THE ELECTRONIC JOURNAL AND ITS IMPLICATIONS FOR THE ELECTRONIC LIBRARY

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1. INTRODUCTION

It is now over ten years since the first electronic journal experiments (e.g., EIES, BLEND) and the intervening years have not seen researchers being idle in this field. Indeed, while experiments have continued apace in an attempt to answer various questions such as the appropriateness of particular interfaces, electronic journals have continued to appear. The third edition of the ARL list (Okerson, 1993) contains 45 electronic journals while the first edition, only two years earlier (Okerson, 1991), listed only 27. This might suggest reasonably rapid growth but in actual fact represents a high rate of turnover also — 16 of the original 27 do not appear in the latest list. We therefore start this chapter from the assumption that electronic journals will continue to be a feature of the scholarly communication process, although not all will survive.

Our second assumption arises from our experiences in the design, implementation and evaluation of information technology based systems in general, not just electronic journals. That is, we assume that in order to be acceptable, any system attempting to replace an existing technology must enable users to perform their necessary tasks in a way which is at least as easy as the existing system. The new system must offer at least as much (and preferably more) than the existing system, otherwise motivation to move from the old to the new is not high. In the present context, this means that the successful electronic journals will be those which not only support the scholarly communication

process and all the other user requirements satisfied by paper based journals, but also support additional, enhanced facilities such as tailorable presentation formats, integrated interactive discussion about articles, flexible indexing and retrieval, hypertext linking and so forth.

2. ESTABLISHING REQUIREMENTS: FROM STAKEHOLDERS TO USERS

From a socio-technical perspective it is important to understand systems as comprising social or human and technological sub-systems and to realise that the success of any technological initiative is a function of the match between these subsystems. Furthermore, the human or social systems extend beyond the obvious users to those whose professional role is influenced in any way by the technology. In the case of academic journals the stakeholders are clearly more than the readers of academic articles but also the authors of the material, the publishers and the librarians who catalogue and manage the storage of journals.

In their own ways, each of these groups will be affected by the shift towards an electronic medium. However, for the purposes of the present discussion we will concentrate on the primary users of journals, the authors and readers, to examine the likely impact of electronic journals since it is their satisfaction that will largely make or break these developments. Interestingly enough, should the technology be designed sufficiently well to prove acceptable to these users, the remaining stakeholders may be placed in a curious 'outsider' position that could dramatically alter their stake in the academic journal system. We will return to this point later. For now, we will concentrate on the user requirements for academic journals in order to focus attention on the targets electronic versions must attempt to meet and eventually exceed.

2.1 Users Requirements Of Academic Journals

Requirements for journals among users differ according to their main task i.e., users as readers or as authors. From a reading perspective, journals serve both current awareness and archival purposes. Scholars browse new issues of journals in order to keep abreast of developments in their field. They refer to the earlier volumes to track historical precedence, intellectual propriety and the rate of progress in a discipline. Readers also use journals as a yardstick of the standards in a field since most readers have an expectation that prestigious journals will have been rigorously refereed.

Beyond the formal requirements of the readers as scholars, other requirements for the use of journals are important. A survey by Simpson (1988) suggested that many academics like to read while on trains or at home rather than in their office or even the library. Hence, the portability aspect of paper is a requirement that must be met to some degree by any new journal form.

For authors of academic articles, the user requirements are also diverse The standard reasons for publishing are to disseminate the results of research, to establish precedence, to advance a discussion and so forth. However, today's scholar has a variety of other reasons. For example, it is widely accepted in academia that promotion and tenure committees use publications as a performance indicator and hence there are career pressures to publish. Increasingly, academic institutions are themselves judged by such indicators and therefore even unambitious scholars find themselves pressured to publish. It is through publishing that a reputation in one's field is established.

In selecting a journal to which a paper will be submitted, scholars typically refer to the proportion of the target population which reads the journal, the belief that the refereeing will be competent and fair and that the journal has already published papers on similar topics (Gordon, 1984). Hence, these considerations can be seen as another set of user requirements which the electronic journal must satisfy.

It is indeed conceivable that above and beyond the user as reader or writer, the user as a member of a professional community has a requirement of academic journals that they provide an information dissemination and record keeping resource of the highest intellectual standard for the community. Furthermore, in the days of increased interdisciplinarity, scholars are as likely to define themselves by the journals they use as by any background qualification or intellectual specialism.

3. HUMAN FACTORS OF JOURNAL USE — THE EVIDENCE TO DATE.

The various requirements of users of academic journals need to be considered in terms of the empirical data that have been gathered in recent years. Such evidence provides clues to the most suitable form an electronic journal might take.

3.1 Negative Human Factors Of Paper Journals

It is clear that there are several problems inherent in the paper system that could be improved with electronic delivery. Journals often seem to be missing — either in use by someone else, mis-shelved, gone for binding, not yet delivered and so forth. Even when journals are available, other problems mentioned are that they are difficult to search through (especially when looking for a half-remembered item of information) and they take up too much space on the shelf. Some readers also complain about the sheer volume of literature and the rate at which new journals are appearing, making it difficult to keep up with developments.

Burrows (1993) points out that 'The main investment in almost all academic libraries is the provision of the shelving and space necessary for direct, open access to as much of the collection as possible.' These costs are increasing as the pressure on space forces many universities to implement a policy of charging departments for the space they occupy.

As an information dissemination medium, paper journals are slow. Leading journals often require more than a year to referee, revise and then publish an article by which time the work can often be out of date. Furthermore, there is a lack of interaction between information provider and recipient that hampers any true information dissemination process.

The common experience of scholars browsing academic journals and finding extremely relevant material serendipitously is both a flaw and a virtue of the medium. While it is always a pleasant experience to find such work effortlessly and almost by magic, it should be worrying to any serious scholars that their standard information searching behaviours could have failed to point them directly at that piece of work. In other words, if one such relevant article is found by chance, how many more are missed forever?

3.2. Positive Human Factors Of Paper Journals

The portability of paper renders journals and articles a highly amenable form of information presentation. Given Simpson's (op cit) perhaps unsurprising finding that scholars like to read outside of library and office environments, it is clear that paper is a most appropriate medium for delivery.

In readability terms, the standard paper presentation compares favourably with all electronic forms in most empirical tests (see Dillon, 1992 for a review). In terms of such outcome measures as speed and accuracy, as well as process measures such as navigation, paper continues to retain dominance over most electronic texts in experimental comparisons.

Paper journals also conform to a certain style that has been shown to be useful for readers as they seek information. Contrary to the naive view of readers as serially ploughing through masses of text due to some form of linear determination found in paper publications (see e.g., Nielsen, 1990), the experienced scholar can use the familiar structural representation of the format and the flexible manipulability of the medium to jump through the information space accurately and reliably. Empirical examinations of readers using journals (Dillon et al., 1988) indicates that few articles are ever read serially from start to finish but tend to be subjected to quick scans and jumps through the text — a by-product in use of the very qualities the medium supports.

The purpose of examining journals in terms of requirements and negative/positive usage aspects is to make explicit the criteria electronic journals will be measured against. For minimum acceptance the new form must maintain the positive and reduce the negative, or increase the positive without increasing the negative. Ideally, a new technology would remove some of the negative and increase some of the positive to be acceptable. It is in this light that we examine some of the attempts at developing electronic journals.

4. SOME ELECTRONIC JOURNAL EXPERIMENTS

In this section we will briefly describe some past and present electronic journal experiments and consider their implications for the variety of user requirements.

4.1 BLEND

The BLEND project (Shackel, 1982; 1991) aimed not only to investigate the feasibility of an electronic journal but also the feasibility of supporting the entire communication process — from authoring and submitting, through refereeing and editing, to publishing — via computer. To this end, a central mainframe was used and the various participants in the process communicated through this machine, with the resulting issues of the experimental journal *Computer Human Factors (CHF)* being stored on it. Users accessed

the system via a remote terminal either over the newly developing British Joint Academic Network (JANET) or, mostly, the Public Switched Telephone Network (PSTN).

In at least one respect, *CHF* proved potentially superior to a paper journal. Although each actual article was 'read-only' once issued and could not be altered, there was space allocated for comments to be entered on each article and these comments could then be seen by subsequent readers of the article. The fact that the articles' authors were also part of the 'electronic community' meant that they too could read — and respond to — the comments. The resulting dialogue created much more of a feeling of 'live' research than is possible in the paper medium where it is not uncommon for an 18-month period to elapse between submission of an article and publication in the journal. Indeed, Pfaffenberger (1986) has suggested that 'Journal publication, in short, confers reward and recognition more than facilitating genuine communication, which in any case has already taken place within research networks if a field is thriving'.

While it might be tempting to think that the electronic medium speeded up the process of publication, this is not necessarily the case. Indeed, Shackel (1991) reported a median publication time of 'just over 32 weeks' (i.e. about 8 months) for articles in *CHF* and it is possible that this could be attributed to a 'novelty effect'. What seems more likely is that the electronic medium more easily supports comment and dialogue than the paper medium, as will be seen in some of the more recent experiments described below.

4.2 QUARTET

Project QUARTET aimed to investigate the implications of information technology for the scholarly communication process. It was therefore somewhat wider than BLEND, being concerned with a broad spectrum of communication activities including electronic mail, computer based conferencing, electronic document delivery, desktop publishing and electronic publishing (Tuck *et al*., 1990). As part of Project QUARTET, what was possibly the world's first hypertext electronic journal, *HyperBIT*(1), was designed and built. This was seen as being made available over a local area network (LAN) rather than the wide area network since it was Macintosh-specific and incorporated graphics. The design was based on the results of various earlier studies by us of journal usage (e.g., Dillon et al, 1988) and as such specifically addressed the issue of user requirements. Hence, browsing through author/title lists at either the issue or volume level was supported, as was searching the entire contents of the journal. Each article was structured

using the Guide™ hypertext system and cross-references in articles were made into active hypertext links, allowing the reader to move quickly and easily between articles. (A more complete description of the design is given in McKnight, Dillon and Richardson, 1991.)

HyperBIT offered the user several advantages over the paper version. For example, it was always available on the desktop. The entire contents of the journal could be searched in order to locate, say, all articles which mentioned 'screen' or referred to work by 'Maguire'. The ability to move between related articles using the hypertext links was also advantageous, as was a pop-up window facility which provided instant access to the bibliographic details of references without leaving the text. This facility was provided on the basis of observations of many users who would keep a finger permanently in the References section of the article when using the paper version, turning to the section when they encountered a reference in the text and then returning to the text. In this sense the facility provided an 'electronic finger'.

4.3 LISTSERV

In recent years another model of the electronic journal has arisen based on the LISTSERV software. This name is an abbreviation of 'list server' which gives some insight into how the system works. In a typical system, a central computer holds a list of subscribers; when a new issue is available, the system sends subscribers a 'contents page' and abstracts via email. Subscribers can then request articles by sending an email message to the server, with the articles being automatically delivered as email by the software.

Although the concept of 'issue' is still used in the typical listserv journal, the issue itself is effectively unbundled since subscribers can request single articles. However, the contents pages and abstracts can be stored for future reference and searching, and articles can be retrieved at any time on demand. Such a system makes effective use of the network 'bandwidth' since only requested articles are transmitted. How many academics could honestly say they are interested in every article of every issue of every journal they receive? Even when the journals are on their shelves, they don't remember what is in them. Shackel (1985), for example, reports on an electronic search of a references and abstracts database: "…33 [references] were subsequently used in the preparation of the

written chapter. Of these 33, 16 were already known to me, but 17 were new, highly relevant references…In almost all cases the relevant journals were on my bookshelves."

Like BLEND, the listserv journals have found that they can support discussion of articles. For example, subscribers to the peer refereed electronic journal PostModern Culture (PMC) can also choose to subscribe to a discussion list called PMC-Talk. Indeed the discussion list provides a forum not only for comment on and debate about the articles in the parent list, it also provides a forum for discussion of the broader issues of postmodernism in general. A further facility offered by PMC is PMC-MOO, a 'real-time, text-based virtual reality environment in which you can interact with other subscribers of the journal and participate in live conferences' (PMC-list, 1993). At the time of writing, it is interesting to note that PMC is about to be published simultaneously in World Wide Web format which would permit the inclusion of graphics, sound and video and include hypertext links to other documents. However, the PMC-Talk and PMC-MOO services will continue to run.

4.4 CORE

The CORE (Chemistry Online Retrieval Experiment) project's aim is to deliver a large majority of the journal literature needed by one academic area in electronic form to workstations in a library and terminals on the desks of academics. Articles are held in both text and bit-map forms and a variety of interface options are being investigated. For example, Landauer et al. (1993) report on experiments comparing performance on five different tasks using a SuperBook interface (which allows browsing and provides many hypertext-like features), a PixLook interface (which combines a sophisticated document retrieval engine with bitmap page images) and paper. Not surprisingly, the results suggest that there is no one 'best' interface. Rather, particular tasks are supported to a greater or lesser extent by each interface; as the task changes, so the optimum form of interface will change.

The CORE project represents a collaboration among five institutions: the Cornell University Albert Mann Library houses and administers the experiment; the American Chemical Society is providing ASCII and microfilm versions of the last 10 years of 20 journals; the Chemical Abstracts Service provides electronic versions of their hierarchical indexing scheme tagged to all of these articles; the Online Computer Library Center (OCLC) is contributing expertise in large database storage, access and search techniques;

and BellCoRe (where Landauer and colleagues work) is contributing expertise on text and graphic conversion and transmission as well as developing prototype user interfaces. At the time of writing, the project is still running and we await its results with interest.

4.5 TULIP

The TULIP (The University Licensing Program) project, a three-year project scheduled to run to the end of 1995, aims to test the feasibility of networked delivery and use of journals. Elsevier Science Publishers are making electronic versions of 42 of its materials science journals available to the 15 colleges and universities (including MIT, Harvard, Carnegie Mellon, Cornell and Princeton) that are participating in the experiment. Each university is providing its own hardware and access and retrieval software. Hence, Elsevier are simply providing a database which Engineering Information, acting as Internet host, archive and customise for each university. The aim is to provide 'as much local autonomy as possible' (Elsevier, 1992) so that a variety of options can be explored and evaluated. The project will examine the economic, organisational and technical issues involved in the electronic transmission of journals as well as considering user issues.

The journals are currently stored as bit-maps and are distributed with index files and a 'dirty ASCII' file. This latter can be searched but not displayed. It is produced by scanning the journals and using OCR software to recover the text. Many people have expressed surprise that it is more cost effective for Elsevier to re-scan and OCR pages which have already existed in electronic form. However, it is likely that this is a temporary expedient in order to get the project off the ground — it was already delayed for some months beyond its scheduled start date. As typesetters move towards a standard format, so it will be easier to produce a 'clean' ASCII file directly. As with CORE, results from TULIP are awaited with interest.

4.6 OJCCT

The American Association for the Advancement of Science (AAAS) and the Online Computer Library Center (OCLC) have also launched an electronic journal, The Online Journal of Current Clinical Trials. This was due to be launched in April 1992 but was beset by technical problems. In addition to the technical problems facing the project, Wilson (1992) reported that "the AAAS must persuade authors to submit high-quality papers in a new medium that may prove to be largely ethereal" (a problem already

reported in the first journal project (Sheridan et al., 1981) and circumnavigated in BLEND (Shackel et al., 1983). Indeed, the number of papers on the system does not seem to have reached the expected level, despite now offering parallel publication in a traditional medical journal. Paradoxically, although the system was designed to be accessed directly by readers, it seems to have received a more enthusiastic reception from the information profession than from end users.

4.7 ELVYN

The ELVYN project involves the Institute of Physics Publishing and Loughborough University with support from SCONUL. This project is investigating a variety of economic, technical and user issues involved in the distribution of an electronic version of a paper journal, Modelling and Simulation in Materials Science and Engineering, to participating libraries (Pullinger and Meadows, 1993). This project has many similarities to the TULIP project: it seeks to involve both publishers and libraries; it is allowing participating libraries to specify the format in which they receive the electronic version of the journal; and it is distributing electronic versions of existing paper journals. This is in contrast to, say, the list-server journals which effectively bypass the publisher and library (or at least the formal representatives of these bodies). In at least one test site, the publisher's SGML files are being converted to the World Wide Web HTML format, with NCSA's Mosaic being used as a client viewer. This allows viewing of full text and colour graphics from the user's desktop microcomputer and could incorporate animation and hypertext links.

The Institute of Physics Publishing also led a consortium of nine publishers in a small project testing journal distribution and usage over SuperJANET, the new British high speed academic network currently undergoing pilot testing. This project aimed to produce a demonstration system and was scheduled to run from January to April 1993 (IOPP, 1993) but the project report has yet to appear at the time of writing.

4.8 CAJUN

Also recently started is the CD-ROM Acrobat Journals Using Networks (CAJUN) project. This project involves two journals already in existence, Wiley's Electronic Publishing: origination, dissemination and design (EP-odd) and Chapman and Hall's Optical and Quantum Electronics (OQE). Dissemination will be both on CD-ROM and over the network.

The 'Acrobat' referred to in the project title is Adobe Acrobat™ which is "a family of products that work together to enable document communications" (Adobe, 1992). The basis of Acrobat is the Portable Document Format (PDF) which is PostScript based but also allows additional document features such as annotations, hypertext links and miniature thumbnail views of each page. Like PostScript, PDF is device and resolution independent and Acrobat viewers (the applications necessary to read, navigate and print PDF documents) are available for Macintosh, Windows, DOS and UNIX platforms. Adobe intends to publish PDF as an open standard.

In the same way that the TULIP and ELVYN projects are important because they explore the role of the publisher and library in the electronic journal, so the CAJUN project is noteworthy since it involves a major commercial software house — indeed, one which has already been responsible for producing the de facto standard page description language, PostScript.

5. DO ELECTRONIC JOURNALS MEET USER REQUIREMENTS?

It is clear from the above that electronic journals meet some of the user requirements of the paper journals. They are less likely to 'go missing', more likely to be available on demand or even on the user's desktop (notwithstanding the occasional network crash — the electronic medium has its own varieties of inaccessibility including the question of long-term archiving, yet to be solved).

In terms of search facilities, the electronic medium offers clear advantages over paper. Modern search algorithms allow very sophisticated searching to be carried out even on the basis of the scantiest piece of half-remembered information. Furthermore, searching need not be limited to bibliographic sources but can realistically be carried out on large, full text databases.

The advantage of the electronic medium in terms of storage requirements is also clear to see. A single copy (plus back-up, of course) held centrally takes up less space than hundreds of copies distributed worldwide. Even in the case of HyperBIT, which was conceived as being distributed, it would have been easily possible to put the entire contents of the journal (eight volumes with four parts per volume at the time of the project) on a single CD-ROM.

Some of the interfaces to electronic journals, for example those of HyperBIT and SuperBook, are designed to allow browsing and seem successful in this respect. Even a minimal electronic journal such as a listserv journal allows browsing of the contents page at the title/author/abstract level, something which many academics do with paper journals. In supporting browsing, such systems also permit the serendipity much valued by academics.

One desirable aspect of the paper journal which does not yet seem to have been tackled in the electronic domain is its portability. The survey by Simpson (1988) referred to earlier suggested that many academics like to read while on trains or at home rather than in their office or the library. A journal on CD-ROM could be carried easily between office and home but would require equivalent equipment at both places. However, there are certainly portable electronic books being developed and it may well be that the portable electronic journal will follow behind. The current growth in laptop computers and 'notepad' computers, combined with a storage medium such as the smart-card, could well support portable electronic journals. However, this would represent a distributed system rather than a truly networked system.

Although systems like HyperBIT allow a reasonable level of graphics, this is achieved by making the system machine specific. Displaying the same graphics on different systems is difficult although the World Wide Web protocol supports common graphics formats (e.g., TIFF and GIF) as long as suitable 'helper' applications are available to display them.

Those electronic journals which are distributed over the network must also recognise the fact that they are most readily accessible to the academic market. There are many researchers located in industrial research laboratories who have no access to this network. It is to this very market that many commercial document delivery companies are now directing their marketing attention. In America at least, an increasing number of companies are connecting into the network, but in Britain the take-up rate is very slow in the industrial and commercial sectors. It is probably significant that the forward-looking IOPP is one of the publishers with JANET access.

Although there are an increasing number of electronic journals, not all of these are the subject of peer review. This raises an important issue which must be addressed by the distributors of an electronic journal, that of quality control. In the paper journal system,

the process of refereeing acts as an important quality control mechanism. While the refereeing system is open to various criticisms, it does confer an aura of respectability on the journals to the extent that academic status and recognition rely on publishing in such journals. The early EIES project (Sheridan et al., 1981) had discovered to its cost that academics could not afford to risk publishing in experimental journals and the BLEND project had allowed authors subsequently to publish in paper journals specifically because this problem was recognised. The OJCCT project appeared to suffer precisely because of this attitude. Hence, if electronic journals are to be successful and attract quality articles, they must be seen to be applying the same standards as their paper counterparts, unlikely to disappear overnight and, perhaps most importantly, recognised by the bodies who for various reasons make judgements of an academic's work based on published output. In this respect, the statement of the recent Joint Funding Council report (1993 – the 'Follett' report) in Britain that "the [UK] funding councils should make clear that refereed articles published electronically will be accepted in the next Research Assessment Exercise on the same basis as those appearing in printed journals" is very important.

6. IMPLICATIONS FOR THE ELECTRONIC LIBRARY

The declining library budget which is a feature of so many academic institutions has put pressure on libraries to purchase 'just in time' rather than 'just in case'. Many librarians have pointed out that the combination of budgetary constraints and developing network services has changed the library's function from a 'holdings' approach to an 'access' approach.

Librarians were relatively quick to take to the CD-ROM, acquiring them and mounting them in the library in much the same way that books were shelved. However, the trend nowadays is for the CD-ROMs to be available across a campus LAN and for access to be supported by the institution's computing service.

Electronic journals such as the listserv journals effectively bypass the librarian and call into question the role of the publisher. The argument is advanced that since scholars are both the source of journal articles and their users, the networks allow the distribution function to be removed from the publisher and the library. Librarians typically counter this argument with the observation that the so-called information explosion makes it impossible for the individual scholar to know what is available and that their role as

information intermediary is therefore retained. However, the growth of 'information agents' and 'selective dissemination of information' (SDI) may tend to undermine the librarian unless librarians in general change to take the lead in the provision of such services.

This is especially the case in the research community. As was emphasised in the 1989 Cranfield Conference on Information Technology and the Research Process, the growth in electronic facilities will increase considerably the sheer volume of material to be searched/accessed/reviewed, leading to even greater need for SDI and similar support. As Shackel (1990) said "For example, the importance of quick access to knowledge about the current and most recent research is emphasised by Gould (1990). The problem of organising all the data which will be accumulated so rapidly when these IT support resources come into widespread use, is another major issue. Obviously, this further development of the

'invisible college' resulting from IT in the future could be helped by librarians and information scientists, but how best to achieve this?"

Projects such as ELVYN have retained a role for both publisher and library. However, even within such frameworks it is not clear that the publisher is 'necessary'. In most of the test sites, it is also the case that the library requires the active support of the computing service in order to mount the electronic version of the journal and enable its accessibility across the campus LAN. As Sidgreaves (1989) said to the 1988 conference on the electronic campus "the boundaries between libraries and computing centres are becoming increasingly blurred".

From the rapid growth of the electronic journal and other electronic facilities outlined above it is obvious that there will in time be many changes in the organisation of the whole system of scholarly communication. The difficult questions to answer are what and when. A wide range of possible scenarios can be envisaged (cf. McKnight, 1991), from very slow evolutionary progress to the extreme of publishers and libraries being replaced by direct interaction via the Internet between scholars as writers and scholars as readers. We tend to favour the middle range of possibilities and in particular we suspect that organisational issues may be more influential than the technological possibilities (significant though these are). For example, among the major influences will be the following: the maintenance of quality via the peer review process (relating also to the

issue of career status for authors); the problem of copyright control; the vested interest of publishers (including especially the learned society publishers) in maintaining income; the consequential uncertainties of how/whether to attempt the transition from journal volume subscriptions to single article fees (which might well require unacceptable levels of perhaps £10 – £50 per article).

7. SOME REMAINING ISSUES

We have largely concentrated on the scholar's needs of electronic journals. However, there are many other important considerations in the development of an electronic journal which need to be taken into account. For example, the question of copyright control is of particular concern for publishers. Although the paper medium is relatively easy to copy using a photocopier, the resulting copy is of inferior quality to the original. In the electronic domain, copying is not only easy and fast but also the resulting copy is identical to the original. If I receive an article over the network, it takes me no more than a few key-presses to forward a copy of the entire article to someone else. This means that either methods of electronic copy protection must be developed or the concept of copyright must be reconsidered. In real terms, the issue for publishers is not copyright per se (since this is often retained by authors) but rather how to derive a revenue from the electronic journal.

In the paper domain, if scholars order a journal they either have to pay for it themselves (a personal subscription) or they must have agreement that the department or university library will pay. If they receive a listserv journal, however, it is not clear who pays. Certainly there are costs involved — there is no such thing as a 'free lunch'! — but they are costs which are largely transparent to the user. The storage costs are met by the host institution, usually a university and in this respect we may be witnessing a return to the situation in which universities were also publishing houses. Certainly PostModern Culture, mentioned earlier, received the support of various departments within North Carolina State University whence it originates, although it has apparently now been 'acquired' by Oxford University Press. Access to the network is paid for as part of the general funding for computing within a university and individual scholars do not receive a bill. Hence, it may well prove necessary to develop new costing models for the production and distribution of journals in the electronic domain. Practically all of the current electronic journal projects follow BLEND (Pullinger, 1987) in being concerned to

investigate economic factors and pricing models in addition to tackling the technical problems.

Although there are advantages to the development of electronic journals, it must be recognised that such developments exclude a large number of users of the paper journal system — those users in countries that do not yet have a stable network or even an established computer base. Clearly, the hope is that such countries will develop a computing infrastructure eventually. We would not argue that we should not develop electronic journals because they presently exclude such countries, but we must recognise that access for a large number of potential users is currently impossible. For this reason if for no other, the paper journal will be a feature of the academic landscape for some time to come.

Hardware and software have been mentioned in passing but it is clear that today's decisions about these aspects will have implications for the future, for example with regard to long-term archiving. At a recent exchange of experience meeting organised by the Royal Society, Mike Lesk of BellCoRe made the observation that the US 1960 Census had been largely lost because it was written on what was (in retrospect) the 'wrong' kind of magnetic tape. How many of us have 78 rpm records but no longer have machines capable of running at such speed? Yet medieval manuscripts are still legible!

8. CONCLUSIONS

In such a complex situation any prediction would be foolhardy. However, there is one scenario which seems to us to have several circumstances in its favour at least as a transition possibility for the academic world. With academic campuses moving rapidly towards full provision of high speed wide bandwidth networks, the dissemination of material with good colour, graphics and multimedia quality will soon be possible for electronic journals via these LANs. This might form the basis for an interim solution to the copyright control and income maintenance problems; publishers might sell site licence subscriptions to the campus library (thus combining two familiar journal and software pricing models) and send, say, a monthly file over the network to the central library for release on the campus LAN and for mounting in the campus indexed database. Whatever proves to be the eventual scenario, we can only be sure of one outcome; the electronic library will certainly evolve to be rather different from the present form and both librarians and their professional skills will need to change and develop to suit.

We believe that the major determinant of success of the electronic journal and the electronic library is their ability to satisfy the needs of the readers and authors rather than the institutional librarian or publisher. This represents somewhat of a shift in the traditional 'power base' and requires an appropriate response from librarians and publishers if they are to play a role in the 21st Century University.

9. Footnotes

(1) The journal used was Behaviour and Information Technology (BIT), published by Taylor and Francis whom we gratefully acknowledge for allowing its use.

10. REFERENCES

Adobe (1992) Adobe™ Acrobat™ Products and Technology: an overview. Adobe Systems Incorporated, November.

Burrows, T. (1993) Serials collection management: the academic library. In H. Woodward and S. Pilling (eds.) *The International Serials Industry*. Aldershot: Gower. pp 207–231.

Dillon, A. (1992) Reading from paper versus screens: a critical review of the empirical literature. *Ergonomics*, 35(10), 1297–1326.

Dillon, A., Richardson, J. and McKnight, C. (1988) Towards the development of a full text, searchable database: implications from a study of journal usage. *British Journal of Academic Librarianship*, 3(1), 37–48.

Elsevier Science Publishers (1992) TULIP: an irregular update. Nº 1, November.

Gordon, M.D. (1984) How authors select journals. *Social Studies of Science*, 14(1), 27–43.

Gould, C.C. (1989) Scholarly information needs and RLG's program for research information management. In M. Feeney and K. Merry (eds.) *Information Technology and the Research Process*. London: Bowker-Saur. pp 171-181.

Institute of Physics Publishing (1993) Electronic journals to be pioneered on SuperJANET. Press release, 21 January.

Joint Funding Council (1993) *Joint Funding Councils' Libraries Review Group: Report*. Available from External Relations Department, HEFCE, Northavon House, Coldharbour Lane, Bristol BS6 1QD, UK.

Landauer, T., Egan, D., Remde, J., Lesk, M., Lochbaum, C. and Ketchum, D. (1993) Enhancing the usability of text through computer delivery and formative evaluation: the SuperBook project. In C. McKnight, A. Dillon and J. Richardson (eds.) *Hypertext: A Psychological Perspective*. Chichester: Ellis Horwood. 71–136.

McKnight, C. (1991) The electronic journal: a user's view. *Serials*, 4(2), 53–60.

McKnight, C., Dillon, A. and Richardson, J. (1991) *Hypertext in Context*.. Cambridge: Cambridge University Press.

Nielsen, J. (1990) *Hypertext and Hypermedia*. London: Academic Press.

Okerson, A. (1991) (ed.) *Directory of Electronic Journals, Newsletters and Academic Discussion Lists*. Washington, DC: Association of Research Libraries.

Okerson, A. (1993) (ed.) *Directory of Electronic Journals, Newsletters and Academic Discussion Lists, Third Edition*. Washington, DC: Association of Research Libraries.

Pfaffenberger, B. (1986) Research networks, scientific communication and the personal computer. *IEEE Transactions on Professional Communication*, 29(1), 30–33.

PMC-list (1993) Postmodern Culture announces PMC-MOO. Message posted to subscribers to pmc-list@listserv.ncsu.edu, 21 May.

Pullinger, D.J. (1987) *BLEND-8: Cost Appraisal*. Library & Information Research Report 53. London: The British Library.

Pullinger, D.J. and Meadows, A.J. (1993) Distribution of an electronic version of a scholarly journal from publisher to libraries. Paper distributed to exchange of experience meeting, Royal Society, 26 February.

Shackel B, 1982 The BLEND System - Programme for the study of some 'electronic journals'. *Ergonomics*, 25(4), 269–284; *The Journal of the American Society for Information Science*, 34(1), 22–30; and *The Computer Journal*, 25(2), 161–168.

Shackel, B., Pullinger, D.J., Maude, T.I. and Dodd, W.P. (1983) The BLEND-LINC project on 'electronic journals' after two years. *ASLIB Proceedings*, 35, 77–91; *The Computer Journal*, 26(3), 247–252.

Shackel, B. (1985) Using RAAJ for real. *Journal of Librarianship*, 17(3), 200–204.

Shackel, B. (1990) Information Exchange within the Research Community. In M. Feeney and K. Merry (eds.) *Information Technology and the Research Process*. London: Bowker-Saur. pp 147-170.

Shackel, B. (1991) *BLEND-9: Overview and Appraisal*. British Library Research Paper 82. London: The British Library.

Sheridan, T., Senders, J., Moray, N., Stoklosa, J., Guillaume, J. and Makepeace, D. (1981) Experimentation with a Multi-disciplinary Teleconference and Electronic Journal on Mental Workload. Unpublished report to National Science Foundation, Division of Science Information Access Improvement, 32O pp. (June). (Available from Professor T.B. Sheridan, Room l-110, M.I.T., Cambridge, Massachusetts O2l39, U.S.A.)

Sidgreaves, I. (1989) The electronic campus – an information strategy: organisation issues. In L.J. Brindley (ed.) *The Electronic Campus*. Library & Information Research Report 73. London: The British Library. pp 65-80.

Simpson, A. (1988) Academic journal usage. *British Journal of Academic Librarianship*, 3(1), 25–36.

Tuck, B., McKnight, C., Hayet, M. and Archer, D. (1990) *Project Quartet*. LIR Report Nº 76. London: The British Library.

Wilson, D.L. (1992) Major scholarly publisher to test electronic transmission of journals. *The Chronicle of Higher Education*, June 3, A17 and A20.