Chapter 2 –
Arguments for open access

Introduction

In order to answer the question "How are the communication practices between researchers affecting the uptake of open access scholarly dissemination in Australia?" it is necessary to adopt a holistic view of the communication practices of scholars, in particular the motivations behind the publication choices they are making. Broadly, the research question relates to scholarly publication and how it fits within the wider scholarly communication landscape. This thesis is looking at a specific area of scholarly communication, and will not attempt to address the entire scholarly communication landscape, however a comprehensive background chapter is required to fully encompass the wider vested interests, financial and otherwise in any change to the scholarly communication system.

This chapter will begin with a discussion of the scholarly communication system, looking at the integral role journals play in the system and how researchers engage with the system. The economics of scholarly publishing is briefly discussed, including how this has changed with a move to electronic publishing, and the level of awareness researchers have of the economic imperatives. The concept of open access is then introduced. The remainder of the chapter is a discussion of the five functions of scholarly journals, Awareness, Certification, Reward, Archiving and Registration, how each of these functions are being affected by difficulties with the current scholarly publishing system, and whether open access offers a solution to these difficulties. The issue of copyright is also briefly discussed in this context. The bulk of the literature on this topic focuses on scientific, technical and medical publishing, and while the scope of this research is wider, the literature review reflects the available literature.

The scholarly communication system

The formal scientific communication process has been described in terms of four functions: Registration (of the author's claim for priority), Awareness (of the publication), Certification (a result of peer review) and Archive (long term retention of the material) (Roosendaal & Geurts, 1997). Van de Sompel (2004) proposed the fifth function of Reward for promotion and appointments. A sixth function has been recently added to the mix, that

of Navigation, “providing filters and signposts to relevant work amid the huge volume of published material” (Ware, 2006, p. 5), but I will not be exploring this function.

The publishing aspect of the scholarly communication system has in many ways changed little in the centuries since the first scientific journal. Researchers write up their work into an article, conference paper or book, submit it to the publication outlet of choice, whereupon it is sent out to other researchers in the field for review. If the work is deemed original and valid research, it is published, and therefore available for the remainder of the scholarly community to read. However, this simple summary glosses over many of the difficulties in the system today, and these issues are the focus of this chapter. It should be noted that while much of the material in this chapter is discussing journal articles, this is a reflection of the available literature rather than a conscious effort to restrict the discussion to the journal article at the expense of other forms of scholarly publishing.

This thesis builds on a rich history of research which suggests it is time to change the scholarly communication system. The literature indicates there has been dissatisfaction with the journal system for decades. In 1960, for example, delays in publication, restrictions on article length with the necessary omission of relevant supporting data, high costs preventing full coverage of any field and the time 'wasted' on editing and reviewing were all perceived to be problems with the system (Phelps & Herlin, 1960). Decades later, the whole scientific communication system came under scrutiny: “It seems inevitable that people should automatically point to the scientific journal system itself as something in need of radical change” (Piternick, 1989, p. 260).

The suggestion that individual papers should replace journals as the primary unit of distribution was first made in the early 20th century with a suggestion for central depositories of background material (what we call grey literature today), which could be “mimeographed or otherwise duplicated and placed in certain repositories” (W. E. Allen, 1922). A 1933 proposal suggested replacing journals with an international publishing house, a ‘Scientific Information Institute’, to take over all existing scientific publishing and bibliography, where authors would submit to the centre. A variation on this theme was the idea of a central editorial bureau of scientific experts to review, correct, edit and verify papers (Phelps & Herlin, 1960). However these authors concluded that the case for replacing the scientific periodical with a centrally controlled system of separates was not proved. That said, there is evidence to show that the articles people are reading are increasingly sourced as individual articles rather than as part of a journal. The journal’s importance in scholarship (to the reader) is decreasing:

> With evolution toward advanced systems, scientists seem to browse journals less often and spend more time searching online. It may be that scientists move away from traditional browsing of journals as electronic access to secondary databases and to aggregated full texts becomes more ubiquitous (Tenopir et al., 2003).

The electronic era has allowed for a myriad of new possibilities. Odlyzko proposed in 1996 that electronic journals could exist as collections of unpackaged but potentially refereed documents in a central server (Odlyzko, 1996). The inspiration for this was Paul Ginsparg's working article server at Los Alamos called arXiv [i], which began in 1991, and is now run from Cornell University. This was followed by the prediction of an "universal, Internet-based, bibliographic and citation database" (R. Cameron, 1997). The concept of an 'electronic aggregator' was put forward in 1999, consisting of a collection of self–published papers (Kling & McKim, 1999).

Current complaints about journals do not differ significantly from those raised in 1960. What has happened since that time is the advent of computers and the Internet, offering unprecedented opportunity for change.

Journals and the scholarly communication system

Scholarly publication used to be synonymous with scholarly communication, but this is no longer the case. Over the past 400 years, the publishing function of journals has shifted from a method of communication to a career tool. The emphasis has moved from Awareness and (to a lesser extent) Certification, to Registration and Reward: "the fundamental purpose of the journal has changed. In no small measure, scholarly communication has changed to become publishing" (Peek, 1996, p. 5).

The separation of the scholarly journal from the scholarly communication system is evidenced by the increasing use of journals as a career tool. Few (if any) science scholars use journal articles as a primary communication tool: "Scientific information is exchanged in a multi-tiered manner, and those myriad other channels render the scientific manuscript optional, if not obsolete … Often the journal article, the bedrock of peer-reviewed scientific knowledge, is the last information source consulted" (Seringhaus & Gerstein, 2006).

Journals still provide a valuable service, according to some arguments, providing a stable archive of the literature and "[t]ogether, they serve the need of today's scientists for more knowledge from a wider variety of sources" (Tenopir & King, 2001). In addition: "Journals have formed the basis for networks of scholars, for which the editor forms a focal point

around which members of the editorial board, regular reviewers, contributors and readers orbit. Such networks of scholarship can be extremely important" (Houghton et al., 2006, p. 52).

This argument of 'community' centred around the journal has been raised by others: "A journal will, by virtue of its history, present purpose, and current editors, have a personality and a set of concerns that stake out a distinctive territory recognised by readers and authors" (Horton, 2003, p. 1512). Some argue that having a journal is central to the establishment of a new discipline (Paul & Matasar, 1993). However, scholarly communication embraces a much wider remit than simply journal publication.

Researchers and scholarly publishing

The academic researcher wears two hats, that of author and that of reader, and the scholarly communication system of journal publication means different things depending on the hat in question (Guedon, 2001). Journals are important to authors because the name, status and impact factor of a journal have implications for assessment, tenure and grant applications. In this context the journal fulfils the roles of Registration and Certification. Authors have specific requirements of the journal system: "they want the ability to target a very specific group of key readers … and they want the imprimatur of quality and integrity that a good peer-reviewed, high-impact title can offer, together with reasonable levels of publisher service" (Rowlands, Nicholas, & Huntington, 2004a, p. 273).

Readers, on the other hand, are not focused on journals, they are focused on articles. This situation creates problems as "researchers as authors want to publish more, while as readers they want to read less" (Mabe & Amin, 2002, pp. 150-151). To a reader of an article, the only factor is the quality of the content, which is partly verified by peer review, and the journal name (or brand, to use a marketing term). This concept of the prestige or 'brand' of the journal does not guarantee high quality articles. It exists, "simply because in the past [the journal] has served as a meeting place where able scholars have coordinated their efforts and libraries their purchases" (T. Bergstrom, 2001, p. 12).

Scholarly communication, and the subset activity of scholarly publishing is central to this research, which is looking at the communication practices of researchers. It is necessary to understand the changing nature of scholarly communication as technology changes the way research is communicated and administered.

Research is a public activity, with 'communism', an extended sense of common ownership of goods, an integral element of the scientific ethos: "The institutional conception of science as part of the public domain is linked with the imperative for communication of

findings" (Merton, 1973, p. 274). This communication has traditionally been by writing and publishing academic articles. Merton stressed the 'universality' of science, that nobody should be excluded from the science process. In order for that to happen, "scientific knowledge must be common property as it otherwise has not optimised its value in the process" (Roosendaal, 2007, p. 2). However, this chapter will demonstrate that the scholarly communication system as it stands is restricting people's access to that knowledge, and therefore the fundamental basis of the activity of science is being hindered.

The economics of scholarly publishing

One of the main barriers that scholarly journals pose to the dissemination of knowledge is their subscription cost. Indeed it was their escalating costs that precipitated the 'serials crisis' decades ago. The subscription model fragments research information behind deals, copyright rules and formats, preventing simple searches for research (Terry, 2006). The economics of journal publishing fuels many of the arguments for change to the scholarly publishing system.

Science and therefore scientific publishing boomed after the 1950s, when commercial publishers became an ever-increasing presence in the market. In Economics alone, the count has increased from 120 journals in 1980, at the time evenly split between commercial and not-for-profit publications, to almost 300 in 2000, but with two-thirds owned by commercial publishers (C. Bergstrom & Bergstrom, 2001). Scientific, Technical and Medical (STM) publishing is a US$7 billion industry (Gooden, Owen, Simon, & Singlehurst, 2002; Worlock, 2004). In the past two decades, journal prices have increased faster than inflation. Since 1986 the average price of a journal has risen by 215%, while the number of journals purchased has fallen by only 5.1% indicating a huge increase in subscription budgets. The numbers are even greater when restricted to science. Between 1984 and 2002, the price of science journals increased by nearly 600% (bepress, 2005). The niche nature of the market and the rapid growth in the budgets of academic libraries have combined to make scientific publishing the fastest growing sub-sector of the media industry over the past 15 years (Gooden et al., 2002). These figures have fuelled a long-standing tension between publishers and libraries:

> The economics of scholarly journal publishing are incontrovertibly unsustainable. Taming price inflation is not enough. Unless we change the current model, academic libraries and universities will be unable to continue providing faculty, students, and staff with the access they require to the world's

> scholarship and knowledge. Scholars will be unable to make the results of their research widely available (University of California Academic Senate, 2004, p. 1).

However, while libraries have been aware of this issue for decades, individual scholars appear to be unaware of the problem and do not (or choose not to) see themselves as part of the problem (Jeon-Slaughter, Herkovic, & Keller, 2005). This observation was also made by the UK House of Commons Science and Technology Committee (2004b): "It is disappointing that many academics are content to ignore the significant difficulties faced by libraries. Until they start to see the provision of journals as, in part, their problem, the situation will not improve". Scholars are disassociated from the pricing structure of the communication system in which they partake.

Given this, it is not surprising that an international survey has found that authors of papers do not consider cost when they are choosing a journal to which to submit work: "In their role as authors … the price of the journal, hence its ultimate affordability, was perceived to be the least influential of the reasons they gave for publishing where they did" (Rowlands et al., 2004a). This study also found that the high level of contribution authors are making in preparing their papers and reviewing others for publication meant, "their perceptions of the costs needed to sustain the system are far lower than those of the publishers themselves" (Rowlands et al., 2004a). This lack of interest in the economics of scholarly publication has potential impact on scholarly careers.

While authors do not seem to take interest in the issue of journal subscription costs, these have a direct bearing on authors' need to ensure their work is visible, and therefore cited. It may seem counter-intuitive, but publishing in traditional journals may be an impediment to having work read by the largest number of people: "The main thing that academic authors want out of publishing is to reach an audience. The high prices charged by journal publishers are an obstacle to this" (Gasson, 2004). Increased subscription costs have a negative effect on readership, and this affects publishers' ability to maintain their journals' Awareness function.

The issue of the high cost of journal subscriptions and how this affects the dissemination of research is central to many arguments for a move to open access dissemination. However, the lack of interest or comprehension of this situation by the research community directly impacts their willingness to engage with open access, the focus of this research.

Open access scholarly publishing

The open access concept has been debated for over a decade. Broadly advocating that peer-reviewed scholarly material should be freely available on the internet at the time of publication, the movement originally developed from a reaction to the scholarly 'serials crisis' of the 1990's when journal prices skyrocketed (Harnad, 2003).

Defining open access

There is some debate about what exactly constitutes open access, and there are numerous definitions, including the Budapest Declaration (Open Society Institute, 2002), the Berlin Declaration (Max Planck Institute, 2003), and the Bethesda Statement (2003). One of the simpler definitions is:

> Open access to scientific journal articles means online access without charge to readers or libraries. Committing to open access means dispensing with the financial, technical, and legal barriers that are designed to limit access to scientific research articles to paying customers. It means that, for the sake of accelerating research and sharing knowledge, publishers will recoup their costs from other sources (Suber, 2002).

Clarke (2007) also notes that "From a legal perspective, the term 'open access' implies that the consumer is not constrained by copyright or other laws from making such reproductions as are necessary to enable access in a form convenient to that consumer".

In order to ensure the broadest discussion of the literature on this topic, this work uses a broad definition of open access, which includes most of the ten 'flavours' of open access described by Willinsky (2006). One flavour of open access that causes some debate is delayed-access, where the articles are made freely available after an embargo period. Some commentators argue that this does not constitute open access, as for items to be truly open access they should be made available immediately (Clarke, 2007; Open Society Institute, 2002; Suber, 2007b). I class the delayed-access option as preferable to closed-access, but not within the spirit of most definitions of open access.

Without using a specific definition, I concur with Houghton (2006), that: "The key element of open access is that the material is made available freely and openly, without charge or usage restrictions, to anyone with internet access" (p. 5). In addition, open access is not restricted to scholarly articles, but includes original scientific research results, raw data and metadata, source materials, digital representations of pictorial and graphical materials and scholarly multimedia material (Max Planck Institute, 2003). That said, this work is concerned primarily with the scholarly article.

Open access is generally achieved in one of two ways, by the publisher of a journal making the articles freely available (in some cases the whole journal, in others specific articles from any given issues), or by the author making the article available online, on a website or in a digital repository. These two routes of open access will be discussed in depth in the next chapter.

Institutional, organisational and government support for open access

There are currently various programs providing wider access to published material, including PubMed Central, the Open Archives Initiative, and the Scholarly Publishing and Academic Resource Coalition (SPARC). PubMed Central[ii] was set up by the US National Institutes of Health and is a centralised digital library providing free access to the full text of all peer-reviewed life-science research articles. Publishers can place delays on their publications on the system, giving their subscribers exclusive access for up to a year before the information is freely available, an example of delayed-access. The Open Archives Initiative[iii] in Britain aims to create a global online archive of all published research.

SPARC[iv] was created in 1998 as part of the Association of Research Libraries in the USA. It aims to return 'science to scientists' by "encouraging scientists to create journals that directly compete with those thought to be overpriced; by giving confidence to scientists to create journals in new areas of inquiry; and by backing scientists who create web-based resources other than journals for their communities" (Tamber, Godlee, & Newmark, 2003). SPARC has created low priced journals in competition with commercial ones: "In most cases the commercial publisher's journal has been quickly eclipsed by the start-up" (Gasson, 2004). Generally, these initiatives are using open access principles.

While open access developed from a need to address the serials crisis, it is now seen more widely "as a way to improve public, educational, and political impact of research" (Willinsky, 2003). There has been "considerable interest in recent years, internationally and in Australia, amongst government agencies, universities and other organisations in 'open access' to the results of publicly-funded research, including data and research papers" (Australian Government Productivity Commission, 2007, p. 5.34). In January 2004 Australia was one of the 34 signatories to the OECD Declaration on Access to Research Data from Public Funding. The Declaration recognises:

> that an optimum international exchange of data, information and knowledge contributes decisively to the advancement of scientific research and innovation … [and] that open access to, and unrestricted use of, data promotes scientific progress and facilitates the training of researchers (OECD, 2004).

Since 2000, a substantial number of studies instigated at the government level (Australian Government Department of Education Science and Training, 2007; Australian Government Productivity Commission, 2007; UK House of Commons Science and Technology Committee, 2004b) and funding body level (Research Councils UK, 2005a; Wellcome Trust, 2003) have looked into the issue of access to scholarly literature. As mentioned above, there have been several open access declarations at an international level, and position statements at a funding level (National Health and Medical Research Council, 2007; National Institutes of Health, 2005; Research Councils UK, 2005b; Wellcome Trust, 2004b). Not all position statements have been in support of open access (Royal Society, 2005), although in this last case the position seems to have softened, which is discussed below.

Open access and public good

Many of these reports, declarations and statements have come to very similar conclusions. One aspect of the debate has been the economic issue. A report to the Australian government argued that the benefits of having public sector research openly accessible through repositories would be 51 times greater than the costs (Houghton et al., 2006). The report argues that benefits are more than just economic, expanding to issues of 'public good':

> Scientific publishing also plays an important role in making research more efficient … Dissemination of findings helps other researchers define their research work, minimises duplicative activities and may provide data which might otherwise have been collected again. Moreover as an evolving process of building on findings, rapid publication and dissemination help to accelerate the advancement of science and, thereby, economic development (Houghton & Vickery, 2005, p. 17).

The Wellcome Trust, after commissioning two substantial studies into the costs of scientific publishing (2003, 2004a) released a statement in support of open access which said in part that the organisation: "has a fundamental interest in ensuring that the availability and accessibility of this material is not adversely affected by the copyright, marketing and distribution strategies used by publishers (whether commercial, not-for-profit or academic)", and that it "supports unrestricted access to the published output of research as a fundamental part of its charitable mission and a public benefit to be encouraged wherever possible" (Wellcome Trust, 2004b).

This international interest has sparked a considerable body of research, much of which is discussed in this thesis. One significant work is a book by Willinsky (2003) which makes

the (substantial) case for open access, arguing that a move to open access is in the public good as it creates additional sources of public knowledge. This knowledge has been increasingly withheld behind spiralling subscription costs, a situation which is very serious in developing countries. In addition Willinsky argues that public access to scholarly publications, particularly in the areas of health and the environment, is grounded in the public's 'right to know' and results in an informed public and support for research.

Another public good argument is that by making work available, open access creates additional sources of public knowledge because it increases the likelihood of cross fertilisation of ideas – with new areas of research becoming possible (Swan, 2007; Velterop, 2008). For example, "text mining will enable new facts to be discovered that would not be possible by humans such as gene associations" (Terry, 2006).

This chapter will now turn to the five functions of scholarly journals, Registration, Awareness, Certification, Archiving and Reward and look at how each of these functions are being affected by difficulties with the current scholarly publishing system, and whether open access offers a solution to these difficulties.

Registration

Registration, establishing intellectual priority, is achieved within the traditional scholarly publishing system by publishing articles in journals. Digital repositories offer an alternative way of establishing intellectual priority. Placing pre-review articles, or post-prints into a repository identifies the author of the idea at the time of deposit. Digital repositories include metadata about the article including submission date.

The Registration function is not integral to the discussion in this thesis but is included here because it is essential to the individual scholar within the scholarly publication system.

Awareness

The function of Awareness is being compromised in the traditional scholarly publishing system in two ways. High subscription costs pose a barrier to the widespread dissemination of published work, and delays in the publication process create a barrier to the use of journals as a communication tool.

Subscription costs and Awareness

Bergstrom (2001) looking at the field of Ecology and extrapolating to Economics, Atmospheric Sciences, Mathematics, Neurobiology, and Physics, has undertaken substantive calculations to support his argument that the high charges of for-profit publishers are not reflected in their readership numbers. Indeed there may be a reverse correlation: "The six most-cited economics journals listed in the Social Science Citation Index are all non-profit journals and their library subscription prices average about US$180 per year. Only five of the twenty most-cited journals are owned by commercial publishers, and the average price of these five journals is about US$1660 per year" (p. 1). When considering these numbers, it is important to note that non-profit publishers do not have to pay tax for which rates can vary between 30-50%. Tenopir and King (2001) also argue that commercial journals have comparatively low circulations, with the median circulation for commercial publishers in 1995 being 1400 subscriptions (compared to 5,600 for society publishers). When the calculations are broken down by citation in the field of Economics, the value-for-money issue is even starker. The average price per page of the commercial journals is about six times as high, and the average price per citation is about sixteen times as high, as for the non-profit journals: "While the nonprofits (sic) are supplying most of the information used by economists, the commercial presses are absorbing the lion's share of library budgets" (T. Bergstrom, 2001, p. 4).

While scholars choose to ignore the realities of their choice to publish in commercial journals, they are potentially 'underselling' their research by restricting its distribution. Perhaps more critically, by not taking advantage of the benefits of having global open availability of research online, the scholarly communication system as it stands is slowing the progress of science (Uhlir, 2006).

Delays in publication and Awareness

Delays in publication mean that the ideas presented in an article are known to researchers in a scholarly field well before publication. In a time of instant messaging (for younger researchers), a 12 month-plus delay is interminable. Communication tools are being developed to take advantage of needs in the marketplace not being met by traditional publishers (Esposito, 2004). These include email lists, deposited pre-prints, mailgroups, weblogs and other forms of modern communication. The availability of these tools raises a question, at least in the area of economics:

> … what does 'published' mean, exactly, for a paper that has already been downloaded thousands of times, whose summarized contents have been read

> by many more thousands …? Whatever the economics journals are doing, 'publishing' is hardly an accurate description (Deaton, 2006, p. 6)

The recent introduction of electronic communication methods has not altered the speed of publication for many disciplines since 1960, when "a committee of the American Association for the Advancement of Science … reported delays of one year from the time of acceptance of a paper to its appearance in print" (Phelps & Herlin, 1960, p. 61). This is a serious problem for fast-paced disciplines where the citation half-life can be as short as a year or two, making it imperative to publish as quickly as possible to avoid irrelevance (Miller, 2004). Publishing delays are exacerbated by the peer review process, discussed in the Certification section below.

Open access and Awareness

Considering the small size of the intended audience of a particular piece of work, it is not surprising that many scholarly papers are never cited. A core of approximately 2,000 journals now accounts for 95% of cited articles (Steele, Butler, & Kingsley, 2006). However, any potential audience is considerably greater if the information becomes openly accessible. There is substantial evidence to show that articles that are made freely available online have a far greater impact than those languishing behind toll barriers. Indeed there is an ongoing bibliography of all research into the relationship between impact and access (Hitchcock, 2006).

A study of the online availability and citation counts of 119,924 conference articles in Computer Science and related disciplines found "a clear correlation between the number of times an article is cited and the probability that the article is online … The mean number of citations to offline articles is 2.74, and the mean number of citations to online articles is 7.03, an increase of 157%" (S. Lawrence, 2001). Analysis of Physics articles from 1992-2001 showed open access to non-open access citation ratios of 2.5-5.8 (Brody et al., 2004). Hajjem et al. (2005) examined 10 disciplines from 1992-2003 and found when comparing open access and non open access articles in the same journal/year, the open access articles had consistently more citations, the advantage varying from 25%-250% by discipline and year. These and other studies postulate that when access to articles is unrestricted authors are able to read them and cite them more easily. This is referred to as the 'open access effect'.

The 'increased visibility' argument puts forward these and other findings as an incentive for researchers to make their work available by publishing in open access journals or by depositing their work in repositories. However, arguments have emerged in later studies that there is more than a simple cause and effect between higher citation and open access:

> … claims that the citation rate ratio of papers openly available on the internet (via ArXiv or some other mechanism) vs those not available through those means is caused by the increased readership of the open articles … are somewhat overstated, especially for well funded disciplines with high barriers to entry (Kurtz et al., 2005).

These authors argue that there are several possible explanations for the higher citation rates for open access articles. One of the reasons for higher citations is simply because the article appears sooner, so it has primacy and longer time in the public eye. This is described as the 'early access' postulate. Obviously any advantage gained by an article being available early is mitigated as the percentage of open access articles available moves towards 100%.

Another possible reason for the higher citations is that the articles being made openly accessible are higher quality articles, referred to as the 'self-selection bias' (Kurtz et al., 2005). There is certainly evidence to show the self-selection bias exists. When profiling people who voluntarily self-deposit, it appears that some self-selection is occurring, with evidence to show that items deposited in repositories tend to be more recent and higher quality articles that have appeared in top journals (T. Bergstrom & Lavaty, 2007) It appears that "journals with a higher impact have a larger fraction of papers that can be found online at non-journal sites" (Wren, 2005, p. 3).

It is not surprising that it is the higher quality articles that are finding their way into repositories. This reflects what Willinsky (2006) describes as the 'vanity factor', where greater research impact is the economy of researchers:

> recognition of one's peers is the principal measure of one's contribution to a field of inquiry … the particular ego economy of being cited by name, and of being so closely identified with one's published work … is not entirely without other kinds of rewards, which follow on this recognition factor (p. 21).

There has been an attempt to explain more clearly the reason for the open access impact advantage. A study that specifically attempted to estimate the effect of 'early view' and 'quality bias' by comparing those papers published in specific journals which were available in the preprint server arXiv and those that were not, found that there was no sign of a general 'open access advantage' but did show that having papers in arXiv accelerates citation because papers are available earlier (Moed, 2007).

It is likely that the early access and self-selecting bias are only two of many explanations for the increased visibility advantage. One clue that this is a complex area is a study which found that articles that are open access on a journal's site have higher impact than articles

that are made open access by other means such as deposit into a repository (Eysenbach, 2006). Interestingly, articles that have been made open access through deposit onto non-journal websites are as likely to have been published in an open access journal as a subscription journal, which means some authors are depositing articles into repositories that are already available as open access (Suber, 2005a). Clearly there is more work to be done in this area.

Making research openly accessible offers the individual scholar greater control over their own career by increasing the visibility, and therefore Awareness of their work. Open access potentially offers benefits to researchers. This would appear to be a considerable incentive for researchers to adopt open access dissemination options, however they do not appear to be doing so. This research is attempting to understand why.

Certification

As discussed above, the function of Awareness is being compromised in the traditional scholarly publishing system partly because delays in the publication process create a barrier to the use of journals as a communication tool. A large reason for these delays is the peer review process, Certification. Of the five functions of the journal discussed in this thesis, Certification is the only function journals play for both readers and authors. Peer review represents a third role for the scholar, that of reviewer. This role is effectively hidden, with most peer review occurring without recognition, but this does not mean that a considerable amount of time is not devoted to the task.

One of the reasons peer review is causing delays in publication is the increasing volume of literature being submitted to journals each year. For example the *Journal of the American Medical Association* (*JAMA)* had 6,000 major manuscripts submitted in 2005, a doubling since 2000 (McCook, 2006). *Nature* receives around 9,000 manuscripts a year which is double that of 10 years ago (P. Lawrence, 2003). *Nature Cell Biology's* submissions are increasing by 10% each year; The *New England Journal of Medicine* received 5,000 submissions in 2005, and submissions increase 10% to 15% each year (McCook, 2006). This increase in information is reflected in the growing size of journals. The *Journal of Biological Chemistry* published 19,862 pages in 1988 and 53,130 pages in 2003. This growth is similarly reflected in *Diabetes Care,* which published 853 pages in 1988 and 3368 pages in 2003 (P. Banks, 2004).

On its way to print, a manuscript will be scrutinised by a reviewer only if it has passed the journal editor's first appraisal. It may be rejected outright if it is obviously flawed or deals with a topic clearly outside the journal's scope. The *New England Journal of Medicine*

publishes about 6% of submissions, but approximately 50% of papers are rejected before peer review, as are approximately 25% of the *Journal of Occupational and Environmental Medicine. Science* is rejecting approximately 6,000 papers per year before peer review, about half of the submissions the journal receives annually. These submissions are steadily increasing (McCook, 2005, 2006). In making these decisions, the editors of these high profile journals are effectively the main reviewers and their decisions have "become, quantitatively, much more important than the judgement of the reviewers" (P. Lawrence, 2003, p. 260). Those articles that pass through the editor's cut are despatched to the reviewers. Most journals select two reviewers for each paper (Vries, 2001, p. 235), although this is discipline specific. This system can cause delays of up to a year. Even journals with what is considered a 'fairly rapid' turnaround, usually take six to eight weeks to make a decision. If this decision is positive (usually subject to amendment), the study is then published within a few months of the final manuscript being received (Torgerson, Adamson, Cockayne, Dumville, & Petherick, 2005).

Ironically, having a high submission rate and therefore high levels of rejection is a sign of a journal's prestige (Vries, 2001, p. 236). Higher profile journals such as *JAMA* have rejection rates as high as 92% (DeAngelis & Musacchio, 2004). All journals in the *Nature* stable have an acceptance rate of less than 10% (McCook, 2006), and *Nature* itself has to reject about 95% of biomedical papers (P. Lawrence, 2003). Even journals with a considerably smaller scope are affected. *The Economic Record* published its rejection rates for the years 2001-2004 which ranged from 56% to 70% of the completed submissions (Editors, 2005). The rejection rate for *Plastic and Reconstructive Surgery* was approximately 55% (Goldwyn, 2005).

The sheer size of these numbers indicates that authors are overestimating the quality of their research and 'aiming too high' when submitting their work to a journal, and so are contributing to the delay in publication of their paper. This is partly due to the intense pressure to be published in a handful of top journals because of the Reward function discussed below, so instead of sending less-than-groundbreaking work to second- or third-tier journals, more scientists are first sending their work to elite publications, where they often clearly do not belong. Unsuccessful papers are then resubmitted to a second journal and so on, ricocheting down the publishing chain (Steele et al., 2006). A delay in having a paper published is only one outcome of this information explosion. Each paper that has been refereed and then rejected also represents time that a scholar has donated to the publishing system as a referee.

A large proportion of the academic community is engaged in some sort of peer review activity such as reviewing papers, editing, and paper selection (Rowlands et al., 2004a).

This is undertaken by the academy for the publishers, usually for little or no compensation. While not explored in this thesis, it should be noted that peer review is not limited to reviewing papers for journals or conferences. Scholars also spend time assessing grant applications and promotions as well as PhD[1] and Masters theses. Peer review is one of the communication practices researchers undertake.

Open access and Certification

The process of peer review, however flawed, is centrally important to the academic community. However, as discussed above, the current peer review system is inefficient: "A pre-print does not need to be resubmitted to multiple rejecting journals of decreasing quality to find its appropriate public venue" (Rodriguez, Bollen, & Sompel, 2006, p. 151). The question arises, can open access offer any improvements to the peer review system? This section will discuss several examples of alternative ways to improve the certification process in new publishing systems. For example, the Berkeley Electronic Press, or bepress[v], allows authors to submit to a central point for assessment so the refereeing only occurs once. This is more efficient because it uses only one set of referees to publish a paper, and has been described as "a market for articles" (R. Watson, 2005).

A more radical proposal is for review to take place after publication rather than before it (Esposito, 2004). In effect, 'preprints' would be the primary publication, and both informal and formal reviews would be appended to them. If editorial-board approval is given, most likely for a revised version, the paper's details would be entered into the relevant journal's contents-page, with a link to that accreditation added to the preprint. Under this model, the journal 'goes virtual'. If this were to become a method of publishing, effective version management would be essential for citation purposes (Pitts & Stanley, 2007). Work is currently underway on developing international standards for version identification (Pinfield, 2007).

In some ways, this model is already being used in *PLoS One*, an international, peer-reviewed, open-access, online publication which accepts reports on primary research from any scientific discipline. Submissions are assessed on technical concerns by a member of the editorial board before publication. Once the paper is published, usually within 14 days of submission, it is made available for community-based open peer review involving online annotation, discussion, and rating[vi].

The peer review system is evidently flawed and requires a large input of researchers' effort and time, and new technologies including open access dissemination options offer alternatives to the traditional system. The question that arises that is relevant to this

[1] At the risk of sounding obsequious, may I thank you here for your time in assessing this PhD.

research is whether peer review is perceived by the research community as being flawed or a drain on research time, and therefore whether arguments that open access can improve peer review are effective within the research community as a reason to adopt open access dissemination options.

Archiving

Issues of archiving are not necessarily considered essential by individual scholars. Indeed, in one study, the two least important conditions of using a digital repository according to the respondents were the long-term preservation of the work (22.6%), and interoperability with other archives (37%) (Pelizzari, 2003).

Open access and Archiving

Traditionally, paper versions of journals were distributed worldwide, so there were copies of the same journal issue in separate locations. This meant libraries acted as archives by default. Now that libraries often only subscribe to the electronic version of journals, and some journals do not actually have a print version, an electronic replica of the old system has begun, called Lots of Copies Keep Stuff Safe – LOCKSS[vii].

Libraries are entrusted with the long-term preservation of knowledge, and institutional digital repositories have been promoted as a potential destination for the grey literature arising from research at a given institution (M. Banks, 2005). Recent calls have echoed these ideals, with a declaration made in 2004 about the openness of data in recognition that, "an optimum international exchange of data, information and knowledge contributes decisively to the advancement of scientific research and innovation" (OECD, 2004). Open access digital repositories offer a solution to the long-term issue of archiving grey literature, the supplementary data and background information that surrounds a research project, which is often important to other researchers wishing to replicate and build on the work at a later stage.

The function of Archiving is relevant to this thesis in that it provides an incentive for governments and funding bodies to develop repositories and encourage researchers to place material in them, however Archiving does not appear to be top of mind for the individual researcher.

Reward

Possibly the most important function of journals to individuals within the scholarly publication system is the fifth function, Reward. This is the function that has been

substantially responsible for the journal's change of focus from communication to career tool:

> Research practices are directly shaped by systems of evaluation, changing funding patterns and priorities. Existing evaluation and reward structures tend to lead to conflicting incentives in relation to scientific and scholarly communication (Houghton, Steele, & Henty, 2003, p.127).

Funding bodies and Reward

Funding for research is increasingly tied into a metric assessment of a researcher's output. A 2002 report on electronic publishing in science stated that: "In science, publication is the key currency. It is the primary measure of a scientist's productivity, and affects one's reputation, promotion, intellectual property claims and future access to both intellectual and financial rewards" (American Association for the Advancement of Science, 2002, p. 1).

The Reward function of journals is often manifested in terms of funding, which is regularly assessed by measuring researcher publications. Money for scientific and medical research comes from various sources. In Australia, the UK and the USA, the largest proportion is government sponsored, through universities and research institutions, "84% of the 65,000 articles originating in the UK in 2002 derived from publicly-funded research" (UK House of Commons Science and Technology Committee, 2004b). In Australia, the Federal Government provides the main source of research funding through direct university funding and through funding bodies such as the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC). In the USA, organisations such as the National Institutes of Health and the National Science Foundation are major sources of funding.

Other sources of funding include trust funds (such as the Wellcome Trust in the UK). In addition, "[n]umerous non-governmental organizations and funding bodies contribute to science. The American Chemical Society, for instance, administers the Petroleum Research Fund (PRF). The PRF distributes some US$20 million annually, providing seed money for research and development in energy and fuels" (Chesler, 2004, p. 292). When determining whether to allocate funds to a grant application, these bodies need a way of assessing the value of a particular scientist's work. Regardless of the many problems with this system of measurement, institutions and governments world-wide are increasingly relying on metrics to make grant and promotion decisions, partly because of the difficulty with assessing the papers of a candidate working outside their own subdiscipline (Monastersky, 2005).

For example, in the UK, the Research Assessment Exercise (RAE) is moving towards a metrics based system after the 2008 round called the Research Excellence Framework, which "will make greater use of quantitative indicators in the assessment of research quality than the present system, while taking account of key differences between the different disciplines" (Higher Education Funding Council for England, 2008). In Australia a change in government at the end of 2007 spelt the end of a planned Research Quality Framework (RQF) (Expert Advisory Group for the RQF, 2005) based on the RAE, however, this has been replaced by a new assessment process called Excellence in Research Assessment (ERA), bearing many similarities (S. K. Carr, 2008). A recent phenomenon, university-ranking systems, such as those produced by the *Times Higher Education Supplement*[viii] and the Shanghai Jiao Tong University[ix], use metrics as one of their assessment factors.

Impact factor and Reward

These metric systems rely on the Science Citation Index (SCI) which was developed by Eugene Garfield in 1961 as a way to: "evaluate the significance of a particular work and its impact on the literature and thinking of the period. Such an 'impact factor' may be much more indicative than an absolute count of the number of a scientist's publications" (Cawkell & Garfield, 2001, p. 154).

The SCI counts how many times an article is 'cited' by other articles. This number then contributes to a journal's impact factor, which is published in Journal Citation Reports (JCR). The more prestigious the journal, the higher the impact factor (Garfield, 2000). The best scenario for an academic is to have an article published in a high impact journal because the JCR impact factor "has moved in recent years from an obscure bibliometric indicator to become the chief quantitative measure of the quality of a journal, its research papers, the researchers who wrote those papers and even the institution they work in" (Amin & Mabe, 2007, p. 1). The JCR impact factor of a journal is calculated by dividing the number of citations it receives in the current year by the number of research or review articles it published during the previous two years. Journals with high impact factors tend to attract leading researchers, and those who aspire to be leading researchers, as there is a strong perception that the higher the impact factor, the 'better' the journal (Steele et al., 2006).

It is widely agreed that using a journal's impact factor as a system of measurement is highly flawed for many reasons (Bollen, Sompel, Smith, & Luce, 2005; B. D. Cameron, 2005; Hecht, Hecht, & Sanberg, 1998; Steele et al., 2006). These include the small number of 'core' journals which are counted in impact factors, the problem with using a two year

citation window in disciplines where papers have a considerably longer half-life, the advantage of disciplines with a high citation rate, the emphasis on English language papers, the difficulties with assuming that all papers in a journal of a given impact factor are of the same quality and the questionable formula used to make the calculations. A major criticism of the SCI is its lack of scope, covering only a few thousand core journals, a small fraction of all scientific journals published in the world: "In effect, what Garfield did was to collapse the entire set of little specialty 'cores' into one big 'scientific core' and he used this set of journal titles as the basis of ISI's emerging Science Citation Index" (Guedon, 2001, p. 12)[2]. By measuring the quality of the *journal* rather than the *article* it leaves the ridiculous situation of a bad paper in a good journal being 'worth' more than an excellent article in a nondescript journal. This system is partly responsible for the high submission load of prestigious journals.

Researchers' publication and Reward

Researchers in Australia answer to three 'masters'. First, they are members of one or several academic communities consisting of the people working in their specific sub-specialisation. These communities are often spread across the world. These communities have their own norms and expectations. However, researchers also work within institutions and must report to that institution for promotion. Their third 'master' is the grant funding body. Grants are highly competitive, of the 4112 proposals for ARC funding in 2008, only 21.4% were successful (Australian Research Council, 2007b). Of those successful grant applications, few are allocated the full amount that was requested (Rowbotham, 2008). In the UK, where applications to the RCUK have a 28% success rate, a study by Research Councils UK (Research Councils UK, 2006) has shown that the annual amount spent on preparing and submitting grant research proposals is £121.5 million. This represents approximately 6% of the total costs of the councils. The cost of preparing grant applications in Australia is proportionally even greater given the smaller research community, with one estimate putting the figure at AU$114million a year in researcher time alone (Houghton et al., 2006).

Researchers are altering their publishing behaviour to meet changing requirements. Butler (2003) showed that when changes were made to the assessment for funding allocation in Australia in 1993 to include publication output, the number of publications rose dramatically, but because there was no measure of quality, these extra publications tended to be at the lower end of the impact scale. Pinfield (2004) made the observation

[2] Eugene Garfield Associates which originally developed the SCI, became the Institute of Scientific Information (ISI) which was sold to Thomson Scientific, which in turn has recently become Thomson Reuters.

that the UK's RAE does not just measure but also determines publishing behaviour in universities: "Institutions and their authors behave in ways that they believe will maximise their RAE scores" (p. 308). More than a decade ago, the observation was made that:

> the increasing awareness of journal impact factors, and the possibility of their use in evaluation, is already changing scientists' publication behaviour towards publishing in journals with maximum impact, often at the expense of specialist journals that might actually be more appropriate (Seglen, 1997, p. 498).

Examples of this behaviour include self-citation and deliberately writing review articles because of their generally higher impact (Steele et al., 2006). The emphasis on impact factors by promotion and granting bodies has spurred papers that explain to researchers specifically what journal impact factors and citation indices are, with the potential attendant aim of demonstrating ways to maximise citations, for example (Cartwright & McGhee, 2005).

This reliance on publication output is a serious situation for many researchers. The world-wide move towards metric, dubiously quantitative, assessment of work potentially poses the greatest barrier to a revolution of the scholarly communication system. The reward system provides a compelling reason for scholars resisting changes to current work practices as any change to the practice potentially jeopardises the academic's standing (Bjork, 2004; Harley, Earl-Novell, Arter, Lawrence, & King, 2007; Steele et al., 2006).

Open access and Reward

There have recently been several suggested alternatives to the current Reward system, which relies almost solely on a journal's impact factor provided by Thomson Reuters. As discussed this is a highly flawed method of measurement. One alternative is the 'journal diffusion factor', which looks at citation repetition (Rowlands, 2002). Others include the Hirsch's h-index which states: "A scientist has index h if h of his/her Np papers have at least h citations each, and the other (Np−h) papers have no more than h citation search" (Hirsch, 2005). There have been criticisms that this index gives undue merit to researchers who publish many papers, and is not necessarily an indicator of quality. More recently, Egghe's (2006) g-index has been proposed, which aims to improve on the h-index by giving more weight to highly-cited articles.

There are simple electronic alternatives to straight citation counts such as counting the number of times an electronic article is downloaded. This means "scholars can have a much more accurate picture of what is being read than what is offered by the traditional

reliance on citations" (Galvin, 2004). One of the issues of measuring usage of electronically published papers is that the number of hits or downloads a paper has had does not necessarily translate into the paper being read. Because of this, one suggested way of incorporating the use of online technologies has been to make comparisons between downloads and citation data (Bollen et al., 2005). There has been some evidence recently that citations of certain articles in journals do not reflect the downloads of articles from the same issue (Coats, 2005), which may indicate that citations are not necessarily a good indicator of actual use of articles. This is countered by research that found Thomson Reuters citations correlated well with web citations if these included all types of web citations, that is: not only citations, but being included in a reading list, if the paper is listed on a CV, if the paper is in Medline, if it is cited in a conference and if a Web bibliometric service lists the article (Vaughan & Shaw, 2004).

Research that has quantified the use of electronic journals found that online researchers read only the abstracts of longer articles but shorter articles are read in full (Nicholas & Huntington, 2006, p. 50). However it seems there is a relationship between online hit counts and subsequent citations of the paper. One study has shown that, "early hit counts capture at least to some extent the qualities that eventually lead to citation in the scientific literature" (Perneger, 2004). This opens up an unparalleled opportunity to track article usage.

In addition, there have been several aggregating tools developed recently in competition with Thomson Reuters' Web of Science. Scopus, launched in 2004 by Elsevier, claims to provide full coverage from 1996 onwards and covers 33 million abstracts, 15,000 peer reviewed journals and 386 million scientific webpages, according to its website[x]. Scopus however only provides citation data for the items indexed by it. Another is Google Scholar, which does not provide information about how many records it includes. Its website states that because it is freely available, Google Scholar indexes data from publishers only if the publisher will provide the abstract free[xi]. However, all aggregators are not created equal, a comparison of the h-indices of specific researchers based on citation counts from the traditional Web of Science, Scopus and Google Scholar showed there were differences both between the databases, and between disciplines (Bar-Ilan, 2008). A separate comparison of the three tools showed little difference between the Web of Science and Scopus, but that Google Scholar produced more citation counts (Bauer & Bakkalbasi, 2005). A study by Clarke (2008) found that for the information science discipline, Google Scholar offered better coverage than the Web of Science database. These results indicate that none of the aggregators are completely reliable, There are many other aggregating tools being developed, for example the freely available 'Publish or Perish'[xii] created by Ann

Harzing, and journal ranking tool Eigenfactor[xiii], which includes journal articles and reference books, newspapers, trade magazines and software packages.

The issue of Reward is central to the reasons researchers adhere to the current scholarly publishing system. They need publications for promotion and funding. However, the link between publication and research evaluation and funding also provides the potential 'leverage' required to encourage open access (Houghton et al., 2006). This research therefore aims to answer questions about how deeply embedded the question of future reward outcomes are in the choices researchers make when communicating and publishing their work, and whether this affects their engagement with open access dissemination options.

Copyright

Copyright sits outside the described functions of the journal, and yet is integral to many of the arguments for a change to the scholarly publishing system. Copyright is a set of rights that sits with the originator of a work of a literary, dramatic, musical, artistic, or cinematographic nature (Clarke, 2005) The basic principle of copyright "protects and balances the rights of the author and public" (Willinsky, 2006, p. 41). Copyright represents control of the academic output, and when considering the costs associated with the scholarly publishing industry it is easy to see there are groups with considerable vested interest.

Universities generally waive their copyright on research outputs, which means that researchers own the copyright of their written work unless they sign it away (Gadd, Oppenheim, & Probets, 2003). The Registration function of journals requires authors to publish in recognised outlets, and copyright is an issue in the open access debate because currently most commercial and many not-for-profit publishers require authors to sign a copyright transfer agreement when they release their work to be published in a journal or conference proceedings. Signing transfer agreement forms giving the distributors (publishers) copyright over their work before publication means the author of a paper must apply for permission to use their own published work if they wish to reproduce some of it later in another form.

In an electronic era, the focus of scholarly communication has moved from publication to dissemination. There is a need for copyright laws which reflect technologies available to the community. Core values of science include access and affordability of scientific information. Increasingly, governments and the scientific community are realising that there is a need for "evolutionary changes in the patterns of current licensing practices for

electronic publishing are required that encourage wider, faster, less expensive access to a broad range of scientific works" (American Association for the Advancement of Science, 2002, p. 3). This requires authors to have more control over the dissemination of, and access to, their work.

While publishers and governments are focused on copyright (Benkler, 2001`), there is a question whether individual scholars care about giving away their copyright. It may not necessarily be a pressing issue for many researchers, but studies have shown that authors do have concerns about copyright. One study which attempted to ascertain what level of copyright protection researchers wanted, found that "academics have a wide range of views on the protection their self archived works require" (Gadd et al., 2003, p. 350). Another study found that copyright is a negligible issue for authors: "Only 13% said that they took a 'detailed interest' in the small print of the copyright agreement when they published their last article and, significantly, nearly half of all authors, 46%, admitted that they took no interest at all" (Rowlands et al., 2004a). Those authors who did express interest in copyright tended to be unhappy with the current copyright system.

Open access and Copyright

Allocation of the copyright of scholarly articles to publishers is considered by many open access advocates to be an issue that must be resolved in any move to an open access system. While the ownership of copyright of published scholarly works is not necessarily a major concern to most researchers, the technical and legal aspects of this issue must be addressed for open access to work.

One contribution of the open access model is avoidance of the loss of copyright control by the authors. It can be argued that publishers require some degree of copyright control as it is by this means that they obtain subscriptions. Even allowing for that, there is still the problem that publishers currently hold the copyright controls in perpetuity. One alternative to this situation is that primary research papers should be held in trust by the publishers for the scientific community rather than owned by the publishers (Hopkins, 2001). Another possibility is that there should be retention of copyright by publishers even under an open access system, but only in the case of commercial use where a fee would be applicable. This ensures "the published content is not misused in any way that would serve a commercial company's business ends at the expense of the integrity of both the researcher and the journal. We maintain another revenue stream for the journal, which allows us to keep author charges as low as possible in the immediate future" (Gedye, 2004, p. 272).

Willinsky (2003) argues that the fee-based model of access to research runs contrary to the spirit of copyright law. Retention of copyright is one of the recurring issues in the open access debate: "The only constraint on reproduction and distribution, and the only role for copyright in this domain, should be to give authors control over the integrity of their work and the right to be properly acknowledged and cited" (Open Society Institute, 2002). In 2008, the Faculty of Arts and Sciences at Harvard University introduced a mandate for depositing all published articles in the university repository which included copyright retention, placing those rights in the hands of the institution running the repository (Darnton, 2008).

There have been several major projects addressing the copyright dilemma. One solution is for authors to attach an addendum to the publisher's agreement:

> For articles published in journals with more restrictive copyright policies, authors may employ a 'pre-print + corrigenda' strategy, where they post an additional file, which lists changes and additions, with the archived pre-print draft of the article. This is a legal method that authors can use to regain control over their own work (C. Hess, 2005, p. 9).

To that end, several organisations have released author rights addenda for authors to attach to publisher's copyright agreements, (MIT, 2007; Science Commons, 2007) being a small sample. Addenda are legal instruments to allow authors to retain certain rights for their articles "such as distributing copies in the course of teaching and research, posting the article on a personal or institutional web site, or creating derivative works" (SPARC, 2007). These addenda are needed for the publishers that do not allow self depositing of articles into repositories, and for situations where the journal later changes its access policy. Many of these addenda have arisen from a large non-profit project out of Massachusetts Institute of Technology called Creative Commons, which "provides free tools that let authors, scientists, artists, and educators easily mark their creative work with the freedoms they want it to carry" (Creative Commons, 2007).

Not unexpectedly, publishers have started fighting back, with the International Association of Scientific Technical and Medical Publishers, the Association of American Publishers Professional and Scholarly Publishing and the Association of Learned and Professional Society Publishers releasing a white paper emphasising an appropriate 'balance' for publishers and authors, stating that academic authors and institutions should be able to use and post their own content for "internal institutional non-commercial research and education purposes" but that publishers "determine when and how the official publication record occurs" (STM AAP PSP & ALPSP, 2007, p. 3).

The issue of copyright is relevant to this thesis because many proponents of open access state that copyright issues are central to change. However, the question is whether copyright is an issue that resonates with the academic population and therefore whether it is a barrier to the uptake of open access scholarly communication in Australia.

Summary

This chapter has provided background to the research question "How are the communication practices between researchers affecting the uptake of open access scholarly dissemination in Australia?" by examining the challenges facing the scholarly communication system within which researchers function. These challenges are that the Reward system requires an increasing amount of literature to be produced and sent to those journals with the highest impact resulting in a high rejection rates and increased time spent in the peer review aspect of Certification, and these delays in turn affect the Awareness function of journals.

This analysis articulates the broad inadequacies of the scholarly publication system defined in Chapter 1: that academic articles are written by the academic community, peer reviewed by the academic community and often edited by the academic community, with no compensation, yet the high subscription costs of commercially published research is a barrier to increased and improved dissemination of knowledge. This chapter also indicates that open access offers solutions to many of these issues, and potentially offers a cheaper and effective method for the dissemination of knowledge. This would appear to be a considerable incentive for researchers to adopt open access dissemination options. This research therefore aims to answer questions about how deeply embedded the question of future reward outcomes are in the choices researchers make when communicating and publishing their work, and whether this affects their engagement with open access dissemination options.

The next chapter will look at how repositories provide an open access option and explores the uptake of open access amongst the academic community.

[i] Website: http://arxiv.org/ accessed 16 September 2008

[ii] Website: http://pubmedcentral.nih.gov accessed 5 October 2008

[iii] Website: http://www.openarchives.org accessed 5 October 2008

[iv] Website: http://www.arl.org/sparc/ accessed 5 October 2008

[v] Website: http://www.bepress.com/ accessed 22 September 2008

[vi] Website: http://www.plosone.org/static/information.action accessed 28 September 2008

[vii] Website: http://www.lockss.org/lockss/Home accessed 16 September 2008

[viii] Website: http://www.timeshighereducation.co.uk/ accessed 5 October 2008

[ix] Website: http://ed.sjtu.edu.cn/ranking.htm accessed 5 October 2008

[x] Website: http://www.info.scopus.com/about/ accessed 5 October 2008

[xi] Website: http://scholar.google.com/intl/en/scholar/publishers.html accessed 5 October 2008

[xii] Website: http://www.harzing.com/resources.htm accessed 5 October 2008

[xiii] Website: http://www.eigenfactor.org/ accessed 5 October 2008