Electronic First: The Upcoming Revolution in the Scholarly Communication System

Journal of Electronic Publishing

Volume 7, Issue 2: *Content Management*, Dec., 2001

DOI: https://doi.org/10.3998/3336451.0007.203 [https://doi.org/10.3998/3336451.0007.203]

There are still quite a few individual scientists and engineers who say they think there is no problem. Some are foremost leaders of their fields for whom meetings, visits, and preprint exchanges have short-circuited the library network. (They spend so much time above the clouds they never see the flood.) Most of the others are so far removed from the main stream that they are in no danger of getting wet at all.

J. C. R. Licklider (1965: 1046).

There has been much written on the scholarly journals crisis, and more written on solutions. In this paper, we'd like to create a metaphor for understanding the scholarly journals system as it stands now. We hope that our metaphor will give us access to a solution. The motivation for this comes from hearing some scholars speak about the scholarly communication crises in terms of another well known and worn metaphor, a Darwinian notion of the "survival of the fittest." For some, it would seem, the elimination of smaller niche journals and the dominance of the big commercial presses and big society publishers is nothing more than an evolutionary shakedown in the publication industry. For them, the current crisis represents a necessary purge of the system to eliminate the weak titles that cannot survive in today's competitive environment. Not surprisingly, those who speak this metaphor are often associated with the larger journals with little to fear from the monopoly scholarly presses.

Of course, Darwin never used the phrase "survival of the fittest." Darwin spoke more of ecological balance, of the creation and occupation of niches in local ecosystems, and of the need for variety than he ever did survival of the fittest. It is this alternative Darwinian metaphor that we'd like to apply to the scholarly journal system.

Ecosystems are fragile. Imbalances, like the disappearance of even a single small organism, can lead to disaster. These imbalances and disappearances (or extinctions) can be caused by normal environmental processes and readjustments, by external interference by organisms — parasites in some cases — penetrating the fragile ecosystem and overtaking the ability of denizens to adjust, or by simple dominance by a single organism. Which process underlies an ecological shift or crisis determines the response that needs to be taken, if any. If it is a normal readjustment, as when forest fires purge growth to recreate fertility conditions, then little should be done. However, if a parasite invasion or a runaway organism is causing an ecological crisis, thoughtful management of this crisis is called for.

The current scholarly communication system is not going through a "survival of the fittest" shakedown. Rather, the system has been thrown out of balance by the over-dominance of a few large organisms that have lost their ability to adapt. While these organisms have in the past been functional in the ecosystem, now their size and age has left them unable to respond quickly to environmental changes. A result of the inherent inertia of these lumbering organisms is that current changes are seen as a threat rather than an evolutionary opportunity. So, rather than responding with a proper adaptation to the new opportunities, these organisms are responding by desperately trying to maintain the old conditions. As a result of this interference, the organisms are creating conditions that threaten the entire ecosystem with collapse.

The fragile ecosystems metaphor seems useful for introducing some new questions for exploration. The current system is, as many have said, in a state of impending collapse. New technologies have created new opportunities for evolution. Yet the traditional organizations that have thrived for so long deny the possibility of evolutionary reform. These organizations prefer the old conditions and the old technologies. Because they are so powerful, they are able to block evolutionary progress. They impose their outdated systems on us at the risk of collapsing the entire system.

Ultimately, we cannot allow the evolution of scholarly publication to be halted by those most threatened by current opportunities. We need to recognize the incredible potentials presented to us by information technologies and move forward from that recognition to support innovators who seek to develop new alternatives. We are not asking for a leap of

faith here. Information technologies have an established record in other industries. And even now, we can say with little equivocation (because of some accumulated experience) that information technology can change our system so drastically and quickly that Darwin's evolution could be termed revolution.

This fast evolution, this revolution, is happening. We have not yet recognized the struggle for survival currently being waged. This struggle is a political/economic one (and not a technological one per se) that pits the old lumbering organizations scrambling for survival in a changed environment against the new, high-speed production houses that are set to emerge into the scholarly publication landscape.

A Call To Arms

We believe that e-publication offers a way to bring a new equilibrium to the scholarly publication ecosystem. We must move beyond our use of past models and develop new ways of thinking about the scholarly communication system and, indeed, new systems unencumbered by the conservative weight of traditional mechanisms of publication. Although it may seem overly optimistic to some, we must recognize that most of the glimpsed potentials of electronic publication have yet to be realized. As Bjork and Turk (2000) point out:

> The current mainstream scientific-publication process has so far been only marginally affected by the possibilities offered by the Internet, despite some pioneering attempts with free electronic-only journals and electronic preprint archives. Additional electronic versions of traditional paper journals for which one needs a subscription are not a solution. A clear trend, for young researchers in particular, is to go around subscription barriers (both for paper and electronic material) and rely almost exclusively on what they can find free on the Internet, which often includes working versions posted on the home pages of the authors.

We must have confidence that technology offers a way forward. We need to learn to see beyond the horizon imposed by traditional publication systems and assess the extent to which new systems of production, unencumbered by traditional assumptions, can move the system out of the current financial morass we find it in. The authors of this paper have considerable confidence in the potentials for revolutionary reform. This confidence comes from having worked for the past few years on developing alternative systems of scholarly publication that are, what we like to say, *electronic-first* as opposed to *paper-first* systems. We believe our systems offer a workable alternative to the top-heavy paper first systems normally used as models for judging the potentials of electronic scholarly publication.

The distinction between paper-first systems and electronic first systems is important because how you think about the publication process and the point from which you start has considerable consequences for the process that emerges at the end. Traditional publishers are paper-first, as their publication process is geared towards producing typeset print publications. Producing paper has always been a complicated and time-consuming process. These inherent complexities have continued even as new technologies have brought potential simplifications. Now publishers may use Standard Generalized Markup Language (SGML) and stylesheet languages such as Document Style Semantics and Specification Language (DSSSL) to transfer SGML to a form suitable for printers. Yet the potential cost savings and efficiencies may not been realized because the newer technologies tend to be tacked on to existing infrastructures or applied in inappropriate ways.

One of the authors heard a speaker at the Canadian Association of Learned Journals annual executive meeting three years ago who said that the University of Montreal Press used multiple DTDs to process their documents. They had DTDs for initial markup, DTDs for a print stream, DTDs for the electronic stream, etc. Each DTD reflected what had been done on paper for each process. Each new technological innovation was not met with a restructuring of the organization or publication process to take advantage of new technologies. Rather, each new technological innovation added to the cost because it was tacked on to the traditional processes. That this should happen is perhaps not surprising, given the inertia that is present in large organizations. But it does make the point. Organizations that start with a paper-first process bring with them the institutional memory and production processes appropriate for a print-only world. This affects how they adopt (and perhaps even if they adopt) new technologies.

"There can be little doubt that publishing a journal with the aid of advanced information technology reduces cost"

Electronic-first organizations do not bring with them this institutional baggage, nor do they bring the complexities of print. They start with an electronic version of the document, and because their processes are so new, they are able to modify them as new technologies become available. This flexibility is extremely important since new technologies (like XML) continue to develop at rapid rates. As new processes are developed and new formats emerge, they may be incorporated into the publication flow and the processes may be changed or dropped as appropriate. Changes are made even easier by

the fact that the goal from the start has been getting a perfectly marked-up electronic version. They do not think about the visual or formatting requirements of print or HTML or PDF. The document must be in an adequate electronic format first. Output formats are another process; they separate the document from its presentation. By focusing on the electronic version, they can ensure that output formats can be added quickly and easily (using various SGML conversion technologies). A paper format can be created as easily and as cheaply as an HTML version from the electronic document. All that is required is another stylesheet. No DTD transformations or additional publication paths are necessary.

Two organizations are taking leadership in electronic first. One is the International Consortium for the Advancement of Academic Publication [http://www.icaap.org/] (ICAAP) which, in the few years since its inception at Athabasca University, has developed some unique approaches to electronic scholarly publication that significantly undercut current cost estimates for the *production* of electronic scholarly journals. The ICAAP system, which we will discuss in more detail below, is based on an intelligent and streamlined use of SGML typesetting and document production technologies and creative programming solutions to some of the problems associated with electronic publication of scholarly journals.

The other organization is represented by the commercial startup, BlueSky. [http://www.blueskyscholars.com/] This company, owned and led by scholars, has developed software that eases the burden of managing a journal's editorial paper flow. The software allows significant cost reductions in the labor-intensive and time-consuming process associated with the peer review at the same time that it adds significant statistical and data mining capabilities. These data mining capabilities help editors understand the review process and extract useful information about individual items (papers), submission rates, rejection rates, reviewer performance, etc.

Taken together, ICAAP's production innovations and the Bluesky system editorial and content management software provide a complete publishing solution that not only cuts current production costs by at least 50 percent, but also provides significant opportunity for adding value to the scholarly publication in ways currently not possible with traditional presses. Before going into detail about the systems at BlueSky, we will review of the cost structure of scholarly communication to gain a better insight into the way BlueSky has attacked the problem of high-cost scholarly publication.

Journal Costs Reviewed

Although there are those do not believe that e-publication can lower the cost of scholarly communication, we believe there can be little doubt that publishing a journal with the aid of advanced information technology reduces cost. Even editors of traditional print journals will admit that introducing information technology into the loop results in substantial savings. Steven B. Silvern, editor of the *Journal of Research in Childhood Education,* said in 1987 that the introduction of electronic page processing cut production time and costs from between 25 percent and 50 percent for his journal. The editor of the journal *Hispania* noted savings in postage, document processing, photocopying, editorial time (including a more streamlined reviewer selection process facilitated by a key word look up of *curricula vitae*), costs of manuscript preparation, and space with the move to a completely paperless editorial office (Irizarry, 1993). Jane Lago (1993) of the University of Missouri Press also introduced an electronic system into the editorial office and reported savings of between $500 and $1,000 USD per manuscript! These are not insignificant cost reductions. What is perhaps most interesting is that these are savings that accrued before the current wave of Web-based e-publication got started.

If those early attempts to streamline the publication process and save dollars could be successful, we can reasonably expect that more recent technological advances and the move to full electronic publication (which has been made possible by the new Internet technologies) can win additional savings.

However, estimates of the cost savings of publishing material in electronic-only format vary from no change over paper-based publication costs to 75 percent (Duranceau, 1995; Garson, Ginsparg, and Harnad, 1994). A number of factors probably contribute to the variation. One is the requirements of different disciplines in scholarly publication. The cost of publishing humanities journals, where typesetting does not require complex tables, mathematical equations, graphics, and special characters, may be lower on average than the cost of publishing chemical journals, for instance (Garson, Ginsparg, and Harnad, 1994).

Another factor may be that unwieldy and top-heavy paper systems, when converted to electronic systems without careful thought, become unwieldy and top-heavy electronic systems. Such conversions are often due to organizational inertia, and an unwillingness to tackle a thorough restructuring to take advantage of electronic-only publication. In an ironic twist, such conversions actually undermine the innovative potential of e-publication by imposing a set of antiquated rules and procedures on a potentially revolutionary system of publication. The net result is an increase in the cost of scholarly publication.

We can perhaps get a better handle on the situation if we consider the various processes that are involved in the construction of a paper journal. That will help better explain where an organization like BlueSky can tackle the costs. Table 1 shows the elements of journal production and their percentage of the total cost of journal production. The italic items would be immediate savings in e-publication, because they are artifacts of the print publication process.

Table 1: Estimated Costs of Journal Production, 1975

Expense	**%**
Editing Labor	25
Typesetting	25
Printing Labor	*25*
Paper	*10*
Postage	*10*
Other	5
Total	100

Source: Metz and Gherman (1991) derived from Economic Consulting Services Inc., "A Study of Trends in Average Prices and Costs of Certain Serials Over Time," report to Association of Research Libraries, 1989.

Printing, Paper and Postage — The Basic Savings

Basic savings can be introduced with the use of information technologies.

- The cost of paper and postage for peer review is eliminated.
- The cost of paper and postage for library subscriptions is eliminated.

Importantly, the technologies for distribution have evolved considerably over the past few years, and options continue to proliferate. Editors can now choose basic HTML, new e-book formats, and even professionally typeset PDF documents.

Printing costs (which *do not* include typesetting labor) are also a substantial portion of the total cost of producing scholarly journals. Printing includes the labor costs associated with the printer's work as well as paper and ink costs. As with postage, printing costs are eliminated with electronic-only journal publication.

> **"Traditional publishers may fail to see the true potential of information technology"**

If we were to stop here and consider only paper, postage, and printing, we have what we consider a conservative estimate of the total savings associated with electronic publication. We say conservative because the savings seem to flow automatically from the elimination of certain hard-coded journal costs. That is, if the paper versions of journals were scrapped and electronic-only publication introduced, then we would expect to see up to a 45 percent savings (10+10+25) over the cost of producing a paper-based scholarly journal. All other things being equal, moving to full electronic publication would in and of itself ensure a revolutionary transformation in scholarly publication costs.

However, the cost savings noted above assume that publishers, in the move from paper to electronic publication, drop the paper system altogether. This is an important assumption, since we believe that attempts to integrate an antiquated paper-based system of publication with electronic publication will not net cost savings. In fact, we are likely to see cost increases (as many publishers have reported) simply because it is so difficult to integrate two entirely different systems of publication and because there is a reluctance to give up traditional assumptions and traditional top-heavy publication systems.

However, in order to achieve cost savings in print as well as electronic, publishers have to retool and establish an electronic-first process. Only then will the efficiencies inherent in e-publication of scholarly material become evident and transferable to the paper process.

Typesetting and Editorial Labor

After printing, paper, and postage costs are eliminated, we are left with only editorial labor (including peer review labor) and typesetting. These last two components account for 50 percent of the total cost of scholarly publication. Because the weighting is so heavy here, any change in the way these two final components are carried out will have a significant

impact on the final cost savings associated with electronic publication. It is with these final two components of the scholarly journals production process that ICAAP and BlueSky have focused research and development.

The processes that we have developed through ICAAP and BlueSky offer significant savings in both of these areas. For its part, ICAAP has developed streamlined typesetting processes based on in-house implementations of the SGML. BlueSky has focused on developing sophisticated software to assist in the editorial and content-flow processes associated with peer review (manuscripts, reviews, feedback, form letters, etc.). Together these systems offer a unique approach to producing scholarly content that is not encumbered by traditional assumptions or conceptual limitations. As a result of this conceptual freedom, these systems represent a significant revolution in the way scholarly journals are produced.

Typesetting and Production

ICAAP's production system is based on its own SGML implementation, ICAAP eXtended markup Language (IXML). Given the proliferation of "MLs" it is worth exploring the relationship between SGML, the propriety IXML, HTML and other markup languages.

- SGML is basically a set of language rules that people can use to develop markup systems that allow humans to identify text in a way that computers can understand.
- HTML, IXML, and other MLs are implementations of these rules that are designed to meet the document-processing needs of various user groups.

Most of us are familiar with the basic SGML rules. Use angle brackets to create tags to contain text (e.g., `<P>`). Specify the order in which tags can appear (e.g., `<BODY>` follows `<HEAD>`). Specify exclusions (e.g., `<HEAD>` elements cannot be contained in `<BODY>` elements). SGML provides only the grammar necessary to create the markup language. How we implement that grammar is up to us. SGML grammar can be applied to multiple ML systems. These systems can be general and designed to meet the needs of a large community (e.g., those who are creating Web pages, who often use basic HTML) or specific and designed to meet the needs of a smaller, more specialized, group of individuals (e.g., scholars).

Because of SGML's central role in text processing, it is a critical component in any journal-production system (Sosteric, 1999). This is so for the simple reason that SGML makes it easy for editors to specify, in language computers can understand, the types of transformations and operations required. SGML is basically a way to encode complicated and variable language rules in an unambiguous fashion. The net result is that SGML makes it easy for computers to exchange and operate on texts. This brings the benefits of computer processing (already present in other areas of human endeavor such as CAD/CAM production) to the written word.

When text is marked in SGML or its derivatives, the purpose of a particular piece of text is made explicit enough for machines to understand, without ambiguity, how to process it. HTML, for example, allows a human to tell a computer software program (such as Netscape Navigator) how to handle text, using an agreed-on set of definitions. `<BLOCKQUOTE>` tells the computer that the text is to be indented left and right. By tagging paragraphs with a P tag, quotations with a `<BLOCKQUOTE>` tag, etc., the browser does not have to guess about how to handle various document elements. It knows without doubt to format the text contained in the `<BLOCKQUOTE>` tag indented left and right. And it would know this regardless of the language or dialect. HTML thus simplifies the representation of text so that the machines can understand it. Without the tagging, it would be impossible for a typical Web browser to apply consistent style and typesetting information.

We all know that users do not normally view HTML code. HTML, or any SGML implementation, requires rendering in order to be useful to non-machine users. Web browsers provide this rendering for HTML. However, HTML rendering is not always the final output of an SGML document. Because the document is already tagged in a form useful for machine processing, other processes and document conversions are made possible. The multiple processing options can be thought of as either cross conversions or down conversions.

In cross conversion, a document is converted from one SGML tagging scheme to another — SGML to ICAAP's IXML, for instance. In down conversion, the rich SGML-based tagging is converted to a simpler tagging — for instance for Adobe Postscript, PDF or word-processing programs. In down conversion a lot of information is lost, and it becomes impossible to convert back to an SGML-based markup automatically. Cross conversion usually occurs when organizations exchange SGML tagged documents. ICAAP may, for example, submit its journals to an online indexing service. That indexing service may have its own SGML DTD to standardize the indexed articles. Down conversion normally occurs on the path to creating a human-readable representation of the document.

Consider for example the down conversion of an IXML AUTHOR tag to Microsoft Word display format. In IXML, a document's author is indicated by a container that includes the author's bibliographic and location information.

Figure 1: IXML Authors

```
<AUTHOR>
<NAME>
<FIRST>Mike</FIRST>
<LAST>Sosteric</LAST>
<HONORIFIC>Dr.</HONORIFIC>
</NAME>
<ADDRESS>
<EMAIL>mikes@athabascau.ca</EMAIL>
<DIVISION>ICAAP</DIVISION>
<DEPARTMENT>Global and Social Analysis</DEPARTMENT>
<ORGANIZATION>Athabasca University</ORGANIZATION>
<POSITION>Assistant Professor</POSITION>
<CITY>Athabasca</CITY>
<PROVINCE>Alberta</PROVINCE>
<COUNTRY>Canada</COUNTRY>
</ADDRESS>
</AUTHOR>
```

Converting this information to Word's RTF format, while very easy, means the absolute loss of all semantic and structural coding.

Figure 2: The Loss of Structure

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Getting the information out of the IXML document and into the non-tagged
presentation format in the Word document is much easier than putting the information back into SGML. How is the machine to know, for example, that the word "ICAAP" represents the organization that the author works for? In IXML, that information is easy to extract. In the Word document, not so. To get it at all, we would have to apply complicated and

error-prone algorithms that would test for the presence of bold and italic codes, compare the location of the "ICAAP" text to see if a word like "department" followed it, etc. Although not impossible, up-conversion is very difficult and error prone. The same cannot be said of down conversion. It is very simple, very robust, and relatively easy to accomplish.

This ability to do cross or down conversion is the key power of SGML. It is also why a document marked up in a good SGML implementation is considered an archival document. Because SGML is a simple ASCII format (and thus easy to interpret), and because the document components are visibly marked, it will always be relatively easy to convert SGML to other formats. The same cannot be said when documents are stored in presentation formats or propriety systems like Adobe PageMaker. Future changes in format and software advances may render obsolete the stored electronic text. What's worse, texts may be rendered inaccessible as software companies drop support for older document formats.

Publishers know how to prepare materials in SGML and convert them to output formats. Typically, a production house will have its own propriety SGML implementation and its own set of conversion scripts. In a print publication house, conversion to printable format is often accomplished using the DSSSL conversion language. [1] [#fn1] This programming language allows publishers to convert SGML to any known output format (like PDF, RTF, etc.). During the conversion, page layout and formatting information is applied to the documents and structural information is discarded. DSSSL is a complicated and highly specialized conversion language requiring a high degree of skill to master. However the principle labor costs are up front in the initial design of the conversion templates and scripts. After the initial scripts are constructed, scripts typically require infrequent maintenance and extension work.

> **"Even small efficiencies in the peer-review and editorial process can realize significant benefit"**

Other conversion strategies are also possible, especially when dealing with electronic documents. More recently, a new and easier-to-understand document stylesheet language known as the Extensible Stylesheet Language (XSL) has been introduced along with the simplified SGML markup specification, XML. These two related technologies attempt to make DSSSL and traditional SGML more available. Since SGML and DSSSL are processes that require high levels of skill and highly specialized knowledge, vendors and groups interested in distribution of texts (scholars, Web authors, etc.) have been slow to pick up the technologies and implement them. XML and XSL are typically easier to use than full SGML systems and retain much of the archival and conversion power.

ICAAP uses SGML and general-purpose programming languages to parse and convert IXML documents. By developing our own SGML implementation, and writing our own conversion scripts, we have gained a detailed understanding of what is possible in the realm of scholarly publication. And we use our own SGML implementation with excellent results. Initial document markup takes only a few minutes (normally less than fifteen), after which output into multiple formats (including PDF, HTML, DHTML, CD-ROM formats, e-book, etc.) is almost instantaneous. In addition, bibliographic information can be extracted and submitted to indexing services, abstract information can be cataloged and browsed, and multiple forms of meta-data can be generated with little or no human intervention.

Using SGML systems, the cost of producing multiple output formats, multiple meta-data submissions, and multiple indexes is a fraction of what traditional publishers claim for article costs.

So what is the additional savings represented by an electronic-first SGML publication process? Our conservative estimate, based on our experience publishing a number of wholly electronic scholarly journals, pegs the savings at about 50 percent over the multiple SGML, top heavy, paper-first systems of journal publication. Our cost per article is about $50.00 CAD. Since 50 percent of 25 percent (the original estimate for typesetting labor) is 12.5 percent, our total cost savings so far is 45 percent plus 12.5 percent or 57.5 percent over paper-based publication. It is important to note that this does not signal a reduction in output options or flexibility. Multiple document outcomes, multiple bibliographic transformations, and even sophisticated document interactivity are simple and inexpensive to implement.

Editorial Labor

In addition to revolutionizing the production of journal articles, information technologies can also impact the scholarly journal back-office workflow. This workflow begins when an author submits a manuscript for consideration and ends when the article is finally sent for production. Between submission and final production, the manuscript must be registered in the journal's own manuscript tracking system, reviewers must be selected, the paper must be sent to reviewers, reviewers must be nagged to complete reviews, comments must be archived, revisions checked, multiple

acknowledgements sent and received, etc. Recall from Table 1 that this process accounts for 25 percent of the total cost of a scholarly journal. It is not atypical for journals to require a full-time managing editor (plus assistants) to oversee the administrative functions associated with peer review.

According to King and Tenopir (1998), the set-up cost per article for receiving, processing, and reviewing a manuscript is approximately $230 USD. Assume a typical journal receives 500 original submissions a year; editorial work will cost at least $100,000 USD a year.This cost is fixed. It is incurred regardless of the destination format (print or electronic) of the paper and — all things being equal — e-journals end up costing as much as print journals because of this fixed cost. This view is consistent with other estimates that have returned high first-copy costs (Fishwick, Edwards, and Blagden, 1998).

> "The machine works on weekends and at night"

What does this mean for the electronic journal? Basically, it means that e-journals begin to reduce the cost over print journals only when the number of subscriptions is high. Because first-copy costs are fixed, the smaller a journal's subscription base, the greater percentage of the total cost of the journal is taken up by the back-office (first-copy cost) processes. For journals with a subscription base under 1,000, 90 percent of the cost of producing that journal are editorial and composition work (Fishwick, Edwards, and Blagden, 1998). It is only when the subscription base goes over 1,000 that this high percentage begins to drop. When it reaches 10,000, Fishwick, Edwards, and Blagden say, editorial and composition work drops to 50 percent of the cost of producing the journal (Fishwick, Edwards, and Blagden, 1998). It is only at that point that savings associated with electronic journals (no paper production) can be realized. Unfortunately, since most journals have small audiences, most journals fail to see significant cost savings from e-publication. Table 2, from the Fishwick, Edwards, and Blagden article, compares three forms of scholarly publication — print only, electronic only, and a combination of the two.

Table 2: Illustrative annual costs of quarterly journal

			200 pp 23.5 x 15.5 cm
	All print on paper	**All electronic**	**50% split**
Origination or first copy costs (fixed)			
Editorial work	55,000	55,000	55,000
Composition	35,000	40,000	40,000
Marketing, promotion and sales overheads	15,000	20,000	20,000
Total	105,000	115,000	115,000
Incremental costs (average per copy)			
Physical distribution	8.00	1.00	4.50
Physical reprint	8.00		4.00
Total cost at subscription numbers			
1,000	121,000	116,000	123,500
2,000	137,000	117,000	132,000
5,000	185,000	120,000	157,500
10,000	265,000	125,000	200,000

Fishwick, Edwards, and Blagden break the first copy costs of scholarly publication into editorial labor, composition, and marketing costs. As we would expect, no savings are recorded for editorial labor in the electronic realm. Curiously however, marketing costs and composition costs (copyediting) go up with "electronic only" or "electronic+paper" publication. It would seem reasonable to suggest that these costs should remain the same between paper and electronic journals just as editorial work remains the same. The authors believe that the rise in cost for electronic+paper recorded in Table 2 implies that the organization is adding processes in for electronic publication.

Fishwick, Edwards, and Blagden also report higher promotional costs for e-journals than has been our experience. The higher promotional costs may be associated with the need to establish e-journals in the market. Presumably, the extra costs would disappear as the e-journal became established and well known in its marketplace. Another factor is, as we suggest, that organizations fail to properly exploit information technology. We will not address what we believe to be marketing and composition inefficiencies implied by Fishwick, Edwards, and Blagden. Instead we will focus our discussion on the 55 percent of the total back-office costs associated with administration of the peer-review process.

Given that so much of the cost (25 percent of the total cost of publication, as indicated in Table 1) is tied up in the editorial back office, a critical question becomes how to use information technology to create efficiencies. Obviously, even small efficiencies in the peer-review and editorial process can realize significant benefit. Several organizations have addressed this problem. Pope and Miller (1998), for example, discuss their own in-house solution to the inefficiency of the scholarly journal back office.

> With the automated peer review system, all clerical steps (e.g. acknowledgement of receipt of a manuscript, nagging and prompting messages) are substantially faster. The machine works on weekends and at night. The sending out of prompts, reminders, and acknowledgements is not constrained to "normal business hours." In an international working environment, immediate response to incoming messages and commands can save several days as delays due to incongruent time zones are avoided. The software has no "time zone" . . .
>
> Database entry is minimized as the authors and the software do the bulk of this. All standard clerical steps — acknowledgements, nagging, prompt — are automated. No paid staff are required to do these tasks. All correspondence is conducted by e-mail, and is therefore free. Formatting, for both copyediting and publication, are done by software. Printing and distribution costs are eliminated, as *Conservation Ecology* is published only on line.

Pope and Miller argue that their automated article entry and peer-review system has netted their journal, *Conservation Ecology,* considerable savings by allowing them to streamline the editorial process. And although they admit they are unable to accurately quantify the savings because the software is still under development, Pope and Miller say that it is clear that they are realising savings through the software. Most importantly, they are saving time even despite the fact that they have had to add quarter-time system support and half-time production support. Pope and Miller's system is a useful model — but more could be done.

Commercial software and services that can track manuscripts through the editorial process and automate the routine editorial functions are available. PaperPath (now defunct), Scholar One, [http://www.scholarone.com/] and Rapid Review [http://www.rapidreview.com/] have promoted their respective systems for the past year or so. After an initial setup and customization process, these systems allow authors, editors, and reviewers to access original and revised manuscripts, comments of peer reviewers and editors, and information on manuscript status and its final disposition, all on line. These commercial systems, although requiring non-trivial setup and customization costs, are priced to lower costs substantially over the traditional paper-centric editorial process.

The costs of these systems range anywhere from $15,000 a year to $65,000 USD, depending on the features and level of customization required. These costs include one-time setup and customization, as well as the regular licensing and maintenance fees. These costs may not faze larger journals with a large subscription base and sufficient cash flow, but small journals with 200 or fewer submissions a year and a small circulation may find that the setup and retooling costs, plus ongoing maintenance, is prohibitive.

Because so much of the first copy costs of journals are tied up in the editorial back office, a solution that is accessible to all sizes of journals is clearly desirable. The authors have such a solution. We have been working on an editorial back-office system that is easy to use, easy to customize, and inexpensive. Although the intent is to create a commercial organization (www.blueskyscholars.com [http://www.blueskyscholars.com]), the technology will also be offered free to small niche journals through the ICAAP Web site (www.icaap.org [http://www.icaap.org]).

Although this is not the place to go into detail about this system, it is appropriate to make a few comments. Based on our experience using the software for The Craft, [http://thecraft.icaap.org/] we can see considerable cost savings in managing the editorial back office. Papers are submitted, along with all relevant meta-data, and editors are notified immediately of the new submission. Because a list of reviewers is already in the system, it takes about five minutes to notify reviewers of an assignment. As with other solutions, the system then takes care of nagging reviewers, tracking reviews, and notifying authors of decisions. The editor normally intervenes only to make an editorial decision and move the article into the production stream.

Although our system is relatively new, we believe that a conservative estimate of the cost savings for this fully automated back office system is about 50 percent over the traditional cost. Since 50 percent of 25 percent (the original estimate for editorial work) is 12.5 percent, the total cost savings for a fully electronic journal would amount to 57.5 percent (the

original savings + SGML) plus 12.5 percent for a total savings of 70 percent. And, since our system is inexpensive, savings are immediately transferred even to the smallest niche journal.

The Road Ahead

As we noted in the beginning of this paper, there is a tendency among some to accept the current state of affairs in the scholarly communication system as an inevitable step in the evolutionary shakedown of the system. According to this view, small niche journals are on their way out because they are too weak to survive. However, as we pointed out, there is an alternative Darwinian metaphor that can be drawn on to understand the current crises. This alternative metaphor puts the real strength with the smaller journals who are able to adapt and adopt new technologies swiftly, and suggests that it is the larger organizations and larger journals which are the real weak links in the current system. Using this metaphor, we see the system is indeed in danger of collapse — but it will be a collapse brought about by the weight of the lumbering print-based organizations who cannot or will not adapt to new technologies.

Which metaphor is the correct one, the Survival of the Fittest or the Evolutionary Shakedown? Probably neither captures the whole truth of the situation. Reality is usually more complex than our shorthand metaphors. Currently, traditional organizations are moving to adopt and advance new technologies. In turn, newer organizations may look to traditional organizations for guidance and direction on implementation and strategy. The point in evoking this metaphor is not to condemn traditional organizations or glorify new ones but to suggest that we need to think more deeply about the current scholarly communication crisis if we are to overcome that crisis.

We believe most scholars see a future where scholarly journals continue to play a vital role in the dissemination of scholarly research. Scholarly journals provide too much added value to be discarded. However, what the exact nature of these journals will be is an open question.

Still it is clear that things have to change. We have argued in this paper that change, rather than having already run its course, is only just beginning to affect the scholarly communication system. This change will accelerate as new technologies emerge and existing technologies (like XML, for example) evolve further to meet the needs of the world's document producers. It will be up to us to ensure that we are able to successfully apply these new technologies as they emerge.

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Notes

1. More information on the DSSSL language can be found at http://www.oasis-open.org/cover/dsssl.html [http://www.oasis-open.org/cover/dsssl.html] [#fn1-ptr1]

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