The Evolution of Electronic Publishing

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ABSTRACT

SUMMARIZES THE DEVELOPMENT of electronic publishing since the early 1960s—when computers were used merely to produce conventional printed products—to the present move toward networked scholarly publishing.

INTRODUCTION

The scope of the term "electronic publishing" can be interpreted in many different ways. For example, it could be considered to include all forms of electronic aids to authors, from simple word processing capabilities to actual typesetting and/or mark-up tools (Pilachowski, 1993), as well as networking support to collaborative authorship and electronic communication among authors, editors, referees, and other participants in the publishing process.

Since "publishing" implies production and distribution, however, the term refers most obviously to the generation of publications in electronic form or, at least, with the aid of electronics. In this more restricted sense, electronic publishing can be considered to have evolved gradually over a period of about thirty years, the evolution having the following manifestations:

1. Use of computers to generate conventional print-on-paper publications. This development can be traced back to the early 1960s (e.g., the production of *Index Medicus* at the National Library of Medicine). The

use of electronics to print on paper is not a completely pedestrian application since it allows new capabilities such as printing on demand and even the production of customized publications tailored to individual needs.

2. The distribution of text in electronic form, where the electronic version is the exact equivalent of a paper version and may have been used to generate the paper version. For secondary publications (indexing and abstracting services), electronic distribution began early in the 1960s. For primary journals, the development occurred somewhat later. Today there is considerable activity and interest in projects that make electronically accessible the text and/or graphics of journals that are also sold in print-on-paper form. Major projects of this kind (in which the electronic version is accessible online, as CD-ROM, or as a combination of these modes) include ADONIS (Stern & Compier, 1990), Red Sage (Borman, 1993), CORE (*Annual Review*, 1992; Borman, 1993), and TULIP (Borman, 1993). Moreover, the full text of a significant number of journals is now made accessible online by vendors such as DIALOG.

3. Distribution in electronic form only but with the publication being little more than print on paper displayed electronically. Nevertheless, it may have various "value added" features, including search, data manipulation and alerting (through profile matching) capabilities.

4. The generation of completely new publications that exploit the true capabilities of electronics (e.g., hypertext and hypermedia, electronic analog models, motion, sound). This phase of development can actually be subdivided into:

   (a) the presentation of existing text and graphics in innovative ways (e.g., the *Perseus* Project) (Mylonas, 1993), and

   (b) the production of publications designed ab initio to exploit full electronic capabilities.

   While these can be considered as logical steps in an evolutionary process, the actual evolution is not easy to depict since all of the steps now co-exist (i.e., the fourth phase of the evolution is already in place, but the first phase has not disappeared). Moreover, the ultimate stage (4[b]) is not yet fully realized: while some authors have produced works that were intended from conception as electronic publications (e.g., for the hypertext medium), this is by no means the norm. Some idea of the true potential of electronics in publishing can be obtained by reading in the area of "virtual reality" (e.g., Rheingold, 1991; Helsel & Roth, 1991; Pimental & Teixeira, 1993). Krueger (1983), in particular, has suggested how electronics allows completely new approaches to the presentation of information, imagination, and inspiration.

Libraries have already been profoundly influenced by the developments in electronic publishing. At the lowest level of effect, it is now commonplace for them to make electronic publications available, through online access or in CD-ROM form, and to instruct patrons in the use of these resources. Several of the larger academic libraries have gone much further by establishing departments designed to support access to publications in electronic form and to exploit their capabilities. Some of these do more than the training of users and the provision of access. For example, the Electronic Text Center at the University of Virginia Library has assumed responsibility for the SGML-tagging of certain texts that lack such encoding (Seaman, 1993). Libraries now being established may be designed from the beginning as "electronic libraries." For example, the Electronic Library at DeMontfort University at Milton Keynes (Leicestershire, England) has entered into its own negotiations with publishers to acquire text in electronic form (Arnold et al., 1993; Collier et al., 1993).

THE ELECTRONIC JOURNAL

The term "electronic journal" is almost as ambiguous as the term "electronic publishing." A very loose definition of the term—any journal existing in an electronic format—would embrace all periodicals available electronically as well as in paper copy, including the text of periodicals accessible through online networks and those periodicals distributed in CD-ROM form.

By a more strict definition, however, an electronic journal is one created for the electronic medium and available only in this medium. If we accept a rather relaxed definition of "journal," electronic journals have existed for about twenty years—the informal newsletters produced within computer conferencing networks or even the messages of the conference itself could be loosely considered as a form of journal.

Sondak and Schwarz (1973) may have been first to conceive of a scholarly journal published in electronic form. However, they visualized the distribution of the journal to libraries as a computer-readable "archival file" rather than by online access, and distribution to individual subscribers in the form of computer-output microfiche. Senders, Anderson, and Hecht (1975), Senders (1976, 1977), Roistacher (1978), and Lancaster (1978) were among the first to discuss possible characteristics of an online "virtual" journal, and Senders, Anderson, and Hecht (1975) presented a detailed economic analysis. Roistacher (1978) and Folk (1977) also included some cost data.

The first experiment with a true scholarly[1] journal—one with editorial standards and refereeing procedures—was conducted with a journal on mental workload within the Electronic Information Exchange

System beginning in 1979 (Turoff & Hiltz, 1982). Shortly afterward, in 1980, the British Library awarded a grant to Loughborough University to establish an experimental online journal in the area of computer human factors (Shackel, 1991). These early prototypes were not completely successful in that the journals thus established were not continued beyond the period of the experiments. Three major problems impeded the permanent establishment of electronic journals a decade or so ago: (1) not enough members of the target community (potential authors as well as potential readers) had the necessary terminals readily available to them; (2) other technological barriers—e.g., telecommunication problems, slow response, poor quality display, lack of "friendliness"—discouraged use; and (3) (and probably most important) potential authors could see no obvious rewards associated with the contribution of articles to an electronic database—i.e., no honoraria; no royalties; no evidence that such publication would carry much weight in promotion, tenure, or salary decisions; and no guarantee that the audience reached would be a large one. Nevertheless, these early experiments were valuable for the very reason that they did expose the problems that would need to be solved before a scholarly journal in electronic form could be sustained.

The probability of being able to sustain a scholarly journal solely in electronic form has increased considerably in the last decade as terminals and workstations have become more widespread, as friendlier interfaces have been developed, and as research-oriented networks have fallen into place. Many different periodicals now exist within the Internet. While the majority are rather informal newsletter-type publications (Association of Research Libraries, 1993), a handful of refereed or "lightly refereed" (Okerson, 1991) journals are operating, and others are in planning or development stages.

Existing electronic journals that can be considered as in some sense "scholarly" include *Postmodern Culture* (Amiran & Unsworth, 1991), *Psycoloquy* (Harnad, 1991), the *Electronic Journal of Communication* (Harrison et al., 1991), *New Horizons in Adult Education* (Hugo & Newell, 1991), the *Journal of the International Academy of Hospitality Research* (Savage, 1991), the *Public Access Computer Systems Review* (Bailey, 1991), and *EJournal* (Jennings, 1991). In addition to these journals existing in university settings, OCLC Inc., in collaboration with the American Association for the Advancement of Science, mounted the online *Online Journal of Current Clinical Trials*[2] and is in the process of implementing further online journals in the areas of nursing and electronics. Clement (1994) lists twenty-five network journals currently operational or in planning stages in the sciences alone.

All of these journals are similar in that they exist only (or, at least, primarily) in electronic form, can be accessed online, and impose

certain standards on the contents of the database. There are also differences among them. Some group papers into "issues" in much the same way that a paper journal does, while others merely add new papers to the databases as they are accepted. Some accept graphics as well as text while others do not. Some journals offer contents pages and abstracts, requiring users to request the full text if wanted, while others initially disseminate the full text to users. The majority are offered free[3] to users, but at least two are available only on a subscription basis. Some of the online journals are merely "delivered" to users via some file server or e-mail system while others allow true interaction between user and journal. Of the existing electronic journals, the *Online Journal of Current Clinical Trials* appears to be the most sophisticated, offering elaborate windowing facilities, hypertext linking (including the ability to view an abstract of an item cited in an article), and graphics.

In discussing journals in electronic form, it is important to make a distinction among these new journals, established within online networks, and the print-on-paper journals that have been made accessible in electronic form by publishers either on CD-ROM or online. Projects that make the text of existing journals available on CD-ROM are primarily electronic document delivery systems. The text is stored as "bit-mapped" images of the printed journal pages achieved through optical character recognition. Bit-mapped images require rather large amounts of storage, allow terminal display that is of low quality compared with the display of computer-readable text (e.g., in ASCII format), and cannot be searched or otherwise manipulated by computer (although ancillary databases, such as indexes to and abstracts of the page images, can be). Nevertheless, the bit-mapping approach has the obvious advantage that it allows older materials to be made available in electronic form without the need for rekeying. Of course, a particular implementation can incorporate both page images (to give the reader "the feel" of the familiar journal format) and computer-readable text; this is true, for example, in the Red Sage project, which makes use of the RightPages system devised at AT&T Bell Laboratories (Story et al., 1992; Hoffman et al., 1993), and in the CORE project (*Annual Review,* 1992; Entlich, 1994).

When the complete text of print-on-paper journals is made accessible through online networks, the text is in ASCII format and fully searchable. Nevertheless, such journals are merely examples of print on paper made accessible electronically. The new journals referred to earlier were designed ab initio as journals in electronic form and can be given capabilities not present in the electronic manifestations of printed journals. For example, the text can be encoded with SGML

tags to improve its functionality (e.g., in the implementation of such features as windowing, hypertext, and the integration of text with graphics).

A scholarly journal in electronic form can potentially offer several advantages over one printed on paper, including:

1. More rapid publishing of research results through electronic submission of articles; network communication among authors, editors, and referees; and by the fact that contributions can be added to a database as accepted rather than held to form the next "issue."
2. More efficient dissemination of information through the matching of articles newly accepted into databases with the interest profiles of potential readers.
3. Innovative ways of presenting research results and other forms of data and information—analog models, motion, sound, hypertext, and hypermedia linkages (including linkages among journals and other electronic resources).
4. Public peer review facilitated through the ability to link reader comments and evaluations to published articles.
5. Lower cost per successful match between article and reader.
6. Speed of publication and ease of communication lead to a more interactive journal in which one contribution may spawn rapid responses from other researchers.

Carried further, an electronic journal established within a network can assume a scholarly role that is more comprehensive than the role played by the typical journal in paper form. As Stephen and Harrison (1993) point out (and Harrison & Stephen do again in more detail later in this issue of *Library Trends*), it can become the central component in an electronic center of expertise and a key element in an online intellectual community.

The fact that several scholarly journals have recently emerged within the networks may give the impression that the problems faced by the prototypes of a decade or so ago have already been solved. This is not entirely true. It is still difficult to attract contributors (Savage, 1991; Jennings, 1991), and even some technological problems still exist. For example, Savage, Hugo, and Newell (1991) have reported that some of their potential subscribers or readers do not have ready access to terminals or lack institutional support for network access; Bailey (1992) points out the limitations of ASCII text files for the distribution of electronic journals and suggests that no existing software tools can do everything needed for a fully successful implementation of a scholarly journal in electronic form. Nevertheless, while Bailey identifies several problems to be solved, he sees none that is insuperable.

There is another potential obstacle that seems to have received little attention—the fact that the desires of authors and of readers may not fully coincide. The designers of electronic journals assume that most users want the ability to jump around in text (and possibly to link with other text or other publication forms), and some writers (e.g., Arnold, 1993) have suggested that a major advantage of electronic publishing is that it can deal in pieces of text rather than complete packages of text and, thus, the distinction between the journal and the monograph might no longer be meaningful. On the other hand, Tenopir (1988) has reported that, in her experience, authors and publishers have strong objections to readers being able to view segments of text out of its complete context because this threatens the integrity of their work and could lead to misinterpretation and misrepresentation. She discusses this matter further in this issue.

Electronic journals accessible through the networks are now receiving considerable attention from academic libraries. For example, one consortium has already accumulated on a server a collection of more than 600 such journals, is developing collection development policies, is taking steps to catalog the collection, and is studying many of the problems involved in providing access to a collection of this type (e.g., problems of archiving and of the incorporation of fee-based titles).

The scholarly journals recently emerging within the electronic networks have mostly been established within academic departments at the initiative of a handful of researchers. The impetus has not come from academic administrators or the university presses. Nevertheless, it is now becoming more generally recognized that:

1. The academic community has lost control over its research output since the published results of its research are not disseminated directly by the universities but by journal publishers, many of these in the for-profit sector, and copyright is usually transferred from researcher to publisher.
2. The university community is forced to buy back, from the commercial sector, its own research output at ever-escalating costs that make the university libraries a continued drain on institutional resources.
3. The existence of computer and telecommunications networks now allow us to conceive of a completely new approach to scholarly publishng, one in which the universities bypass the present journal publishers and publish the results of their own research in electronic form.

Some examples of this rumbling of discontent and the attendant call for significant change include the following:

the continuing trend toward cancellation of journal subscriptions indicates that the costs of the practice of paying scholars to

> produce knowledge and then paying a second time to acquire it
> from publishers needs reevaluation. (Britten, 1991)

> a vision of university-based electronic networked publishing is ex-
> pressed by many librarians and other members of the university
> community in conversations about academe's regaining control
> and distribution of its own intellectual output. (Okerson, 1991)

> Unthinkable as it might have seemed until very recently, the idea
> of the academy retaking control of the bulk of scholarly publish-
> ing is being forced into consideration by the practices of the com-
> mercial publishers themselves. Their bills simply cannot be paid
> indefinitely, and something must give....The responsibility for the
> creation of an alternative scholarly communications system rests
> with the faculty and administrators of all major universities in
> this country and beyond. (Metz & Gherman, 1991)

Of course, a networked approach to disseminating the results of
academic research does not necessarily imply that each institution
would publish its own research output. A more likely model is one in
which each university would take on the responsibility for creating
and maintaining databases in a few areas in which it is recognized to
be excellent. Researchers from all over the world would submit ar-
ticles to be accepted into these databases in much the same way that
they now submit to the publishers of paper journals, and submissions
would be subjected to rigorous refereeing.

While the academy is now the center of scholarly research and of
informal scholarly communication, it is not really the center of for-
mal scholarly communication since it does not directly control its own
published output. By becoming the disseminators of their own re-
search results, the universities would become the centers of scholarly
communication in the broadest sense of the term.

The final article in this issue of *Library Trends* presents the results
of a survey of attitudes in academia toward networked electronic pub-
lishing of the results of scholarly research.

NOTES

[1] For the purpose of this article, "scholarly" refers to a journal in which stringent
criteria on acceptance of contributions are imposed by external referees or
by an editor or editorial board.
[2] Purchased from AAAS in 1994 by Chapman and Hall.
[3] This is a little misleading. While free online access is allowed, other options—
e.g., to receive in paper, microfiche, or diskette form—will involve a cost to
recipients.

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