

Malaysian Journal of Library & Information Science, Vol.4, no.1, July 1999: 61-69

METAMORPHOSIS OF THE SCIENTIFIC JOURNAL : PAST, PRESENT AND FUTURE

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ABSTRACT

Describes how the scientific journal has undergone changes over a period of time from print medium to electronic form, as an innovative medium for communicating scientific literature. With the advance of science and technology, information grew and related technology emerged from long letters containing primary literature in 16th century to electronic database, online hosts etc. The electronic journal offers a faster method of disseminating information with effective retrieval efficiency and its capability to hold large amount of information in compact form. Further explores the importance of electronic journal, its growth and the key issues regarding its progress. The paper concludes with a remark on the part of librarian and information officers in handling the electronic journals weighing all the possible alternatives while keeping in view the changing user needs.

Keywords: Scientific journals; Electronic journals.

INTRODUCTION

Private correspondence was the predominant means of scientific communication in the middle of seventeenth century when Royal Society of London came into existence. The idea of the journal to disseminate scientific information was first mooted by Sir Robert Moray, president to Royal Society in 1661. Henry Oldenberg, secretary to Royal Society continued to write long letters to scientists all over the world communicating recent scientific achievements. As a medium of exchange, personal correspondence had many defects (Subramanyam, 1981). The first scholarly journal 'Journal des

Scavans' was published as a medium of communication in 1665 and was soon followed by 'Philosophical Transactions of the Royal Society' (Onburn, 1984). For more than three centuries, the journal has played a pivotal role in the creation and transmission of knowledge by serving as a medium of scholarly communication and has remained essentially unchanged in form and function over its lifetime. Science as we know is hardly imaginable without the scholarly journal. The journal as carrier of scientific ideas has evolved over the years into a form that is more or less regulated. The most salient feature in the refereeing process to which many contributed papers are subject. Even in

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case of purely commercial publishers, the refereeing process integrates journal into the scientific community (Vngem-aternberg and Lindquist, 1995).

Despite its benefits to science and scholarship, the paper journal has been subject to criticism that includes peer review process, high costs that are escalating faster than the rate of inflation, publication delays and retrieval efficiency due to growth of journals.

Technology innovation increasingly offers the possibility of using computers and communication networks to create alternative electronic forms of the conventional paper journal. It is possible that these new forms of computer-based communication will transform the scholarly communication system by providing the best and most cost effective way to access these resources.

Senders (1976) pointed out that computer networks could be used to establish the 'electronic' or 'virtual' journal which could solve the traditional problem of a journal. While Lancaster (1979) predicted the nature of libraries by the turn of twentieth century as: The rapid decline of the artifact particularly printed book as the primary device for storage and transmission of recorded knowledge and replacement of these artifacts with data ... accessible electronically (Lancaster 1979).

EVOLUTION OF STORAGE MEDIUM

Man's basic instinct and crave for preservation of knowledge led to the development of different media of storage of information through centuries.

In the early civilisations of Assyria, Babylonia, China, Egypt and India, knowledge was transmitted largely through oral communication, fragments of paparia, cuneiform clay tablets and later, paper which gave a boost for storing information. The invention of movable type by Gutenberg in 1455 was a landmark in the history of written communications. The printing press made it possible to prepare and disseminate multiple copies of manuscripts. During sixteenth and seventeenth centuries written communication was largely through books and gazettes.

Microfilm was developed in 1952 and has been used to store several hundred thousand papers of information. The development of computers and magnetic storage devices (magnetic tape and floppy disk) was a breakthrough for storing and retrieving information. The next major storage device was optical storage i.e CD-ROM (1982). Recently developed digital video disk (DVD) has the capacity to hold between 4.7 GB and 17 GB.

GROWTH AND INFORMATION RELATED TECHNOLOGIES

The propagation of scientific information from its generation as a result of research and development takes place through its dissemination in primary literature, its surrogation in secondary services and its essential integration and compaction in reviews, textbooks and encyclopaedias. There had been impact of technology innovation in generation of information storage, dissemination and retrieval technology. As the application of each

technology has become more widespread, the user's ability to deal with the information outputs has reached a breakdown point and new technologies have been developed to introduce new levels of control and organisation of information.

By the middle of 18th century there were still only about 10 scientific journals in existence ; around 1800 there were 100 and in 1850, 1000 journals and the beginning of twentieth century about 10,000 journals (Garvey, 1967). At present, it is estimated that there may be around 90,000 to 100,000 scientific and technical journals in the world. As the size of journal literature grew, new tools were needed to facilitate access to primary information. At this point, the first abstract journal appeared, designed to assist the researcher in identifying the most important literature. In due course of time, many of these abstracting and indexing journals grew to a point where comprehensive searches could no longer be carried out efficiently using manual techniques that has led to the computer-based information retrieval systems providing the researcher with powerful and very fast tools for overcoming the problem associated with paper based products. This led to the emergence of electronic databases with both abstract and fulltext information. The emergence of the Internet has been a boom to information producers to launch information products on the web, both abstracting services and journals in electronic form that facilitated users to access information and related technologies over a period of time.

EMERGENCE OF THE SCIENTIFIC JOURNALS

The technological innovations essential to the development of the scientific journal were in place long before the journals themselves appeared in the mid-seventeenth century. The most important of these, is the introduction of print technology in the late 15th century, brought a wide range of changes to virtually every aspect of human life. The widespread use of printing press resulted in many changes in common forms (Einatien, 1979).

The journal has the following characteristics developed through ages for greater standardisation offered by the printing technology.

- *The use of alphabetical order for organising information.
- *The title page.
- *Regularly numbered pages
- *Punctuation marks
- *Indexing of individual works.
- *The ability to cite previous works.

FUNCTIONS OF SCIENTIFIC JOURNALS

Once the transition has been made, new technology may allow us to add new roles, to drop some of the traditional roles or fill them intrinsically in different ways. So, electronic journals must at least serve the basic functions that print journals have traditionally served. Schaffner (1994) proposed a model which includes the following functions:

1. Building collection knowledge base

The main function of a scientist is not only to produce knowledge through research and development efforts but to make it publicly available. It is rightly said that, research is not complete until published (Crane, 1967).

2. Communicating information

Certainly most scientists publish with the expectation that, their works will be read, confirmed, praised, cited, analysed and commented for future work.

3. Validating the quality of research

The articles of a journal are subject to peer review process in order to maintain quality in the face of increasing number of fraud or error. This peer review can monitor the accuracy and quality to certain extent, the scientific community has always relied a great deal on this.

4. Distributing rewards

Journals establish priority in research securing rewards for scientists, be they tenure, grants or simply recognition.

5. Building scientific community

This gives a way for development of invisible colleges overcoming geographical barrier to identify, interact and exchange information among peer groups.

ELECTRONIC JOURNALS

Even the most conservative readers agree there will be transition, the only question is when. The advantages are obvious. The electronic journals offer faster dissemination at lower cost, allow for the addition of colour, video clips and instant link to other works, that would be

difficult if not impossible in print. Those closest to the process have overestimated the speed of the transition. Some editors have made it clear that they are not ready to give up the print versions of the journals just yet.

In the context of electronic publishing, libraries are becoming more electronically based. This process started some thirty years ago with the automation of internal operations which were previously managed in a manual fashion, such as acquisition, serial's control, circulation, searching reference databases, etc. Online Public Access Catalogue (OPAC) were the first major development to bring the benefits of automation directly to the user. We are now moving towards the prospect of a predominantly electronic library (Schaffner, 1994).

Electronic journals are often called as virtual journals, journals without walls, on-line journals and journals on CD-ROM.

Major publishers that announced their commitment to provide web access to electronic journals include Blackwell, Elsevier, Academic Press, John Wiley, Kluwer, Oxford University Press, ASLIB, etc.

How can information industry, specifically database producers, library and users take advantages of electronic journal? The electronic journal provides unique opportunity in the form of a low cost delivery mechanism for full text documents with graphics and ensures; economy in storage. Users gain access to

current and archival issues due to retrospective conversion of back issues of journals and there is no time lag in the publication of current issues and the nascent information is always at the users disposal. Keyword based search facilitates quicker and easy access to the articles and users can download only desired articles. The hypertext feature used by many electronic journals help users to trace a reference quickly and gain access to the full article. If users prefer print copies for serious reading, they need easy access to printers with good graphics capabilities. Figure 1 presents the general overview of publishing

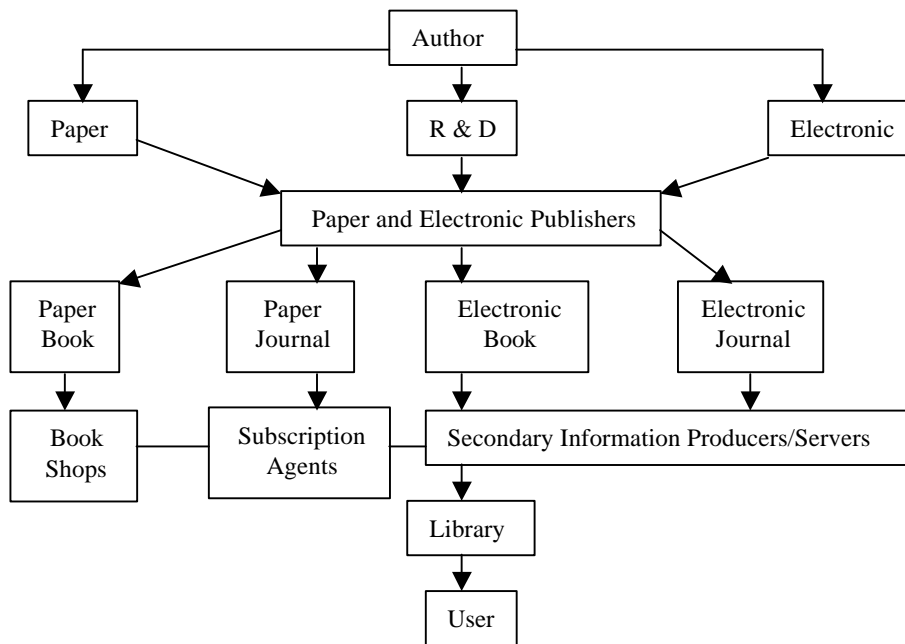
system, which includes both paper and electronic publishing.

GROWTH OF ELECTRONIC JOURNALS

Many of electronic journals have evidently raised from an introspective consideration of a new communication medium themselves and a concern with how long they will affect society and traditional disciplines and communication patterns.

Scientific and scholarly journals are today being published in several media in-

Figure 1: Overview of the Publishing System



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cluding print, CD-ROM, listserv, World Wide Web (WWW) and hybrid versions. However, no single medium will solve all the information needs of today's scientists and no single field is covered by a single medium. Electronic equivalents of print journals are distributed by online services such as DIALOG, OVID and LEXIS-NEXIS.

Although the electronic journals have been under development since 1976, electronic journals in their non-experimental phase did not begin until 1990's with a few exceptions. The first peer reviewed full-text electronic journal, including graphics was *Online Journal of Current Clinical Trials* (OJCCT). In a recently published list and one of the few research projects involving electronic journals, Harter and Kim (1996) identified 115 scholarly, peer reviewed electronic journals in science and technology and there are many more in the social sciences and humanities.

The growth of electronic journals are shown in Table 1.

Table 1: Growth of the Electronic Journal

Year	CD-ROM	Online
1990-91	304	2,269
1992-93	559	2,790
1996	1,966	5,517

Source : *Ulrich's International Periodical Directory*, 1996.

According to full text sources online (Harter and Kim, 1996), there is currently

2,107 scientific, technical or medical full-text sources available from commercial online vendors. The number of scholarly electronic, newsgroups and discussion forums in the sciences grew from 175 titles in 1991 to 853 in 1995 and then to more than 2,375 in 1996 (Okerson, 1994).

Harter and Kim (1996) in their citation and reference study showed subject categories with highest frequencies i.e education, literature and mathematics were the top three categories with library and information science a somewhat surprising fourth as shown in Table 2.

Table 2: Subject Categories with Highest Number of Electronic Journals

Subject	Electronic Journals
Education	13
Literature	12
Mathematics	10
Library & information science	7
Computer science	6
Communication	5
Information technology, media & society	5
Medicine	5
Political science	5

COMPLEXITIES OF ELECTRONIC JOURNALS

Emerging electronic publishing and communication revealed a more complex picture than the traditional print journal system. The picture is muddled by indecisiveness in pricing policies, licensing agreement and copyright agreements.

Although the number and availability of electronic journals are increasing drama-

tically, there is still far less scholarly scientific materials available in various electronic forms than there is in print. Of the electronic materials, some of them are imperfect and others are unique electronic journals available in different media like CD-ROM, Online, Listservers, World Wide Web. The Internet is the main source for electronic online journals. The issue regarding the progress of electronic journals are as follows:

1. Pricing policy

The chief barrier to acceptance of electronic journal has been resistance on the part of scientists and uncertainty about subscription prices on the part of publishers. One thing that complicates the pricing policy for the online journals is the common notion that they involve no cost of printing and mailing. Getting the first copy of a print journal ready is by far the most expensive part and is calculated to be 70-80% of the cost of electronic journal. The print journal Biochemistry costs US\$137 per year while web version costs an additional US\$68 (Okerson, 1994)

As a result of the above, major publishers have come out with a novel plan to economise the pricing policy of electronic journal to be cost effective. For instance, DIALOG Information Service provides access to more than 700 databases with a US\$28.00 minimum subscription plus pay as you use for what you access (connect time + download time).

2. Archiving of information

The major challenge before the librarians is how to archive the online versions of

print journals and one has to work out strategy as to how to make this possible.

3. Peer review

A critical factor in maintaining the quality of journal publication evolved slowly. Even today with a lot of technological impact on the publishing industry, some journals do not follow the practice of the referee process. Especially in the case of electronic journals, any member of the system can put a paper into their own web page and so also an electronic book which may be accessed by the scientific community. Harter and Kim (1996) reported an analysis of the scholarly nature of electronic journals in Table 3.

Table 3: Scholarly, Peer-Reviewed E-Journal

Journal	No. of electronic journals
Scholarly peer reviewed	77
Scholarly not peer reviewed	16
Neither peer reviewed nor scholarly	25
Eliminated for other reasons	13

4. Copyright

Authors, publishers and database producers are concerned with the status of copyrighted electronic journals. This is because of the ease of downloading, copying and even further distributing data which makes it very difficult to know when an infringement has occurred.

At this juncture of technological impact on publishing industry, the library is under a dilemma as to whether they should go for printed version or electronic format. The advantages of electronic journals are the disadvantages of print

journals and vice-versa. In a country like India, an electronic journal acts as a supplement to a printed journal and not as a substitute. Many libraries are not aware of the importance of electronic journals, even though, they are facing difficulties due to complexities with respect to its pricing policy, copyright, referee board, etc. Thus, the scenario of electronic journal is not very clear. The librarians need to weigh all the alternatives and procure some of the journals in electronic form be it online or CD-ROM keeping in view its retrieval efficiency and capacity to hold enormous amount of data in compact form in the best interest of user community.

CONCLUSION

Electronic journals should mimic the traditional journals at the start till the transition and disassociate themselves from the innumerable bulletin boards existing on the Internet and maintain their separate entity. Yet, information on new media and databases will grow; research will be more multiform. The demand on the library will increase and be met. The key issues regarding the progress of the electronic journal are: how to charge for online editions; quality control of article in journals; archiving of information; and copyright problems. Libraries should consider all the options, select the best format, negotiate site licenses and optimise information use throughout the organisation. Access to scholarly scientific and other journals remain vitally important to researchers and others in organisations. Providing the best and

cost-effective access to these resources is more complex than ever and requires someone who can weigh all the alternatives for every title and every potential user. The librarian's role has to be redefined in view of technological impact on libraries. Instead of being caretakers of materials, a librarian has to act as a navigator, aiding users to exploit resources on the net; trusted guide for a person who knows what he or she needs. A librarian has to be very fluent in electronic handling without losing his humanistic origin.

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