Publishing Trends and Practices in the Scientific Community

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Abstract: Scientific, technical, and medical (STM) publishing has been changing over the past 10 years. In Canada it has multiple business models that differ significantly from those in the humanities and social sciences. STM publishing worldwide is dominated by a few major publishers but is also very dispersed. The introduction of electronic publishing has changed the business model. This paper presents the results of a reader and author survey and discusses the implications of these results for STM publishers and their library clients.


Keywords: Scientific, technical, and medical publishing; Online publishing; Scholarly journals; University libraries

Introduction
Scientific, technical, and medical (STM) publishing has been undergoing significant changes over the last 10 years. The driving force for many of the changes has been the constraints in funding for universities worldwide, which in turn have impacted the budgets of the libraries that are the primary clients of the publishers. The limitations in funding have not reduced the amount of research being done as more and more students go on to pursue postgraduate studies; in fact, this increase in the number of researchers has stimulated the competition for research funding. A key element in the successful application for research funds is the list of peer-reviewed publications. This cycle of “publish or penury” has led to a steadily increasing volume of material for publication and the redirection of funds to the

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research itself rather than the acquisition of the peer-reviewed results of the work of others to support it. This pressure to increase the volume of content being published while maintaining prices has caused publishers to seek novel solutions for publication and new business models. The key changes we have seen are the introduction of electronic versions of the paper journals, the sale of licences to bundles of these electronic publications, and an overall increase in basic prices.

Background
An institutional subscription to a scientific, technical, and medical (STM) publication can cost anywhere from $60 to $12,000 or more, while a personal subscription costs, on average, about one-third of that. STM publishing relies heavily on these institutional subscriptions; typically 78% of subscriptions to peer-reviewed research journals are institutional. The exceptions to this are the journals provided free to members of large societies, which are mostly supported by advertising, for example, medical journals and journals aimed at practitioners rather than researchers. For Canada’s largest STM publisher, the National Research Council of Canada, an electronic site licence to its 15 titles costs 10% more than the subscription to paper, and 92% of the journals’ revenues derive from institutional subscriptions and licences. Unlike the humanities and social sciences journal publishers, who may be supported through the publishing program of the Social Sciences and Humanities Research Council, not-for-profit publishers in the natural sciences in Canada do not receive subsidies from the Natural Science and Engineering Research Council, so business models to cover full publication cost including all the administrative overhead have been developed.

In the scientific and engineering communities the publishing of books and journals by societies or other not-for-profit organizations has traditionally been viewed as a service to the community. In the case of some of the large international societies, publishing is a revenue generator to support the other outreach and training activities of the society, for instance, the Royal Society of Chemistry or the American Institute of Physics.

It is difficult to be precise about the total number of STM journals being published. The line between the peer-reviewed journal and society newsletter blurs, with some newsletters including the publication of research articles of more general interest. There are, according to Ulrich’s International Periodicals Directory (2003), about 12,600 peer-reviewed STM periodicals in publication; this includes serial publications, series, annuals, and newsletters. In 1998 the Institute for Scientific Information rated 7,710 STM titles (Office of Fair Trading, 2002); these may be expected to correspond to the core research titles.

The position taken by librarians over the past 10 years has created an impression that STM publishing is controlled by a few major commercial publishers, but the data do not support this. Forty-six percent of the content in terms of number of articles is indeed published by six commercial publishers in 3,120 titles. The remaining 54% of the content is published by over 90% of the publishers. Elsevier has a dominant position of 25% of the content, but no one else has more than about 5% and most publishers have less than 1% (Office of Fair Trading, 2002).
By the middle of 2003 at least 80% of this content was available in electronic format.

The end use of peer-reviewed research is mostly in the academic community. A 2002 survey by the research organization Outsell published the following finding:

Academic Information users…prefer to operate independently, seeking out what they need online before turning to libraries for personal assistance…. Faculty work with information most of the time from their offices and homes with significant implications for the technology infrastructure. (Watson Healy, Dagar, & Wilkie, 2002)

This finding was not specific to the STM community. The implication of this is that as the academic user becomes more comfortable using the computer to access scholarly journals, the need for personal paper copies of journals will be replaced by access to an online subscription, probably paid for by a site licence by his or her parent institution. Ingenta, a major aggregator of electronic journals, reported a doubling of monthly article downloads each year between 1999 and 2001 and reported in 2003 that they are serving 6 million researchers and librarians a month (Ingenta, 2003). In this rapidly changing world the pricing of electronic publications becomes a key concern to both libraries and publishers.

**Pricing of electronic publications**

The availability of electronic publications is increasing every year, and it is to be expected that almost 100% of the STM research being published will be available electronically within the next five years. There are various business models supporting the availability of the electronic publications. Some of the very high circulation journals have advertising revenue sufficient to support the whole publication process, and in this case the electronic versions of the journals are available free of charge. Outside medicine and some applied sciences this model does not exist. If the publications serve only a narrow research community, the circulation numbers are low and there is no interest from advertisers. Some of the larger societies have very steep membership fees that cover some or all of the publication costs, thus reducing or eliminating the charge for the electronic product. Some societies include the cost of the electronic product in the pricing of the paper publication. The choice of model varies from society to society. Canadian scientific societies have been trying to keep their fees and the cost of their publications low to prevent members leaving for the larger American societies, which are perceived as having more extensive member benefits and wider circulating, more prestigious journals.

Without the financial support of a society or significant advertising revenue, there has to be a mechanism to secure a revenue stream from electronic publications if the publisher is to survive. This means controlling access to the electronic publications by validating IP addresses or passwords of paid up subscribers. There was a perception in the early days of electronic publishing that it would reduce the costs of STM information (Okerson & O’Donnell, 1995). In reality, Canadian research libraries are now spending over 20% of their materials budget on elec-
Electronic content (CARL, 2003) in addition to maintaining the greater part of their paper collections.

Not-for-profit publishers have identified a need to protect their revenue stream. They are doing this by working out new pricing models and developing solid legal agreements for site and consortium licences. Consortia licences are of mutual benefit for both library and publisher if the price is fair, but not if consortia try to flex their muscles to force prices down too much.

**Publishers’ costs**

A large part of the rising cost of periodicals to the libraries reflected the rising costs the publishers were incurring as they began to invest in electronic production systems and electronic publications. From 1986 the median number of serials being purchased by libraries declined steadily and the expenditures for these serials rose by 215% (ARL, 2002). At NRC Research Press, a small not-for-profit publisher with a worldwide market, the costs of journal publishing rose steadily from 1986. The cost of peer review increased 117%; the cost of copy editing increased 160% (NRC, 2003). These costs were first-copy costs, incurred regardless of the format of final publication. The cost of printing declined as print runs were reduced due to cancellations and switches to electronic licences.

![Figure 1: Changes in publishers’ costs excluding technology](image)

Figure 1 does not show the cost of technology. In 1986 NRC Research Press had no computer specialists on staff; one was added in 1993 to support the subscription and manuscript tracking systems; two were added in 1996 as the re-engineering of the production process to enable the creation of electronic journals
began; and now the Press uses between five and six full-time computer support staff to keep the internal systems running smoothly and to keep the electronic publications up to the increasingly high standards demanded by the clients. On top of this the cost of hardware and software rises every year. The experience of NRC Research Press seems to be that hardware and software need significant upgrading or replacing every three to four years if a publisher is to take advantage of new technologies that will enable them to meet client expectations. When this snapshot of the rising costs of electronic publishing is viewed in conjunction with the parlous state of library budgets it is obvious that some tension is inescapable. We are only just beginning to see librarians having enough confidence in the long-term stability and availability of electronic versions of key journals to be willing to cancel the paper versions. While libraries try to hold onto both versions in an era of steadily rising costs they will be forced into cancelling an increasing number of titles not deemed as core to their collections.

NRC Research Press has been an electronic publisher since 1997. It now has more than 15,000 articles available online. In 2002 the average number of downloads per article was 47. This number excludes Web crawlers and internal, administrative hits. An article in the “top 10” of most heavily hit articles typically gets 40 to 50 downloads a month. The total number of downloads in 2002 was 704,983, of which 313,613 were in Canada. NRC Research Press is funded as a government publisher to make its electronic content available to all Canadians through the Depository Services Program. At current levels of funding and of usage by Canadians, this means that the cost to Canada is $5.10 per article, a cost that is declining as usage increases. The number of articles being purchased at $20 per article through pay-per-view was a mere 444 (NRC, 2003).

**NRC survey of readers and authors**

To get a better understanding of the reader and author clients being served, NRC Research Press conducted an online survey of the authors and readers over four weeks in September and October 2002 (Charron, 2003). The survey elicited responses from 258 scientists and engineers who had published in the NRC journals over the previous 12 months and from 756 readers of the electronic versions of the same journals. The sample of readers was clearly biased to those who were already using electronic journals. The questions asked were based on questions asked three years earlier by the Association of Learned and Professional Society Publishers (Swan & Brown, 1999).

**Readers and authors**

Authors were found to be the more conservative group, wanting both print and electronic versions of the journals available; 64% said it was important to have print and 59% said it was important to have electronic versions. This may reflect a lack of confidence in the acceptability of electronic publications as well as the traditional prestige attached to print publication. Readers, on the other hand, as might be expected given the nature of the sample, were strongly supportive of the electronic journals, with 86% saying it was important to have the electronic version.
Forty-three percent said it was important to have the electronic version of articles available ahead of the print version. The statement in the Outsell report quoted above was confirmed by a finding that 59% wanted access from home (Watson Healy, Dagar, & Wilkie, 2002). The NRC survey seems to confirm that a significant number of scientists and engineers like to do their literature searches from home!

**The value-added services of electronic publications**

STM publishers have been wrestling for some time with the question of what value-added services were worth investing in. In the NRC survey, 59% of respondents wanted linking from citations to cited articles and 41% wanted alerting services. Respondents showed little interest in multimedia (11%) and interactive content (21%). Of more concern to the publisher was the level of interest in the back files: 87% of readers wanted at least four years of back files available, and 66% wanted more than 10 years of back files. This raises questions related to digitizing and archiving older content.

**Meeting reader requirements**

In an attempt to satisfy the need for reference linking, a group of major STM publishers joined forces to create the Digital Object Identifier Foundation in 1998. In its turn the foundation created a not-for-profit business arm called CrossRef that allowed publishers, for a small fee, to list identifiers for the articles they published and to create links to articles published by other members. By 2003, 209 publishers accounting for 7,879 titles belonged to CrossRef to permit DOI-based reference linking. Publishers who published beyond the STM disciplines included all their content in the system, so the elements for linking beyond STM are in place. Alternative ways of reference linking using open URLs are also widely in use. The weakness of open URLs is that once published, the URL is fixed, and if the location of the URL is changed, a constant effort by all those using those URLs to create links is needed to keep them up to date. The advantage of the DOI/CrossRef system is that a publisher can simply notify the central system that the DOI now links to a different location and then anyone linking to that reference using the DOI will still find it.

The desire for back issues of journals to be available electronically raises the question of the responsibility for archives of journals. This has traditionally been the role of libraries, but they are not necessarily in the best position to create the electronic archive of material originally published in paper. Digitization is an expensive proposition and it would not be cost effective for every library to do it themselves, nor, in most cases, do they have the rights to do so! However, the relationship between library and author is changing, and some libraries are offering to authors in their institutions the ability to archive their current works electronically. This is usually based on the metadata standards set out by the Open Archive Initiative (OAI) and is currently getting a lot of attention. It raises several questions: Does a research scientist really have the time or interest to make sure his paper complies to the OAI standard? Will the libraries provide the servers and the technology to refresh the information to ensure real long-term availability? This will
assist the availability of work deposited in electronic form, but it does not help the researcher who wants electronic access to work originally published in paper. When an article has been deposited in an archive by the author and then published in a peer-reviewed journal, it becomes unclear which version is the archival version for reference linking purposes.

The funding for the digitization of back issues has to be found, but it is not in any of the current business models where the electronic product is free. The option of charging for access to the electronic versions of back issues is an obvious solution but not one that is well received by librarians or researchers.

The STM publishing community is already confronting and dealing with the technical requirements to meet reader and author expectations through economies of scale. Publishers have clustered together and service organizations specializing in electronic journal publishing and distribution have emerged. Examples are Ingenta, which now has 259 publishing clients (Ingenta, 2004); HighWire Press, which services 165 publishers with 464 journals; Allen Press, with a client base of 112 journals; and even NRC, which has 12 client journals in addition to its own 15 titles. It is interesting to note that some of the large commercial publishers are using multiple electronic publishing service bureaus.

**What it takes to be an electronic publisher**

To provide these services as an electronic publisher, it is essential to have the availability of an archive, access to a strong technological infrastructure with high bandwidth, good connectivity, and 24/7 availability. Without this infrastructure the response times that researchers have come to expect cannot be met. To support this it is essential to have access to technological expertise. As mentioned above, NRC Research Press is supported by at least five computer or systems specialists from the Canada Institute for Scientific and Technical Information (CISTI). This support is crucial as the difficult decisions are made about the acquisition or development of software to produce the electronic products. Perhaps the most important, and for a not-for-profit publisher the most difficult, thing is a willingness to make capital investments. The investments in the tools to sustain a professional electronic publishing operation are not insignificant. There are cheap solutions, but inevitably these depend either on the goodwill of institutions or of individuals. This raises issues about their long-term sustainability. To support the investments a sustainable business model is therefore needed. Finally but perhaps most important of all is quality content that is of interest to the community. The following challenges confront anyone considering becoming an electronic publisher:

1. The market for electronic content is still under development. Electronic publishing is still relatively new and the market for it is not yet stable.
2. The role of copyright is confusing and uncertain in the digital environment. STM publishers typically require transfer of copyright or a royalty-free licence from authors to permit the dissemination in all formats—something that publishers did not request 20 years ago, raising the possibility that publishers may not even have the rights to digitize and distribute older material.
Copyright, trust, and archiving remain outstanding issues. Continued dialogue between all the parties involved is gradually improving the situation.

3. Trust between publishers and librarians is proving difficult to establish. It was seriously affected some years ago when journal prices began their rapid rise. This was followed by the creation, with the support of the library community, of new journals to compete with journals perceived as expensive. It was also clear that as new “cheap” journals were created the libraries would start cancelling titles, and it was always very unlikely that their faculty would let them cancel those expensive, prestigious titles until the new journals were really well established. This meant that small society journals were likely to be some of the first casualties. Perhaps the most unfortunate breakdown of trust was the misuse of licence agreements by libraries. The business model made it easy for the library to purchase a site licence for one library and then network it across campus. This was in part due to the pricing and distribution models in use and the confused role of the subscription agents. The result was a loss of revenue to the publisher. This problem is being resolved by better communication between all parties involved and more flexible pricing models.

4. The lack of trust between authors and publishers has also been an issue. It has led to initiatives such as the Public Library of Science, the Budapest initiative, and the Regina declaration. These initiatives have all placed publishers on the defensive. The scientific community wants to get as much content as possible free to the desktop and to support only journals that comply with their demands for free access or at least release material free after a certain period of time. This implies no charge for digitized back issues or any older electronic publications. These initiatives have been a struggle because the editors and editorial boards of the non-compliant journals have been reluctant to resign from the editorial boards supporting these journals. The prestige of serving on these editorial boards is important for the career of a faculty member. It is also true that publishers have begun to assist in funding conference attendance so that the editorial boards may meet annually. This travel was formally funded by the institutions but has been caught in the university budget squeeze.

5. Archiving is a major challenge for any responsible electronic publisher. It is not clear how it is to be done. Some STM publishers are depositing their content with national libraries; some of the richer societies claim to be building and protecting their own archive, for example, the American Chemical Society. These archives are offered for sale or licence with no discount to those who already own the paper versions of the same content.

6. Readers’ expectations are rising. The standards for electronic content and access interfaces are being set by the rich commercial publishers. It is unlikely that the volunteer-based or do-it-yourself electronic publishing model can survive and compete for authors and readers.
Conclusion—Lessons for non-STM publishers

- Electronic publishing can give authors and readers a lot of what they want but it takes significant investment.
- Content creators, libraries, and publishers have to maintain open dialogues.
- The economic models for publishing and archiving of the research record must be economically sustainable. This will be difficult in an environment of tight university budgets. The trend for libraries to move further into the realm of publishing does not solve the problem, for the basic costs have to be covered from somewhere. The best business model will take some time to emerge.

- *Library purchasing* behaviours make the survival of small publishers problematic as libraries cancel individual titles to protect funds to acquire the large bundles of titles from the commercial publishers.
- Careful, considered *rights management* (copyright and licensing) is the way of the future. Small publishers have to be diligent in ensuring that they have the rights they need to publish and distribute their publications in electronic format.
- There are advantages in *economies of scale*. Sharing the investment and the technologies will enable small publishers to meet reader and author expectations affordably.

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Note

1. The financial data are based on the internal financial reports prepared by NRC Research Press. Copy editing is the labour cost for both internal staff and contract copy editors. Peer review is the funding provided to the universities to support the editorial offices; it does not include any payments to editors. Printing costs include both internal and contract printing of journals.

References


