COLOPHON

This paper was one of two Invited Keynote Addresses at the ICCC/IFIP Conference on refereed electronic journals held at the University of Kent (UK) in 1997. The second invited keynote address was given by Andrew Odlyzko.

Unfortunately, the text of my invited paper did not make it to the printers in time and so it does not actually appear in the printed Proceedings.

This final draft version of the paper is typeset in Lucida Bright and was prepared using UNIX *troff*.

Electronic Publishing: the evolution and economics of a hybrid journal.

David F. Brailsford

Electronic Publishing Research Group
Department of Computer Science
University of Nottingham
NOTTINGHAM NG7 2RD
E-mail dfb@cs.nott.ac.uk

ABSTRACT

The technical, social and economic issues of electronic publishing are examined by using as a case study the evolution of the journal *Electronic Publishing — Origination, Dissemination and Design* (*EP-odd*) which is published by John Wiley Ltd. The journal is a 'hybrid' one, in the sense that it appears in both electronic and paper form, and is now in its ninth year of publication. The author of this paper is the journal's Editor-in-Chief. The first eight volumes of *EP-odd* have been distributed via the conventional subscription method but a new method, from volume 9 onwards, is now under discussion whereby accepted papers will first be published on the *EP-odd* web site, with the printed version appearing later as a once-per-volume operation.

Later sections of the paper lead on from the particular experiences with *EP-odd* into a more general discussion of peer review and the acceptability of e-journals in universities, the changing role of libraries, the sustainability of traditional subscription pricing and the prospects for 'per paper' sales as micro-payment technologies become available.

1. Introduction

In 1987 I founded a journal called *Electronic Publishing — Origination, Dissemination and Design* (*EP-odd* for short) and became its Editor-in-Chief. Richard Beach, of Xerox PARC, agreed to become the US co-editor. This journal is published by John Wiley Ltd and until recently it appeared in print form four times per year. From the outset the journal set out to be broad-ranging. Our slogan might well have been "everything from slab-serifs to SGML; everything from hyphenation to hypertext". The contributors and subscribers are, in the main, computer scientists interested in digital documents and electronic publishing, together with some professional practitioners from the print and publishing industries.

It might be thought that a journal with such a title would be refereed and disseminated electronically from the very outset, but there were a number of difficulties. My US co-editor and all of our editorial board were anxious to create a solid and highly-respected journal. There were severe doubts in the early days (not entirely resolved even now) as to whether any purely electronic journal, however scrupulously its papers were refereed, could compete in prestige with the existing traditional journals.

Another important factor — often overlooked — is that the economics of electronic journal dissemination cannot be entirely divorced from the electronic format that is

used. The desired quality level of the 'deliverable' form (e.g. in terms of typography and illustrations) is still a major factor in determining production costs.

2. The early days

As early as 1989, when the journal had been in existence for about two years, its two editors were asked to write a paper for *Computer Journal* setting out our experiences in producing *EP-odd* and examining the prospects for making it be truly electronic [Brailsford, 1989]. From the outset we realised that the very title of the journal put a great burden of responsibility upon us:

> This journal about electronic publishing reflects a unique situation: the scope of the journal encompasses the process for producing the journal. The message is the medium.

With the benefit of hindsight we should have said:

> "… for producing *and disseminating* the journal."

because CD-ROM and the World Wide Web have now moved us forward in ways that were hard to imagine even eight years ago.

Even so, the futuristic vision had been there for some time. In a highly influential paper from Ted Nelson, building on previous work by Vannevar Bush and Doug Engelbart, the world's information resources were envisaged as becoming one vast hyperdocument [Nelson, 1980] — a quite remarkable precognition of the World Wide Web. But at that time, more than ten years ago, when e-mail was about the only networked information system available to the average user, a more accessible experiment in terms of pure electronic journals was afforded by the BLEND project [Shackel, 1982] [Shackel, 1983], which used Infomedia Corporation's *Notepad* software to disseminate drafts of papers and to run a newsletter and e-mail service in the Computer Human Factors field. The main problems were the primitive state of network communications and the low-quality output devices (these latter were mainly dot-matrix printers; PostScript laser-printers began to appear only as the project ended). For all these reasons Dodd's summary of the project's findings [Dodd, 1990] recommended a 'hybrid journal' approach in which all pre-press stages are carried out electronically while retaining ink-on-paper for the final dissemination.

It was precisely this hybrid approach that we followed for the next six years of the journal's evolution while gradually extending the notion of 'hybrid' to encompass not only electronic pre-press processes but electronic dissemination as well. (In what follows I shall use 'hybrid journal' for something that appears in both electronic and printed forms, and 'e-journal' for a purely electronic publication.)

It was appreciated from the outset that the typographic complexity of some of the *EP-odd* material demanded that it be typeset in PostScript. This seems straightforward enough these days, with PostScript being the *de facto* typesetting standard in the Scientific, Technical and Medical (STM) journal world. But back in 1987 it added considerably to the journal's production costs and the only comfort was that our ever-expanding archive of PostScript, plus the corresponding source texts (in LaTeX or UNIX *troff* formats), would be a valuable resource when the journal became truly electronic.

3. Technical issues of electronic formats

Over the years from 1988 to 1993 careful consideration was given to formats that might enable the journal to be distributed electronically. The most obvious approach would have been to construct electronic document systems based on scanned page images, as in Knowledge Set Corporation's *Knowledge Retrieval System* and in the *Right Pages* project at AT&T [Story, 1992]. But there are many difficulties with this approach. A 300 dots per inch A4-size page occupies about 1 Mbyte unless compression techniques are used. By dropping the resolution to 150 dpi, as in Group 4 FAX, and applying

compression algorithms, such a page can be stored in as little as 2.5 Kbytes but the image quality is poor and colour is out of the question.

An additional difficulty is that searching on bitmap pages for a particular word or phrase cannot be done directly. In many such systems, therefore, searching within an article is impossible and locating the article itself has to be done via separately-keyed header information. Moreover, since the bitmap page is the ultimate physical representation it has no abstract knowledge of the underlying document structure, so it follows that any form of added value in terms of hypertextual information, tables of contents and so on (particularly where these are based on structural elements of the document) is difficult, if not impossible, to provide.

For all these reasons, even at the stage of our *Computer Journal* article, the 'quality' electronic options seemed to revolve around either Display PostScript or an SGML-based structured-document approach. The first of these was carefully considered and could address all of our typographic quality concerns but had to be rejected because of unwieldy file sizes, lack of hypertext facilities and performance problems. By contrast, structured document systems, often with hyperlink capabilities and based around SGML, were available in software such as Dynatext but in these systems one lost all control of the precise fonts and layouts so necessary to many of our papers.

As it turned out, our identification of these contrasting options correctly foresaw the emergence, in the 1992–94 period, of the two major electronic document standards of today: Adobe Systems Inc's Portable Document Format (PDF), with its associated Acrobat range of viewer software, and the World Wide Web's Hypertext Markup Language (HTML) with associated viewer software such as Netscape and Internet Explorer. The first of these formats, PDF, remains close to Level 2 PostScript but has a range of compression options available to reduce file sizes [PDF, 1993], while incorporating imageable objects and hypertextual objects into a tree-based data structure of pages. One of PDF's features is that, being page based, it can guarantee full page fidelity with respect to the printed version of the journal.

The approach taken by HTML, which is an SGML-like form of markup, is to allow documents to use abstract tags for specifying traditional structure elements, such as headings, paragraphs and tables. HTML also supports hypertextual links, which are specified in a way which indicates *where* the target document is located on the Internet. However, the ethos of HTML in terms of visual presentation, is to forsake any page-based model and to adopt a moderate-quality approach where the minutiae of presentation, layout, line-breaks and fonts do not matter too much.

The precise reasons for our adoption of Acrobat and PDF for the electronic version of *EP-odd*, within the CAJUN project, are described in [Smith, 1993] which also gives some details of our methods for the automated placement of PDF hyperlinks and a more general overview of the CAJUN project is given in [Brailsford, 1994a] and in [Brailsford 1994c]. In 1994 we also produced a CD-ROM of the entire *EP-odd* archive in Acrobat/PDF form (probably the first such product in the world for a learned journal) while simultaneously making seven sample papers from the *EP-odd* archive freely available on the journal's web site [EP-odd, 1997]. We are now moving to a new phase, described in a later section, of making the whole archive freely available, putting newly accepted papers up on the Web straight away, and relegating the printed version to a *post facto* once per year operation.

4. *EP-odd* — the publisher's viewpoint

EP-odd has always been something of a niche-market journal, catering to specialists, and with a circulation (predominantly to libraries) of a few hundred copies per issue. Even with its relatively high subscription fee of $190 per annum the publishers report that it rarely did better than to break even once editorial, distribution and printing costs were taken into account. For all of these reasons, given that PDF is now an

established *de facto* standard in the STM journals world, it is now the right time to make *EP-odd* be electronic in the first instance and to explore lower-cost options for the print-run, whenever that is needed.

Perhaps the most valuable aspect of *EP-odd* from the publisher's perspective is that the very nature of the subject matter and the relatively relaxed schedule of four issues per year, made it an ideal candidate for hybrid journal experimentation. Our publishers have used it extensively as a case study for the changes in production methods that would be necessary for transferring other journals to 'parallel publication' in electronic and print form. The on-going CAJUN II project [Cajun, 1997] at Nottingham is taking on the task of transferring no fewer than 15 journals into a similar hybrid form.

5. *EP-odd* — the editors' viewpoint

In late 1989 Richard Furuta (now of Texas A&M University) replaced Richard Beach as US co-editor of *EP-odd*. Since that time the joys and woes of *EP-odd*'s two editors have been little different from those experienced on conventionally produced journals with more mainstream subject matter. *EP-odd* is respected in its field and its authors, being well placed to understand the advantages of dissemination via PDF and WWW have been, in the main, very co-operative in using our LaTeX macro sets that make this production process easier. However, we have struggled for some years with a boom-bust cycle in terms of paper flow which forced us to take rather unusual remedial measures.

Ever since 1986 there has been a biennial series of conferences organised by a programme committee with a membership that substantially overlaps that of the *EP-odd* editorial board. Unsurprisingly therefore one of the board members, espying that the conferences took place in even-numbered years proposed that they be christened the *EP-even* series …

From 1986 to 1992 the *EP-even* conference proceedings were published by Cambridge University Press but in 1994 we persuaded John Wiley Ltd to publish the conference proceedings for that year as part of the *EP-odd* issue sequence. The editors were puzzled and frustrated to find, after a period of 'drought' with respect to *EP-odd* submissions, that the papers submitted to the 1994 *EP-even* were very good, that they in no way diluted the quality of the journal into which they had been subsumed. It was even the case that a few of the "near miss" submissions, that did not quite make it into the conference, were capable, after some more work by the authors, of being turned into perfectly respectable *EP-odd* journal papers. It has been well established for many years that refereed journal papers take second place to refereed conference proceedings as the preferred mode of publishing within the Computer Science community. Our experience with *EP-odd* and *EP-even* leads us to suggest a blurring of the journal/conference distinction and to propose, in the final section of this paper, a new rôle for the year-end print run of *EP-odd*.

6. Electronic vs. print — an author's preferences.

Few people have the fortitude or the eyesight to read a lengthy academic paper from the display of a large-screen workstation, let alone from a small-screen laptop. Even if an online version of a paper brings added value in terms of animated graphics, video clips etc. there still seems to be a residual need for a predictable mapping of (at least a subset of) the journal's information on to the printed page[1]

[1] I recall with amusement a discussion in the bar, during a 1994 ACM conference on hypermedia, along the lines: "We are all wedded to the demise of the page and to multi-media presentations at conferences, so why do we sulk if we don't have printed conference proceedings to read in bed at night?"

In assessing the rôle of paper, and the stages at which one commits to this medium, it might be useful to reflect on practices employed in writing this present article, which was thought about and drafted at work, at home and on train journeys to and from London. The printed material I wished to refer to was carried around in my briefcase as follows (where authors of the corresponding material are given in parentheses):

(i) Two issues of *Ariadne* (Rowland, Harnad)

(ii) A soft-bound copy of conference proceedings (Brailsford, Garson, Harnad)

(iii) An e-mail draft and a LaTeX printout (Odlyzko)

(iv) Four offprints from the *EP-odd* archive (Brailsford, Dodd)

(v) Pre-print of a paper in ACM conference on hypermedia (Brailsford)

(vi) Photocopy of a report (Rawlins)

Locating this material caused me no problem, except in case (vi), as the following analysis shows. In case (i) the journal issues were light in weight and also sufficiently recent that they hadn't been lost; in case (ii) the convenience of having three papers of interest in the one volume, and its easy accessibility from my bookshelf, made up for the added weight in my briefcase; in case (iii) the printouts were, again, recent enough not to have been lost; in case (iv) the taking of a fresh set of 4 offprints from the *EP-odd* archive was no problem at all; in case (v) I was only interested in having access to my own paper at the ACM meeting, which did not justify the extra weight of the full proceedings, so I took my own online preprint version instead. Case (vi) caused a problem because it had been mislaid and was in any case available only as a photocopy (it was eventually located in a pile of similar photocopies on a cupboard shelf). That is to say, it was not available in a bound volume and not available online (though a Web search might have found it).

This example illustrates very graphically the advantages of having all reference material online, in one form or another, if only to make repeated offprints when existing paper copies become lost or illegible. So great is this need that I have started to use Adobe Acrobat Capture software to acquire electronic copies of paper-only archive material in PDF form. (Acrobat Capture is an OCR program which not only acquires text of a document from TIFF scans but also recognises the typefaces, line lengths, line spacings and page lengths in use, It then 're-typesets' the document into PDF yielding a full-text searchable FILE which is generally much more compact than the TIFF scan.)

To be fair, the advocates of the great new economic order in e-journals do not deny the need for paper offprints of the sort described above. What they do challenge is the continuing need for the appearance of expensive bound copies of a journal, either before or after the electronic version.

7. Electronic vs. print dissemination — the wider debate

A far-sighted report from Gregory Rawlins [Rawlins, 1992], reminds us, very forcefully, in its opening paragraphs of the huge social and economic changes brought about by the invention of the printing press:

> Over the past two decades printing, paper and transportation costs rose while their electronic counterparts: computing, electronic storage and communication costs halved roughly every four years. Both trends are expected to continue for two more decades.
>
> The last time something this radical happened was in the 15th century when the printing press used the newly available cheap paper to take over the manuscript market, throw scribes out of work, and explosively increase the number of available books.

> Print led to pagination, indices and bibliographies since they were now possible and they made searching easier. And that forced people to learn the alphabet so that they could use the new indices. Print increased literacy, democratized knowledge, increased accuracy, made fiction possible, made propaganda possible, created public libraries, and created the idea of authorship.
>
> Print also decreased the importance of memories — and their main possessors, the elders; loosened the hold of the Church and led to the Reformation; added fuel to the Humanist movement and led to the Renaissance by putting classical authors back in print; increased education, science and technology transfer; and created publishers.

It is not too fanciful to envisage similar profound changes in society being brought about by the Internet in general, and the World Wide Web in particular. But whereas the printing press virtually annihilated all previous technologies, it now seems clear that the printed word has a secure place, within some bigger electronic backdrop, for the foreseeable future. The 'paperless office' never came about; instead the blizzard of paper is relentless now that low-cost laser printers make it possible to get a printout of virtually anything. And we must not forget that it is possible to flick through a paper copy of a journal far faster than can be done with keyboard and mouse; paper is a light and flexible medium which can easily be angled to take maximum advantage of bad lighting conditions and which does not require any external power supply. Paper is here to stay — but almost certainly as a secondary rather than a primary, medium for the scholarly journals of the future.

Since so much of a publisher's pricing model for journals is bound up with printing, binding and distribution costs a spirited debate is under way about the economics and relative importance of bound paper copies of the 'hybrid journals' of the next few years. The issues are set out in two contrasting viewpoints from Fytton Rowland [Rowland, 1997] and Stevan Harnad [Harnad, 1997]. The debate also centres around the acceptability of pure e-journals and their perceived quality. One of the major factors here is peer review and we need to examine, in more detail, its relative importance.

8. The quality factor — is peer review sufficient?

The mechanisms for electronic dissemination of a peer-reviewed academic journal have been examined by Harnad [Harnad, 1994] who illustrates many of his points with reference to his own Internet-disseminated *Psycoloquy* journal. This paper was written at a time, in early 1994, when FTP was the best generally available technology for electronic dissemination of journal papers. Even so, he identified as a problem the common perception of the Internet as purveying only low-quality ephemera. This perception is now doubly underlined with the advent of the World Wide Web and its reputation, in many quarters, as being a vehicle for pornography, vanity publishing, exotic cults and celebrity trivia. Moreover, from a University standpoint, the moral degeneracy of the material pales into academic insignificance beside the fact that *it has not been refereed …*

It is certain, therefore, that peer review of any Web-based journal is *necessary* for conveying a sense of worth — but is it *sufficient*?

If recent experience in the UK academic world is anything to go by the answer is: "not yet"; anecdotal evidence from the recently-concluded Research Assessment Exercise in UK Universities indicates that assessment panels wanted to know the publisher of a journal, and its publication history, as well as being reassured about its peer review process. Interestingly, Computer Scientists, who might be expected to be most receptive to the idea of e-journals, had an assessment panel which was every bit as emphatic as other disciplines in requiring traditional, ink-on-paper, journal evidence — perhaps

Computer Scientists are more aware than most of how easy it can be to fake up bogus "reprints" from electronic-only journals.

All of this is not to say that pure electronic journals will forever be unacceptable in research assessment and tenure decisions, but before they achieve full respectability they have to provide adequate substitutes for the following attributes still enjoyed by bound journals:

1. A sense of 'archive' and 'continuity'.
2. A sense of worth conferred by high-quality paper and glossy bindings.
3. The protection from fraud (in the sense of replicating a complete issue of a prestigious journal with an author's rejected paper inserted into it) which is obtained because the technology for printing and binding, at high quality, is either not available to fraudsters or is uneconomic for them to use.

Academic and commercial publishers have made a start in addressing these issues for e-journals and hybrid journals but it needs some more time yet of continued Web presence by the reputable journal publishers — Cambridge University Press, John Wiley, Elsevier, Academic Press, Springer Verlag and so on — as a foundation of trust. In this transitional period the optional availability of current and archived issues, as either bound volumes or on CD-ROM, is yet another reassurance of stability. Any e-journal administered solely by an editorial board of academics, with no element of publisher involvement, still has to challenge the perception — no matter how distinguished the board and how impeccable the peer review policy — that it might all disappear from the Web overnight, either in some monumental disk crash or by the Editor-in-Chief walking off in a huff to take up some newly-tenured post at the University of Southern Antarctica.

Perversely, then, the residual attachment to what Harnad calls the "papyrocentric corpus" is precisely because its technology of high-quality bound-volumes, and the cumbersome and expensive distribution channels required to distribute them, are not available to the lone academic. Commercial publishers, and the more successful University Presses, do have these technologies and mechanisms in place — though in the latter case the robustness of the international distribution of printed products (or the lack of it) is every bit as important as a University's reputation when determining the perceived quality of its in-house press. Professors Brailsford and Harnad would be the first to testify to the spirited e-mail discussion when their invited papers (and those of other speakers), at a certain conference on electronic libraries, [Brailsford, 1994b] [Harnad, 1994] appeared via a less prestigious publisher than had been promised and in a less-than-helpful electronic format.

The current period of transition from conventional journals into e-journals and hybrid journals leads to an amazing situation where a paper [Odlyzko, 1995] may be cited in several ways — firstly as a pre-print, secondly by its inclusion in a reputable traditional journal and thirdly by its inclusion in an e-journal. The inescapable conclusion is that authors increasingly feel that they can handle their own pre-print electronic dissemination but still turn to conventional publishers for the expensive, bound-journal, 'seal of approval'. This cannot be a stable situation for long because commercial and learned-society publishers want to remain just that, i.e. disseminators of information in all the relevant media. They do not want to be downgraded within the electronic domain and relegated to being mere printers and distributors, simply because of their existing investment in these high-cost activities. In attempting to resolve these contradictions we need to examine the economics of e-journals and what Odlyzko calls "other perverse economic factors".

9. The economics of hybrid journals and e-journals

The 'electronic vs. paper' debate produces widely differing estimates about the cost savings that can be made by e-journals. On the one hand [Garson, 1994] we are told that production costs of e-journals will be at least 70% of traditional print-only versions and on the other hand [Odlyzko, 1997] that the fractional costs need only be 20%.

I do not propose to argue about the exact magnitudes of these percentages except to observe that the wide disparity occurs because their proponents are talking about two very different things. It is absolutely true that an e-journal can be produced at low cost provided that there is no necessity *even to contemplate* a high quality printed version at any stage in the future. Given these conditions Web journals can quickly use the present HTML approach, which amounts to tagged-text-plus-GIFs on a browser-based rolling autocue. Alternatively, authors can submit electronic copy, typically in Word, LaTeX, PostScript or PDF form, that is of pre-print quality and will not adhere to any particular journal style. This is exactly the sort of electronic pre-print service provided by Ginsparg's Physics archive [Ginsparg, 97].

If the electronic corpus has to be provided in a form compatible with present or future bound-journal publication (as in my own *EP-odd* journal PDF archive) the 'electronic' costs are much higher: copy editing and proof reading has to be undertaken; the author's submission has to be formatted into the standard journal layout; the new pagination may require diagrams to be relocated; 'widows' and 'orphans' have to be eliminated; diagrams of inadequate quality have to be re-scanned and passed through software such as Adobe Illustrator and so on. All of these need lengthy human intervention, costing time and money, which goes some way to explaining the 20%–70% disparity in cost estimates.

10. The rôle of university libraries

The University library, and the way that it is funded, are pivotal issues in analysing the future of paper journals and the prospects for success of electronic-journal subscription models. If the Information Society has caused publishers some heartsearching about what they are and what they do, the same is equally true for university librarians who increasingly find themselves merged into some Information Services strategy for a whole campus or group of campuses. It is likely that the Computing Centre and its staff, being the experts in the new dissemination technologies, will be heavily involved in any merged operation. This shift in balance between paper-based and electronic information in universities is complicated by the fact that, as Odlyzko points out [Odlyzko, 1997], the library budget is generally top-sliced from university running costs (the same often being true for the computing centre as well). Heads of academic departments may be given choices of which journals are to be cancelled, within some overall library budget allocation, but almost never are they given the option of taking their fair share of total library costs into their own departments to spend on books, e-journals and information systems staff as they see fit.

Here, then, is a key reason why the journal subscription model, though under severe pressure, still lingers on. It is because journal subscriptions are predominantly taken out by libraries and not by individuals. And while that remains the case the preferences of librarians for traditional vs. electronic media need to be taken into account. The impression I have is that librarians still feel most comfortable with traditional bound journals which they have been trained to acquire, catalogue and archive. CD-ROMs seem to be widely regarded as valuable for the end-users of that journal but a nightmare for librarians if they have to become involved in tutoring aforesaid end users, on library workstations, in the delicate arts of CD-ROM information access. The widely held view is that CD-ROMs should be kept on a 'jukebox' on some powerful journal-server, which is seamlessly integrated into the campus information network and thence to the Internet. This machine can then also act as the guardian of

any campus-wide electronic journal subscriptions to electronic journals.

11. Copy protection and piracy in the digital age

In his 1992 report Gregory Rawlins opines that copy protection will become all but impossible in the digital age [Rawlins, 1992]. Events have proved him right. To take but one example, papers in PDF format can be protected via a password which the journal subscriber has to key in to the Acrobat Reader in order to decrypt the material. Moreover the encrypted file can be set up in such a way that the end-user can read the material but is prevented from making further copies. Fine so far, but the weakness comes because the user *must* be allowed to make a hard-copy printout of the material. To disallow this would cause immediate cancellation of subscriptions. But once this is allowed it is trivial to trap the output PostScript and re-distil it back to PDF thereby allowing multiple further copies to be made.

Alternative copy-protection methods involve 'watermarking' the pixels of a bitmapped page, via various statistical techniques, which are undetectable to the naked eye but which allow the source of this pirated TIFF to be ascertained. The idea is that Web crawler software will trawl for watermarked TIFFs on the Internet; 'intelligent agents' will analyse the bitmaps and, in all probability, will then e-mail litigious letters to the offenders. Here again, the problem lies with the fact that not only are bitmaps low-quality cumbersome entities for Web distribution (having none of the compactness of HTML or PDF) but also it is all too easy to circumvent watermarks. Many of them are not, in any case, robust against photocopying and rescanning but in any case Acrobat Capture can now process the watermarked TIFF and re-typeset it, in either the original font or in some close substitute. Any bitmapped diagrams in the paper can always be re-processed in Photoshop to disguise their origin.

The depressing conclusion for publishers is that because electronic documents are indistinguishable from software, then e-document piracy will become at least as prevalent as software piracy. If this is to be the case then what new economic model will enable journals to survive and, most important of all, who will pay?

12. Subscriptions, page charges and micropayments

Harnad has recently [Harnad, 1997] summed up journal publishers' present subscription strategy as follows:

> Produce parallel print and paper editions, offering the electronic one for slightly less than paper and both for slightly more than paper, on the assumption that if and when the centre of gravity shifts to electronic only, the cost recovery model will stay the same

He then goes on to say that this strategy is non-viable and, in the long run, I think he may be right — though the reasons he gives for the strategy's ultimate demise may be masked by other considerations, not least of which are the 'perverse economic factors' and 'top-sliced funny-money' so prevalent in academe.

Essentially Harnad's thesis is that the journal subscription model was viable only as long as the sole mechanisms for bound-volume production and dissemination were expensive and generally confined to the publishing industry. The argument is that authors want to get their papers into good journals and yet they want these papers to be available *gratis, in perpetuum*. The cost of running an e-journal is smaller than for a traditional or hybrid journal, but in any event journals are niche-market products and so authors of accepted papers should be willing to pay page charges to offset the costs of putting the paper into print and/or up on the publisher's Web site. He also admits, somewhat ruefully, that he has long ago given up trying to predict the day of this page-charge Apocalypse!

The present transitional stage in journal publishing has many elements of Chaos Theory — a number of conflicting variables, very delicately poised, such that a small change in any of them could hasten, delay or even modify what seems to be an inevitable outcome. Journal Apocalypse prediction seems to be every bit as hard as exact weather forecasting. Consider the following conflicting factors:

- The page charge model has compelling logic behind it (just like the argument for top-up tuition fees in UK academia). But previous attempts to levy them have generally failed and though the argument is now stronger than ever nobody wants to be the first to insist on them (c.f. top-up fees, again).
- For the moment hybrid journals are far more popular than e-journals and so much of the subscription goes on producing the print version.
- Journal subscriptions are paid by libraries, not individuals. Any wholesale change in policy is bound to be tied up with complex issues of library staffing and top-sliced funding.
- Authors generally don't care whether their library has a subscription to the prestigious journal that has accepted their most recent paper. All they want is to be published in Journal X and for their work to be widely available. If subscriptions are deemed economically necessary by the publisher then the author's hope is that other institutions are still happy to pay up and keep the show on the road. If a tenure committee or research assessment panel demands a bound volume then some library somewhere is sure to have one.
- A traditional subscription ensured a high-quality master copy of a paper delivered to one place — usually the library. Photocopies of this original were clearly of poorer quality and distributing them (e.g. in the current UK inter-library loans mechanism) leads to delay. But a site licence for a publisher's e-journals, and hybrid journals, puts master-copy quality in the hands of the individual. Copy protection mechanisms are either ineffective or if not are fabulously expensive, military-grade, encryption solutions utterly at odds with the author's wish for widespread dissemination. Thus, one way or another, high-grade electronic copies of a paper will migrate from licensed to unlicensed sites.

The picture we have is of an ever-narrower subscription base supporting hybrid journals, with institutions being reluctant so far to give up the bound copy option and with the remaining subscribers being increasingly reluctant to foot the papyrocentric bill on behalf of everybody else. Meanwhile, publishers feel the need to make freely available on their Web sites the Title, Author, Keyword and Abstract information for accepted papers, in the hope of attracting new e-journal or hybrid journal subscriptions. But this same information can also be used by the researcher to track down the full paper, without any form of subscription, because it is increasingly likely that the author will have a Web-site draft pre-print version. Under these circumstances a researcher's local site licence for that journal becomes marginally useful only if the author's copy is unavailable for some reason. And if a site licence doesn't exist it's very likely that colleagues elsewhere will have access and would be willing to provide a single offprint for research purposes. This offprint can nowadays be cheaply scanned and processed via Acrobat Capture so that it takes its place in the researcher's personal, full-text searchable, corpus of reference material.

Faced with future unlicensed copying and distribution of papers, on a scale that makes present photocopying look minor league, what can publishers do to recover costs? If a robust system of Web-based micropayments was in place it is possible that the subscription model could be largely dispensed with. Researchers would find the papers of interest via the free abstracts and would then be invited to pay $1 (say) for delivery of the full version. If the cost were low enough then researchers would

certainly pay up, deeming it not worth their while to try obtaining a copy by the means previously outlined. The only problem here is that micropayments are, for the moment, an end-user nightmare. Special software has to be installed, digital cash acquired and at present only a few trial projects, such as COPINET, are in place. What is needed is for micropayment software to become 'part of the scenery' or, more accurately, 'part of Microsoft Office', so that everything is utterly straightforward and transparent to the user. Trials are currently under way of the SET protocol, which aims to make micropayments cost effective within existing credit card systems. Rumours also abound of some deal having taken place between Microsoft and David Chaum's Digicash company — which specialises in anonymous, secure, digital cash and is capable of supporting micropayments [Chaum 1985].

Once the reputable journal publishers have successfully transferred their high-quality journal image away from the paper Rolls-Royce into something like an electronic BMW then page charges or micropayments might provide a new economic model. But in the meantime are there any other transitional arrangements that could work? One such solution is under consideration for *EP-odd* and is described in the next section.

13. A new model for *EP-odd*

Although *EP-odd* has been a hybrid journal from the outset, and its entire archive has been converted to PDF within the CAJUN project, the Web availability of its material has been limited to just seven test papers. The low volume of its subscription base did not encourage any experiments with electronic subscription models. The proposal now is to make the eight volumes of the existing archive be freely available on the Web and, furthermore, to apply this policy also to accepted drafts of papers in the current volume. The costs of preparing the papers as PDF files is being absorbed within the CAJUN project for the moment but the investment of effort in getting them into this 'print ready' format will be tested by marketing each volume, at the end of a year, as a sort of yearbook i.e. containing not just the accepted papers but also a linking commentary, edited feedback on the papers from the Web site and so on. Something of this sort i.e. 'electronic first, bound volume later', is already being tried with the Springer journal *Molecular Modelling*, but still within a subscription framework. The novelty of our proposal is that we want to try satisfying the need for a bound volume with a compendium of 'what has happened in electronic publishing in 1997', sold more in the spirit of Conference Proceedings or Workshop Papers and at a price that is closer to an expensive textbook than a journal subscription.

The key point is that we want to add some extra features, and change the page layout a little, so that it is marketed more like a book than a journal, thereby exploiting a completely different economic model. The editors will opt for a yearly contract, modest up-front expenses, with royalties if, and only if, the previous year's book is a success. There is just a chance that this approach might work, navigating as it does between the Scylla of Harnad's journal apocalypse and the Charybdis of astronomical subscription fees taken from declining library funding.

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