/c_res_pract.pdf.
- ISWorld Encyclopedia. (2006). "Information System." *ISWorld Encyclopedia*. Retrieved 3/1/2006, 2006, http://ispedia.terry.uga.edu/?title=Information_System.
- Lafferty, S. (2005). "Australian Digital Theses Program and institutional repositories: who's disrupting who?" *ETD: Evolution Through Discovery. The 8th International Symposium on Electronic Theses and Dissertations*, UNSW, Sydney, Australia, <http://adt.caul.edu.au/etd2005/papers/097Lafferty.pdf>
- Lafferty, S. and J. Edwards (2004). "Disruptive technologies: What future universities and their libraries?" *Library Management* Vol. 25 No. 6/7: pp. 252-258,
- Lawrence, S. (2001). "Free online availability substantially increases a paper's impact." *Nature Web Debates*, Retrieved 23/10/2005, <http://www.nature.com/nature/debates/e-access/Articles/lawrence.html>.
- Malhotra, Y. and D. F. Galletta (2004). "Building systems that we want users to use." *Communications of the ACM* Vol. 47 No. 12: pp. 89-94,
- Mark Ware Consulting Ltd (2004). "Pathfinder Research on Web Based Repositories". *Publisher and Library/Learning Solutions (PALS)*. Bristol. <http://www.palsgroup.org.uk>.

- Markus, M. L. (2004). "Technochange management: using IT to drive organizational change." *Journal of Information Technology* Vol. 19 No. 1: pp. 4-20,
- Moynihan, T. (2000). "Coping with 'requirements-uncertainty': the theories-of-action of experienced IS/software project managers." *Journal Of Systems And Software* Vol. 53 No. 2: pp. 99-109,
- Oppenheim, C. (2005). "Publish OA if you can - self archive either way." *American Scientist Open Access Forum* Retrieved 18/10/05,
<http://listserver.sigmaxi.org/sc/wa.exe?A1=ind05&L=american-scientist-open-access-forum&F=l#219>.
- Oppenheim, C., (project leader). (2005). "Rights and Rewards in Blended Institutional Repositories." *Joint Information Systems Committee* Retrieved 12 January, 2006,
http://www.jisc.ac.uk/index.cfm?name=project_rights_and_rewards.
- Pinfield, S. (2005). "Self archiving publications". *Scholarly Publishing in an Electronic Era*. G. E. Gorman and F. Rowland. London, Facet. pp. 118-145.
- Poynder, R. (2004). "No gain without pain." *Information Today* Vol. 21 No. 10: pp. 1-5,
- Poynder, R. (2005). "Institutional Repositories." *American Scientist Open Access Forum* Retrieved 23/12/2006, 2005,
<http://listserver.sigmaxi.org/sc/wa.exe?A1=ind05&L=american-scientist-open-access-forum&F=l&O=T&H=0&D=1&T=1#137>.
- Robey, D., J. W. Ross and M. C. Boudreau (2002). "Learning to implement enterprise systems: An exploratory study of the dialectics of change." *Journal Of Management Information Systems* Vol. 19 No. 1: pp. 17-46.
- Rowland, F. (2005). "Re: Functioning IRs - today's real realities." *American Scientist Open Access Forum* Retrieved 20/12/2005, 2005,
<http://listserver.sigmaxi.org/sc/wa.exe?A2=ind05&L=american-scientist-open-access-forum&D=1&F=l&O=D&P=92104>.
- Sale, A. (2005a). "De-unifying a digital library." *First Monday: Peer Reviewed Journal on the Internet* Vol. 10 No. 5: pp., <http://eprints.comp.utas.edu.au:81/archive/00000174/>
<http://eprints.comp.utas.edu.au:81/archive/00000174/01/FirstMonday.htm>
- Sale, A. (2005b). "The impact of mandatory policies on ETD acquisition." *Preprint*
http://eprints.comp.utas.edu.au:81/archive/00000222/01/EDT_acquisition.pdf
- Sale, A. (2005c). "Comparison of IR content policies in Australia." *Preprint*,
<http://eprints.comp.utas.edu.au:81/archive/00000230/>.
- Sale, A. (2005d). "Re: Functioning IRs - today's real realities." *American Scientist Open Access Forum* Retrieved 20/12/05, 2005,
<http://listserver.sigmaxi.org/sc/wa.exe?A2=ind05&L=american-scientist-open-access-forum&D=1&O=D&F=l&S=&P=92702>
- Sale, A. (2005e). "Software." *AuseAccess wiki* Retrieved 9 January, 2006,
<http://leven.comp.utas.edu.au/AuseAccess/pmwiki.php?n=Software.Software>.

- Segars, A. H. and V. Grover (1999). "Profiles of Strategic Information Systems Planning." *Information Systems Research* Vol. 10 No. 3: pp. 199+
<http://search.epnet.com/login.aspx?direct=true&db=buh&an=2545872>
- Suber, P. (2003). "Removing the barriers to research: an introduction to open access for librarians." *College and Research Libraries News* Vol. 64 No. February: pp. 92-94,
<http://eprints.rclis.org/archive/00001027/01/acrl.htm>
- Swan, A. and S. Brown (2005). "Open access self archiving: An author study". Truro, Cornwall, Key Perspectives: Consultants to the Scholarly Information Industry.
http://www.jisc.ac.uk/uploaded_documents/Open%20Access%20Self%20Archiving-an%20author%20study.pdf.
- Swan, A., P. Needham, S. Proberts, A. Muir, C. Oppenheim, A. O'Brien, R. Hardy, F. Rowland and S. Brown (2005). "Developing a model for e-prints and open access journal content in UK further and higher education." *Learned Publishing* Vol. 18 No. 1: pp. 25-40,
- Tenopir, C. (2003a). "Use and Users of Electronic Library Resources: An Overview and Analysis of Recent Research Studies". Washington, D.C., Prepared for Council on Library and Information Resources.
<http://www.clir.org/pubs/abstract/pub120abst.html>.
- Tenopir, C., X. Zhou and D. King (2005). "University of New South Wales Academic Staff Journal Reading Patterns; Factual Summary of Results of the Survey Conducted September-October 2004", UNSW. pp. 1-67.
- Testa, J. and M. McVeigh. (2004). "The impact of open access journals: a citation study from Thomson ISI." _ Retrieved 20 January, 2006,
<http://scientific.thomson.com/media/presentrep/acropdf/impact-oa-journals.pdf>.
- The Open Citation Project - Reference Linking and Citation Analysis for Open Archives (2005). "The effect of open access and downloads ('hit') on citation impact: A bibliography of studies." *The Open Citation Project - Reference Linking and Citation Analysis for Open Archives.*, <http://opcit.eprints.org/oacitation-biblio.html>
- Wellcome Trust (2003). "Economic Analysis of Scientific Research Publishing: A Report Commissioned by the Wellcome Trust". Histon, Cambridgeshire, SQW Limited.
http://www.wellcome.ac.uk/doc_wtd003181.html.
- Wellcome Trust (2004). "Costs and Business Models in Scientific Research Publishing: A Report Commissioned by the Wellcome Trust". Histon, Cambridgeshire, SQW Limited. http://www.wellcome.ac.uk/doc_wtd003185.html.
- Wikipedia Contributors. (2006). "Information system." *Wikipedia, The Free Encyclopedia* Retrieved 3 January 2006 23:54,
http://en.wikipedia.org/w/index.php?title=Information_system&oldid=32852657.
- Wikipedia Contributors. (2006). "Information Systems." *Wikipedia, The Free Encyclopedia* Retrieved Retrieved 23:52, January 3, 2006,
http://en.wikipedia.org/w/index.php?title=Information_systems&oldid=33385222.

Wilson, C. S. (1999). "Informetrics." *Annual Review of Information Science and Technology (ARIST)* Vol. 34 pp. 107-247,

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