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Scholarly publishing is undergoing a transformation that affects every participant in the information chain. Serials, used to be a relatively uncomplicated activity, driven by the need of scholars and researchers to publish.

Since the early 1980s, both journal price inflation and the growth in the number of journals and the numbers of papers published, have outstripped the ability of even the most lavishly funded library to purchase what faculty and students demand. At the same time, modern technology has offered us the opportunity to develop new ways of distributing scholarly literature that offer the researcher facilities and qualities that cannot be undertaken in the print medium.

There is a great deal of data to demonstrate that the number of papers has increased at roughly the same rate as expenditures on research and development in western economies. The number of papers published per scholar has remained level over the past 20 years; it is the number of scholars that has doubled. In the USA in 1975, 2.64 million scientists are estimated to have published 312,200 articles; in 1995, there were 5.74 million scientists and 577,100 published articles. Meanwhile, library expenditure has increased by less than half that rate. The broad funding outlook remains gloomy; for example, in the UK, student numbers have increased by 15 percent in the three years up to 1996, but funding per student decreased by 30 percent.

The geographical distribution of subscriptions has also changed. For many years after World War II, the major research libraries in the USA maintained complete collections of all the literature published in the field; they were a dependable and significant body of subscribers. In the mid-1970s this started to change. For most publishers, the USA has declined as a proportion of the total world market. While southeast Asia and western Europe have, until recently, been expanding markets, the decline in US library spending has removed a stable growth factor. Most publishers now expect volatility, more cancellations or non-renewals, and more new subscription orders.

Suddenly our simple model has become more complex and uncertain. Change is relentless. The development of resource sharing means a single subscription where once there were many. The growth of consortia — there are over 200 in the USA alone — and the demand for institutional, system-wide or even statewide licensing implies a clear demand for more for less. Document delivery now provides a “pay by the drink” model that potentially and fundamentally changes the pattern of income a publisher receives. Nevertheless, the number of papers seeking publication continues to rise relentlessly, causing information overload in even the most specialized areas of interest.

What has happened to the underlying costs of producing a journal? It is worth noting at the outset that paper, printing and distribution account for a small portion of the total subscription price. Between 60 and 70 percent of the cost of publishing a journal is incurred in processes that are inescapable, regardless of the medium of output. Carol Tenopir and Donald King in an excellent article in the Journal of Scholarly Publishing, analyze the factors that characterize our economic model:

- The average fixed cost of producing the first copy of an article is about US$ 4,000, covering direct costs such as review and refereeing, editorial work, preparing illustrations and making the master copy (i.e., printing plates), and indirect costs such as subscription maintenance, marketing and author administration. Naturally, costs vary from one journal to another, depending on the subject and the complexity of the text.
- While price increases typically will result in reduced subscription numbers, a greater influence will be the size of the market served, being the readers interested in the information conveyed by specific journals.
- Publishers are, on average, publishing more articles and more issues per journal, and more pages per article. The average number of issues increased from 6.5 in 1975 to 8.3 in 1995, and total pages from 820 to 1,723 in the same period.
- In the 1980s, there was a distinct shift from individual subscriptions to library-provided materials. Thus subscription numbers dropped, and the high fixed costs had to be spread over fewer, mainly library, subscriptions, thus increasing institutional prices at a rate greater than inflation and size increases from existing resources — i.e. from the revenues earned from existing titles. The risk for the publishers is considerable, with the accumulated loss on a new STM title reaching US$150,000-200,000 by the end of the third year; it will not cover its accumulated investment until volume 6. In the humanities and social sciences, the break-even may be achieved sooner, but still requires the original decision to invest for the future.

Publishers have compensated for the underlying cost increases they face, in an under-

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funded market, in various ways:

- They have tried to develop links with
  learned societies to sell more copies to
  individual society members at discounted
  prices, thus covering a portion of the fixed
  costs that have to be recovered.

- They have developed non-
  subscription revenues such as advertising,
  supplements and special editions sold to
  industrial or special interest
  groups, and license revenue from document
  delivery services and CD-
  ROM publishers who reach
  markets that are unlikely to subscribe to the
  journal.

- Publishers have been putting more
  words on the page, by increasing the size of
  the page, reducing type sizes, using double
  column setting and narrower margins.

- Most important, the production systems
  used have been transformed by technology.
  Computerized typesetting and page layout
  software is commonplace. Journal articles
  are frequently submitted on a disk; publish-
  ers apply their skills in quality management,
  presentation and layout to material already
  in machine-readable form. The printed prod-
  uct may look traditional, but it has been
  output from a system that our forebears
  would find unrecognizable.

- Nevertheless, journal prices have
  increased dramatically in the last three
  decades. Journals in the humanities and
  social science now average US$185, in medi-
  cine US$106 and in science and technology
  US$902. Overall, journals are 30 times
  more expensive in 1997 than they were in
  1970. This represents an average annual
  increase of over 13 percent. Clearly, this
  cannot go on forever.

- Publishers have started to output their
  journals in electronic form, in response to
  innovating paper, printing, binding, stor-
  age and transportation costs. Nevertheless,
  it is just as costly to employ highly skilled
  editorial and technical staff to prepare data
  for electronic publication as it is for paper-
  based publishing. The savings on marketing
  costs are not obvious at present, as users still
  need to be identified and reached with
  information about the product; the next few
  years may see changes in this perception as
  we use the Internet more as a medium for
  information distribution. Nevertheless, the
  technology will continue to require heavy
  capital investment in computer equipment
  that needs to be renewed every 18 months
  to two years in order to keep pace with soft-
  ware developments. That universities are
  able to replace their equipment only every
  three years — or longer — creates furt her
  problems of matching product delivery to the
  recipient's capability.

- There is still a marked ambiva-
  lence about electronic publishing in the
  academic community that goes beyond a
  reluctance to learn how to use new
  technology. Many academic readers are not yet using
  many electronic journals, whether
  they are free or on
  subscription, though most use
  the Web frequently. The power and rigor of
  searching secondary databases to identify
  literature to read is universally appreciated.
  When it comes to primary research litera-
  ture, many academics are openly skeptical.
  They want to publish in print. Their reading
  will generally be done at home, using
  the printed word. Many social scientists go fur-
  ther, and decry the loss of authority and sta-
  tus that they believe is inherent in electronic
  publication. This has been described as the
  "cartooning" effect: such material is not
  worthy of serious study because it comes in
  the same format as "The Simpsons" or
  "Beavis and Butthead," and is therefore to be
  treated with the same level of serious-
  ness and attention. That publishers are
  reluctant to abandon print and embrace the
  new technologies wholeheartedly is a reflec-
  tion of the concerns of their authors and edi-
  tors.

- On the other hand, publishers will
  support electronic modes of publishing
  wholeheartedly when it is clear that a
  corpus of academics do.

- So we proceed with caution.
  Nevertheless, publishing printed and online
  editions of journals in parallel represents the
  start of a process of developing truly multi-
  media scholarly publishing, where the elec-
  tronic edition of a journal paper may dis-
  play features like video, sound, moving
  graphics and models, as well as interactive
  features that the paper edition, by definition,
  lacks. However, we have still paid too
  little attention to which features of the elec-
  tronic edition really add value for the reader.
  And we still need to develop the protocols
  necessary for effective peer review and quali-
  ty control of those features. It has to be
  emphasized that the paper edition has the
  authenticity and permanence that the elec-
  tronic version still appears to lack.

- Electronic journals create the
  opportunity to provide a range of fea-
  tures of real value to work-
  ing scholars. We, like many
  publishers, have asked
  them what they want, and they tell us their list com-
  prises:
  - full reference retrieval;
  - linked footnotes;
  - complex figures converted into mov-
    ing pictures;
  - embedded links that are continually up-
    dated both forwards as well as backwards;
  - direct access to the data on which the paper is based; and
  - concept, or thesaurus-like, searches, which will require major developments in arti"

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vocal demands from librarians, many of whom clearly believe that technology holds the solution to the economic problems they face. When one examines the benefits and disbenefits of the electronic and printed media, the future is much less clear. From the financial point of view, electronic publish-

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The Association of Research Libraries published a report which broke down scholarly information transfer into three models:

- The traditional "classical" print-based model;
- The "modernized" parallel publishing model; and
- The "emergent" model that bypasses print that uses computing and telecommunications technology exclusively to create what is referred to as knowledge management systems called "collaboratories."

The AAU/ARL concluded that 50 percent of scientific literature would still be in print by 2015, and that there would be no single dominant model for the foreseeable future. Nothing has really become clearer since the publication of that report. Print is a feature of our landscape for the foreseeable future.

The principal issue facing publishers is how to maintain the viability of their activities, and the role they play in scholarly publishing. That role is especially important in relation to managing and certifying the quality of published output through the peer review process. To forego that certification process is to reduce the value of the formally published paper from the authentic scholarly work to just another piece of noise on the Net.

The principal issue facing librarians, it seems to me as a sympathetic publisher observer, is how do they meet faculty and student requirements for information in multiple formats that may involve significant support costs out of budgets that do not even keep pace with the cost of information in the traditional medium?

The environment is clearly ready for new business models. Some tentative steps have already been taken to develop new pricing and purchasing models on two fronts:

- Publishers have begun to develop licensing schemes that provide extended access to their journal material, whether in print or electronic form, on terms that are intended to meet the teaching and research needs of the licensed institution, including copying for the reserve collection, use in course packs, etc. Academic Press's APPEAL scheme is the best known. This provides extended access to the entire list electronically, and discounted rates for new or additional print subscriptions. For the publisher, it stabilizes revenue. As these schemes tend to be priced with reference to current subscription rates, questions remain to be answered in relation to future prices, the cancellation of titles no longer needed, and the incorporation of newly launched journals.

- Resource sharing has been developed into formal purchasing consortia, either on a membership basis like the Southern Universities Purchasing Consortium in the UK, or on a regional, state or even national basis.

Development of these new models is at an early stage, but does offer the prospect for both publishers and libraries of breaking out of the straight-jacket of the individual journal subscription price. Publishers need to be more flexible in meeting the legitimate demand for information they publish, especially if it involves broadening the circulation. Librarians need to concede that effective negotiation requires a centralized, well-briefed office with authority to negotiate on behalf of all the members of the institution or consortium. Both parties need to recognize and articulate the legitimate concerns of the other in a way that implies a partnering rather than an adversarial relationship.

There is also an important role for intermediaries or aggregators in this scenario. No library wants to provide access to electronic data using more than one system, or even a common system, or front end. There is a constant demand for standardization. The problem with standardization is that it assumes mature technology and clear and settled demand. Neither exists in our world at present. To standardize on present technology is to stifle competition and inhibit the introduction of new, better, software.

The alternative to standardization is the intermediary who supplies a standard interface and stands between the library and the many information providers and publishers and their myriad systems. Sufficient it to say that subscription agents have always provided an invaluable role in rationalizing journal subscription ordering; the launch of products like Blackwell's Navigator, SwetsNet, and Dawson's Information Quest and EBSCO Online simply represents an enhancement of the vendor's traditional role. Other players have developed similar services, like OCLC. Many of the consortia are based on established services that provide a common interface. Other organizations are aggregating content into collections available online or on CD-ROM, like Ovid, UMI, EBSCO Publishing and Information Access. It is entirely reasonable to assume that they will develop this activity by providing a single access point to electronic information from many publishers competing with different systems.

The future is likely to involve more collegial methods of working together. How we do this will be a matter of controversy as well as innovation for many years to come.