Open Access: the future of scholarly communication

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RESUMO

A evolução do conhecimento assenta numa eficaz comunicação dos resultados da investigação. As descobertas necessitam ser largamente disseminadas para que outros investigadores possam construir a partir delas o seu próprio saber, contribuindo, assim, para dar corpo e expandir o conhecimento.
A Internet dá-nos oportunidades nunca antes sonhadas para nos assegurarmos de que todos aqueles que podem beneficiar do acesso à investigação tenham efectivo acesso a ela. Infelizmente, o actual modelo económico (subscrições, "grandes negócios", etc.) restringe o acesso àqueles que podem proceder ao pagamento.
Este facto retarda todo o processo de pesquisa e conduz às ineficiências da comunicação do conhecimento.
O Open Access dá-nos um modelo em que o acesso é alargado a toda a comunidade académica, em todo o mundo. Este artigo descreve duas modalidades complementares do acesso livre (repositórios e artigos de publicações periódicas em acesso livre) e dá exemplos dos passos que estão a ser dados no sentido de implementar o acesso livre para benefício dos autores, dos leitores e da sociedade em geral.

PALAVRAS-CHAVE

ACESSO LIVRE

PUBLICAÇÕES PERIÓDICAS

REPOSITÓRIOS

COMUNICAÇÃO CIENTÍFICA

ACESSO AO CONHECIMENTO

ABSTRACT

Advances in scholarship rely on the effective communication of research results. Discoveries need to be widely disseminated so that other researchers can build on them and contribute to an ever-expanding body of knowledge.
The Internet age gives us opportunities never before dreamt of to ensure that everybody who could benefit from access to research has access. Unfortunately, current business models (subscriptions, "big deals", etc.) restrict access to those who are able to pay. This slows down research and leads to inefficiencies in scholarly communication.
Open Access gives us a model in which access is widened to all of the academic community world-wide. This paper describes two complementary modes of open access (repositories and open access journals) and gives examples of active steps that are being taken to implement open access to the benefit of authors, readers, and society as a whole.

INTRODUCTION

The birth of modern scholarly communications can be dated to the second half of the seventeenth century with the launch of the *Journal des Savants* in 1665 and the *Philosophical Transactions of the Royal Society* in 1666. At this time researchers were driven by two motives to publish – they wanted to communicate their discoveries and share knowledge, but they also wanted to lay intellectual claim to their discoveries and insights, so registering intellectual priority. Over the 300 years that followed authors continued to feel the force of these drivers. As researchers increasingly had to compete for research grants and university positions their publication records became the main features of their CV. Journals, therefore, had a ready supply of "raw material".

Journals also attracted readers. Researchers need to keep up with the latest results and the scholarly literature became a research tool as new discoveries were built upon the work of others described within journals. Quality was assured through the system of independent peer-review and libraries ensured the continuing availability of historical research by maintaining archives.

The number of researchers, the amount of research published, and the number of journals has grown steadily since 1665, until in the second half of the twentieth century the system began to show signs of severe strain. Libraries could no longer afford to purchase all the journals that all the researchers at their institutions required. This led to declining subscriptions followed by increased prices as publishers tried to maintain their profits. Prices increased more rapidly than library budgets so leading to more cancellations, further price increases, more cancellations, and triggering a vicious cycle of reduced access to research. This is the well-documented "serials crisis".[1]

Many thousands of words have been written on the serials crisis and its causes. Basically, it represents a gap between the proportion of the literature that libraries can access and the information that researchers need to be effective. This gap has widened as over the last few decades the annual rise in average subscription price for science, technical, and medical (STM) journals has outstripped the increase in library budgets around the world. For example, the Association of Research Libraries (ARL) report that the average cost of STM journals rose by 188% between 1986 and 2004, while the US consumer price index rose by 73%.[2] During this period, spending on

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journals by ARL libraries managed to keep pace with the price rises, but only by transferring an ever increasing proportion of the library budget to journals. Not all institutions worldwide, especially those institutions that are less well funded than the ARL members, have been able to keep up with price rises.

This information gap has resulted in widespread dissatisfaction with the current scholarly communication model at a number of levels. Authors want to put their work before their colleagues and before society as a whole, and they do this without any expectation of direct financial reward, e.g. from royalties. In fact, they often have to make a financial contribution to the costs of publication in the form of page charges, figure reproduction charges, reprint costs, etc., as well as giving away the copyright in their text, so limiting their further use of their own work. In return for donating their papers (together with a financial contribution and surrender of copyright), the current system places barriers between authors' work and their potential readers, so resulting in reduced dissemination and impact of their work.

Readers are dissatisfied as they cannot get access to all the research that they need. The research literature is the most potent research tool available – it educates, provokes, and inspires researchers. The current system denies access to the complete body of the literature, so making the tool much less powerful and reducing the effectiveness of researchers. Librarians are dissatisfied as they are not able to meet the information needs of their users (both researchers and students). Even the wealthiest institutions cannot purchase access to all the information that its researchers require to be effective. In 2003 a UK report accepted that «…providing all of the information required by UK researchers is beyond the capability of any single library; and indeed that the aggregated efforts of all UK research libraries are failing to secure a national collection in keeping with the researchers' current and emerging needs and demands».[3]

Finally, society as a whole loses if we continue with sub-optimal communications channels that restrict the free-flow of information between the world's scholars and the public.

This is where SPARC Europe comes in. SPARC Europe was launched in 2002 as a response to the success of SPARC (the Scholarly Publishing and Academic Resources Coalition) founded in 1998 by members of the ARL. Both SPARC and SPARC Europe exist to challenge the status quo of scholarly communications and to help expand information dissemination and use in a networked digital environment while responding to the needs of academia. Today, SPARC and SPARC Europe are alliances of universities, research libraries, and organizations (205 members in North America, Asia, and Australia, and 110 members in 14 European countries) that respond constructively to market dysfunctions in the scholarly communication system.

NEW OPPORTUNITIES

As a result of the problems described above, many organisations, including SPARC Europe, have looked at the continued development of the Internet and new electronic publishing tools and have asked whether it is possible to totally reengineer the scholarly communication process. Rather than only producing online versions of print journals accessed using traditional subscription-based models, are there new financial models that use new technology to better fulfil the functions of journals? Can new models better provide the international dissemination and impact that authors require, together with quality control and access needed by readers, so better serving authors, readers and, ultimately, research?

The most profitable approach to finding ways of using new technology and business models to provide solutions to the serials crisis is to look carefully at what it is that journals actually do. Journals perform four functions registration, certification, awareness and archiving.[4] That is,

- **Registration** – the author wishes to ensure that he or she is acknowledged as the person who carried out a specific piece of research and made a specific discovery.
- **Certification** – through the process of peer-review it is determined that the author's claims are reasonable.
- **Awareness** – the research is communicated to the author's peer group.
- **Archiving** – the research is retained for posterity.

The traditional journal integrated all these functions into the print issue, distributed to subscribers. This made perfect sense in the print environment where the production of extra copies incurred extra costs, which could be recovered by charging subscriptions. In the new environment dominated by the Internet and digital publishing it is perhaps no longer the case that integrating these functions is the most efficient solution.

In December 2001, a meeting was convened in Budapest to address these issues,

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to scrutinise potential new models, and to investigate the best ways in which the new technology could be used. As a result of this meeting the Budapest Open Access Initiative (BOAI) was published in February 2002.[5] Open access can be defined as the free and unrestricted access through the Internet to all the published primary research literature. This literature is given to the world by scholars without expectation of payment and in the hope that it is distributed and read as widely as possible. Making it freely available over the Internet immediately distributes it to the 850 million people worldwide who have Internet access. Giving all interested readers access will accelerate research, enrich education, share learning among rich and poor nations, and, ultimately, enhance return on investment in research (much of which come from the world's taxpayers). From being in a position where institutions cannot supply all the information need of researcher, researchers will be able to access all of the relevant information they need to be effective

Open access also provides major benefits for authors. Rather than their paper being seen by readers at the few hundred institutions lucky enough to have a subscription to the journal, the paper can now be seen by all interested readers. This increases the profile of the authors, their institutions, and their countries.

The BOAI identified two parallel and complementary strategies that could be used to move towards open access and a fairer, more equitable, and more efficient communications system. These were self-archiving and open-access journals.

· Self-archiving refers to the right of scholars to deposit their refereed journal articles in searchable and free electronic archives.

· Open access journals do not charge for access to the papers, but make the papers available to all electronically and look to other financial models to cover the costs of peer-review and publishing. They do not invoke copyright or exclusive licenses to restrict access to the papers published within them, rather they encourage the dissemination of research limited only by the reach and extent of the Internet.

These complementary approaches will now be investigated in more detail to show how by acting together they can fulfil the functions required of a "journal".

SELF-ARCHIVING IN INSTITUTIONAL REPOSITORIES

The terms "institutional repositories" and "open archives" have been used to describe digital collections capturing and preserving the intellectual output of a single or multi-university community.[6] They may contain a wide range of materials that reflect the intellectual wealth of an institution – for example, pre-prints and working papers, published articles, enduring teaching materials, student theses, data-sets, etc. The repositories are cumulative and perpetual, ensuring ongoing access to material within them. By building the archives to common international technical standards – specifically, to the Open Archive Initiative (OAI) standards[7] – the material deposited within them is fully searchable and retrievable, with search engines treating the separate archives as one. Readers do not need to know which archives exist or where they are located in order to find and make use of their contents. To maximise the use and impact of the repositories the material within them should be available freely over the Internet.

While an institution repository can make available a wide range of material (as described above), this paper is concerned only with the peer-reviewed research literature. If researchers place the results of their research into their local institutional repository (i.e., self archive their papers), three of the functions of a traditional journal are immediately met:

1. **Registration** – by depositing in the repository the researcher makes claim to their discovery.
2. **Awareness** – as the repository is constructed to OAI standards the researcher's work can be found by search engines and made available to their peers. New alerting services can be developed that inform readers of new papers deposited in any repository that matched their research interests (in the same way that journal table of contents can be received).
3. **Archiving** – the institution takes responsibility for maintaining the long-term archive of all the work produced by members of that institution. This places the onus of archiving back onto the library community where it has rested for centuries, rather than on the publisher community where it has migrated following the transfer from print to online. In many cases the research library will be best placed to maintain over many decades an archive of the institution's own research.

As well as fulfilling these three functions of the traditional journal, there are many benefits, at many levels, to institutional repositories:

• For the individual:

· They provide a central archive of the researcher's work;

· By being free and open they increase the dissemination and impact of the individual's research;
·They act as a full CV for the researcher.
• For the institution:
· They increases the institution's visibility and prestige by bringing together the full range and extent of that institution's research interests;

· They act as an advertisement for the institution to funding sources, potential new researchers and students, etc.
• For society:
· They provide access to the world's research;
· They ensure long-term preservation of institutes' academic output;
· They can accommodate increased volume of research output (no page limits, can accept large data-sets, "null-results", etc.).

PEER REVIEW AND OPEN ACCESS JOURNALS

The one function of the traditional journal that self-archiving in institutional repositories does not fulfil is certification or peer-review. Each institution will be able to make its own policies on how material is to be deposited in the repository, and some may insist that papers receive at least an initial review before being made widely available. However, this is not a substitute for independent, international peer review. Peer review serves the reader as a mark of quality (helping them to decide which papers they wish to read), while it is used by authors to validate their research (which is of particularly importance in their next grant proposal or attempt at promotion).

Peer review journals could sit comfortably with the network of institutional repositories. Authors who wanted their work to be peer reviewed could, after they had deposited it in their local repository, send it to their journal of choice. At this stage the work would be evaluated as in the current system and, if considered by the editor of the journal to be acceptable, the paper would be published in the journal and so receive the journal's quality stamp. The authors could then place a peer-reviewed "post-print" onto their local institutional repository ensuring that both versions were archived.

Obviously, with all the relevant material available for free on a network of institutional repositories it becomes impossible for a journal to charge a subscriber to access a paper in the journal. The peer review journals, therefore, would need to have no access restrictions on them – that is, they would be open access.

Without subscription income publishers will have to look at new financial models to support their journals. There are costs associated with the peer review process and with publication of a paper (even if it is only online), and these costs must be met somehow. A number of possible revenue sources for open access journals have been identified,[8] but one of the most stable for the science, technical, and medical fields may be that where authors pay a publication charge, so ensuring that the publisher would receive sufficient revenue to make the paper available to all with no access restrictions. Ultimately, it would be for the research funding body or the institution to cover the publication charge, but basically, this model looks to a move for paying for access to material (through subscriptions) to paying for dissemination.

PRACTICAL DEVELOPMENTS

The scenario above gives a vision for a fair and efficient mechanism for scholarly communications. All research material is made freely available in a worldwide network of fully searchable repositories. A sub-section of the material in the repositories – peer reviewed papers – receives a certification "quality stamp" from journals. This process is financed by the authors' institutions and funding bodies, rather than through the readers' libraries, so allowing free access to all interested readers to all peer-reviewed papers via the Internet.

This vision may sound utopian, but already many steps are being taken around the world to realise this future, and the pace of change appears to be increasing.

Institutional repositories

At least four open source software packages exist for setting up and implementing institutional repositories[9] and hundreds of institutions worldwide have used these packages to set up repositories. In addition, a number of national initiatives have been set up to provide infrastructure support for repositories – these include SHERPA in the UK, DARE in The Netherlands, and the provision of Australian $12 million to promote institutional repositories in Australia.[10]

As the amount of content in the growing number of repositories continues to increase, new services are being developed to make use of this content.

To date, the most active area of service provider development has been the construction of search engines that can search over a number of repositories simultaneously, so ensuring that the reader can find material irrespective of where it have been deposited.[11] One of these search engines, OAIster, now searches through over 5,500,000 electronic items in almost 500 repositories.[12]

Open access journals

The number of open access journal publishing high quality, peer reviewed research is growing. Lund University has compiled the Directory of Open Access Journals (DOAJ) listing fully peer-reviewed journals that place no financial barriers between the papers published online and readers.[13] The DOAJ was launched in May 2003 with 375 titles, a figure that has increased to over 1550 titles in two years. One feature of the DOAJ is that records for each journal listed can be easily download by librarians and entered into their catalogues, thereby allowing readers to learn about the journals.

New open access journals are regularly being announced. In October 2003 the first issue of *PLoS Biology* was launched.[14] Produced by the Public Library of Science, *PLoS Biology* is the first in a proposed stable of journal titles. It is aiming to publish the highest possible quality papers – rivalling such established titles as *Science* and *Nature*. The first issue generated massive international publicity, with reports and editorials in many of the world's leading newspapers and ISI have announced that *PLoS Biology* has a preliminary impact factor of 13.9, ranking it first in ISI's category of general biology journals.[15] *PLoS Biology* was followed in October 2004 by *PLoS Medicine*, with three further titles to be launched in 2005 – *PLoS Computational Biology*, *PLoS Genetics*, and *PLoS Pathogens*.

In addition, a plan has been put forward to transform current subscription-based journals into open access journals.[16] Under this plan, authors are given a choice as to whether or not they are willing and able to pay a publication charge. If they are (and, of course, the paper is judged acceptable for publication following peer-review) the paper is made open access on publication. If they are unwilling or unable to pay the paper is only made available to subscribers. Over time, the proportion of authors willing to pay should increase and the publisher can begin to reduce the subscription price. Eventually, the entire journal will be open access.

This model has proved to be attractive to a number of publishers, especially smaller and society publishers who believe in the moral case for open access but who did not see a way of converting their journals. The model gives authors who pay the benefits of open access (i. e., wider dissemination, higher citation, greater prestige, etc.), while allowing those authors who do not pay the opportunity to still publish in their journal of choice. As the benefits of open access become clearer (and in this hybrid model they can be accurately measured) authors will place pressure on their funding bodies to provide grants for publication.

While not eliminating financial risk for the journal owner, this model does reduce the risk by providing a smooth transition period as the decline in subscription revenue is matched to the increase in publication revenue. It is probably for this reason that a number of "traditional" publishers such as PNAS, Oxford University Press, the Company of Biologists, and Blackwell's are experimenting with variations of this model.[17]

Support from funding bodies

Over the past couple of years we have seen increasing support for open access (in the form of both self-archiving and open access journals) from the funding bodies that pay for research. In October 2003, all the major German funding bodies signed a declaration in strong support of open access.[18] The "Berlin Declaration" has also been adopted by, amongst others, the CNRS and INSERM in France, by the FWF Der Wissenschaftsfonds in Austria, the Fonds voor Wetenschappelijk Onderzoek in Flanders, and the rectors of almost all Italian universities. This support from the funding bodies has come about as they realise that, to quote the Berlin Declaration, «Our mission of disseminating knowledge is only half complete if the information is not made widely and readily available to society». They increasingly believe that it is in their interests and it is their responsibility to support the wider dissemination through open access of the research results that they have funded.

A number of follow-up meetings have been held to monitor progress towards achieving the ideals of the Berlin Declaration and to map-out future work. At the third meeting, held in Southampton, UK at the end of February 2005, a simple and clear statement was drafted that described how, in order to implement the Berlin Declaration institutions should:
1) implement a policy to require their researchers to deposit a copy of all their

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published articles in an open access repository;
and
2) encourage their researchers to publish their research articles in open access journals where a suitable journal exists and provide the support to enable that to happen.[19]

In the US, the National Institutes of Health (NIH) has instituted a new policy aimed to increasing access to the research it funds. The NIH is the world's largest public research funder with an annual research budget of approximately $26 billion. As of 3 May 2005 all researchers who receive a NIH grant are "requested" to deposit their papers within 12 months of publication in PubMedCentral – a centralised repository run by the NIH.[20] This policy, if followed by researchers, could make up to 60,000 papers freely available year.

In the UK, the Wellcome Trust has issued a stronger policy on open access. The Trust is an independent research funding charity, spending over £400 million per annum, mainly in the biomedical field. As of 1 October 2005 all papers from new research projects funded by the Trust must be deposited in PubMedCentral within six months of publication. The Trust is also working with the NLM (who run PubMedCentral) to establish a European site for PubMedCentral. The Trust will also provide researchers with additional funding to cover the costs of page processing charges levied by open access publishers (which it has estimated at no more than 1-2% of total research spending).[21]

The power of open access

As open access is a relatively new concept, it is difficult to compare directly open access publication (either through self-archiving or in peer-reviewed journals) with closed, subscription-based access. However, initial evidence is accumulating that supports that intuitively obvious assertion that open access will give greater dissemination and impact.

Recent figures from the *Astrophysical Journal* show that for 72% of papers published free versions of the papers are available (mainly through ArXiv). Citation analysis shows that these 72% of papers are, on average, cited twice as often as the remaining 28% where there are no free versions available.[22] At this stage it is difficult to show clear cause and effect, but it is an intriguing indication of the increase in impact of authors' work if they self archive.

Some interesting figures are also coming from open access journals. *Limnology and Oceanography* is a journal published by the American Society of Limnology and Oceanography. It offers a hybrid model where authors can take the option to pay to make their paper open access on publication. This means that any issue of the journal may have a mix of open access papers, available to any interested reader, and close-access papers only available to subscribers. The open access papers published in 2004 have been downloaded almost 4 times more often than non-open access papers and for papers published in 2003, 199 of the 200 most downloaded papers were open access.[23]

The highly prestigious *Proceedings of the National Academy of Sciences* (PNAS) also operate a similar hybrid system. Their initial statistics suggest that open access papers in PNAS receive 50% more downloads that the papers only available to subscribers.[24] PNAS has a much larger number of subscribers than *Limnology and Oceanography* and so the open access benefit is smaller. However, it is interesting that even for such a widely distributed journals as PNAS there is an open access benefit.

NEXT STEPS

There is growing international momentum in favour of institutional repositories and open access journals. Increasing numbers of libraries are taking on the role of hosts for institutional repositories, becoming responsible for maintaining the intellectual heritage of their institutions. The libraries are also increasingly resisting the old models of subscriptions and big deals. Growing numbers of open access journals are attracting high profile editors and quality papers from excellent authors. These papers are viewed by more and more readers, increasing the impact and visibility of the journals. In addition, the continued success of these open access journals is proving the feasibility of the new business models.

As issues surrounding institutional repositories and open access journals become more widely discussed there is increasing awareness amongst authors of their need to retain their publishing rights (e. g., does assigning copyright mean that they cannot put a copy of their own paper on their departmental website?). There is also increasing awareness amongst editors and editorial board members of their power and responsibilities to engage their publishers in discussions regarding fairer publishing practices. As described above, the past few years have seen a burgeoning of interest internationally in publishing issues amongst funding bodies and at the political level.

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As success is proved, more authors, readers, university administrators, librarians, and funding bodies are becoming aware of the limitations of the current system and the possibilities of the new models. More importantly, they wish to take positive action to bring about a change in the system as quickly as possible.

Over the next few years all players in the communication process can play a part in making change happen. In particular, authors can:

• Deposit their work in institutional repositories.
• Support open access journals by submitting papers to them and refereeing, reading, and citing articles in them.
• Launch new open access journals if appropriate.
• Discuss publication rights, open access, and reasonable prices with the publishers of the journals they use regularly (especially if they are editors or board members).
• Discuss with funding bodies and university administrators funding and promotion criteria to ensure that researchers are not penalized for using repositories or publishing in open access journals (especially those that are online only).
• Lobby funding bodies for specific publication funds to take advantage of the benefits of publishing in open access journals.

Librarians can:
• Establish institutional repositories.
• Help faculty archive their research papers (new and old) within the repository, digitizing older papers if necessary.
• Help open access journals launched at their institutions become known to other libraries, indexing services, potential funders, and potential readers.
• Make sure scholars at their institutions know how to find open access journals and archives in their fields and set up tools to allow them to access them (e.g., by including the journals listed in the DOAJ in their catalogues).
• As open access journals proliferate, and as their usage and impact grow, c ancel over-priced journals that do not measure up.
• Engage with university administrators and funding bodies to raise the issue of open access. In particular, librarians can work with administrators to develop university policies on open access (see, for example, the policy of the University of Minho [25]).
• Familiarize themselves with the issues. [26]
• Support SPARC and SPARC Europe to multiply their effort. [27]

CONCLUSION

The continued growth in interest in open access and experiments in both repositories and open access business models for journals is easily explained when it is realised that open access appeals to all of the major players in the scholarly communications system. The funders of research see the wide dissemination of the work they fund as an increased return on their investment in research. Many also believe that widespread access is a public service. Authors can see the increased dissemination and impact that they achieve through self-archiving and publishing in open access. Readers appreciate that open access gives them access to an ever-increasing amount of the primary literature, making this vital "research tool" more powerful. While the editors, editorial boards of journals and the reviewers of articles feel that their work is more valued if it is more widely disseminated.

Librarians are welcoming open access as it allows them to meet the information needs of their users. Universities see the increased prestige and presence that comes from making all of the research carried out at the institution freely available at a central repository. Finally some small and society publishers see open access as a survival strategy that will allow them to compete with the "Big Deals" from commercial publishers, while matching the central remit of their societies to further research and education.

The text of the Budapest Open Access Initiative opened with the statement «An old tradition and a new technology have converged to make possible an unprecedented public good». We can see how by harnessing the power of the Internet we can construct a system of scholarly communication that better serves authors (by given them the wide dissemination they require) and readers (by removing access barriers to the information they need). This in turn will enhance research and education worldwide and bring great benefits to society.

Obviously, any attempt to change such a well embedded system with large degrees of inertia will be difficult. However, the advantages of the new model are immense. By working together we have already made many great strides towards the new system and by continuing to work together we can achieve it. That is the aim of SPARC and SPARC Europe and of the many thousands of librarians, authors, readers, funders, publishers, etc. who see open access as the future of scholarly communications.

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[8] See the Crow and Goldstein "Guides to business planning for open access journals" http://www.soros.org/openaccess/oajguides/index.shtml

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DSpace – http://www.dspace.org/;
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[27] http://www.sparceurope.org