J. Webster (ed.), *Wiley Encyclopedia of Electrical and Electronics Engineering*

PROFESSIONAL JOURNAL ARTICLES

Professionals and scholars communicate with each other and with the public in a variety of ways, both formal and informal. The *informal* means are myriad: in person, by phone, by email, chatrooms, conferences, exchanges of work in progress, and so forth. The four chief means of *formal* professional communications are conference proceedings, journals, books, and reference works. In addition, trade magazines and trade newspapers are increasingly important communications media in electrical and electronics engineering.

Proceedings feature presentations prepared for a specific conference. These papers, generally prepared in advance of a meeting and rarely edited, often are the engineer's first presentation of a discovery or an application. To be published in a journal, this work must be polished and documented, perhaps further researched. Although journal articles are expected to be state-of-the-art work, they must also be rigorously substantiated and carefully drawn. Once scholars have tried out their work in journal articles and had the benefit of responses, either published or unpublished, they may be ready to compile their information for a full-length book or a chapter in a multiauthored book. Whereas journal articles are expected to be original, books generally present established ideas or practices. Reference works, such as encyclopedias or other compendia, distill the established work further into material that will serve as a longer-term guide for a broader audience. Trade publications, particularly in fields that are changing rapidly, deliver technology summaries, information on new developments, and pointers to other work. They are, however, less rigorous than professional journals.

This article addresses journal articles, the purposes they serve, their components, how they are selected, and how they are produced and disseminated. Although it is not a how-to guide to writing journal articles, the author hopes that it will be helpful to aspiring authors, researchers, and practitioners as they evaluate the literature they read and develop their own contributions to the engineering literature.

Journal Literature Media

Until the mid-1660s, scholars communicated with each other in correspondence, often forwarded from one to another, to share new discoveries and queries. In early 1665, almost simultaneously, the first two scientific journals were published. In France, the Académie des Sciences published the first issue of *Journal des Sçavans* in January, and in England the first issue of *Philosophical Transactions of the Royal Society of London* was released in March (1). From that point to the late twentieth century, print journals were the sole delivery medium, although electronic abstracting and indexing services came on the scene in the mid-1970s.

Print Journals. Advances in technology made print journals possible in the late seventeenth century. More than 200 years had passed since Gutenberg first adapted an olive press to use movable type for printing. Not only had printing progressed; improved roads and efficient postal systems made dissemination easier. In the three intervening centuries, technological discoveries have continued to enhance the production and distribution of scholarly and technical journals. Today, many engineering journals are published in four-color process on glossy paper, and they look remarkably like consumer magazines. Because of improvements in

production and mailing procedures, they also reach their readers more quickly, albeit not as quickly as many would like.

Print journals continue to be the preferred medium for professionals and scholars, despite many predictions that electronic journals will totally replace them (2, 3). Their portability and ease of use are two reasons. To read a journal in print requires no electricity, equipment, or training. In addition, Schaffner (4) noted that the order and format of the printed page—abstracts, heads and subheads, references, and so forth—help the reader absorb the content. The electronic journals available as we approach the twenty-first century do not offer the same tactile pleasures of holding paper, scribbling in margins, underlining, and generally making the content your own. Further, as Lieb (5) said, print journals emphasize community building and dialogue with letters to the editor, essays, book reviews, and other general information that are still missing in electronic journals in the late 1990s. He suggested that electronic journals are currently more mausoleum than salon, despite their potential for much greater interactivity.

Electronic Journals. Moving journals into electronic media opens up many possibilities for interaction and greater functionality. Their speed of delivery makes them ideal for alerting scholars and professionals to new discoveries and research. They support far more sophisticated graphics to aid understanding. Whereas print journal pages are flat surfaces, the electronic journal can feature graphics in three dimensions and animation, and it can include video, audio, and other multimedia. Searching is far easier in an electronic journal. In a giant leap from the print reference list, an electronic journal can feature dynamic links to citations, to underlying data, and to other works in progress.

However, electronic journals are in their infancy at the end of the twentieth century. In 1999, electronic journals constitute only a small portion of the total journal literature, and nearly all are electronic versions of a traditional print journal. For example, the *Journal of Technology Computer Aided Design* is IEEE's only solely electronic journal (see http://www.ieee.org/products/online/journal/tcad), and the Institute of Physics produces the *New Journal of Physics* (see http://njp.org/). Although there is no question that the number of electronic journals will grow rapidly, they are likely to be an adjunct to print, rather than a replacement. Meyers and Beebe 6 posited a "multiformat" future in which readers use electronic journals for current awareness and links to other works and print journals for reading and reflection.

Journal Articles Described

Characteristics of Journal Articles. A professional knowledge base cannot exist only in the minds of its practitioners. For a field to grow, scientists must find a means to exchange technical information broadly, to record knowledge permanently, and to describe the profession to the community at large. Since 1665, when the first scientific journals were published, the chief medium for scientific communication has been the scholarly journal. Bishop (1, p. 4) asserted that the heart of scientific literature is the primary journal . . . "upon which all the other parts depend and from which they are derived." According to Osburn 7, the journal is the " . . . key instrument of science, the social sciences, and of much of the humanities for the assessment and validation of an individual's work." Journal articles, in general, reach their audience much more quickly than other formal publications, and, most importantly, they provide a forum for open information exchange that is not possible with other means of publication. Journals create a stage for dialogue among scientists.

Originality. Unlike books, which typically provide established ideas or basic information, such as that found in textbooks or manuals, primary journals publish new materials. Articles in scholarly journals are expected to report original results that have not been published elsewhere. Publishers of journals in electrical and electronics engineering state specifically in their guidelines that submission of a manuscript constitutes a declaration that the paper has not been published anywhere else and is not under consideration by any other journal. Some authors have interpreted the requirement to mean not published in their field, and they have learned to their dismay that "not published elsewhere" means precisely what it says. If a paper has been

published anywhere—in the *New York Times*, in a journal published in another language, or in a popular magazine—it is not eligible for publication in a professional journal.

The requirement for originality has several implications for authors. The first is that one paper, a specific arrangement of content and words, should not be replicated. Beyond that, authors are also expected to take care not to duplicate their own previous work or the work of others. The terms "salami publishing" and "least publishable unit" describe an unsavory habit some authors have of slicing their research studies into tiny pieces to try to get credit for more publications than the research results warrant. Similarly, some authors stitch together review articles that simply report the work of others without adding their own analysis that would move the science forward. Both practices violate the rules of originality in journal publishing.

On the other hand, graduate theses are often the source of journal articles. This use is perfectly legitimate so long as the author uses the research as a basis for additional analysis and recommendations. Likewise, a review or tutorial article that surveys other published contributions does not violate the rule of originality if the author contributes some conclusions.

There can also be some genuine confusion about what prior publication entails. Throughout history, scholars have tried out their ideas in various discussions and exchanges with their colleagues. The most common methods have been conference presentations and circulation of drafts to other scientists. In the 1990s, the Internet offers authors opportunities to obtain feedback from a broader group before they actually submit a paper for publication. For example, they may post a draft manuscript on their Web site or, in some fields, submit it to a preprint server that offers wide distribution. As publishers scrutinize these distribution methods more carefully, authors may find that inclusion in a preprint server makes their paper ineligible for a scholarly journal. Guernsey and Kierman (8) reported that many publishers are declining to review manuscripts circulated on preprint servers.

Significance. A key criterion for acceptance in a professional journal is that the information have significance for the field. The primary journal article is expected to advance knowledge and build a base for future contributions to the literature. Scope and aim statements for some engineering journals use such descriptors as "vital," "evolutionary," and "important" to highlight the level of significance they seek. Even if the research is flawless and the article beautifully written, a paper is likely to be rejected if the results are trivial.

Efficiency. Brevity, clear lucid prose, and the lack of extraneous information all contribute to the efficiency of an article. Although article lengths vary considerably from one journal to another, few journals accept papers more than 40 manuscript pages in length, and some have outside limits of six or eight pages. Guidelines for many journals point out the diversity of their audience and cite the need for clear, accessible language. Rather than adding to scholarship, turgid, ponderous language simply interferes with communication. Likewise, extraneous information, such as material that can easily be found in other publications, often adds length without contributing to knowledge development. The structure of the article, with the correct placement of the correct elements, is also a key to efficiency. Efficiency is increasingly important as the total amount of scientific information grows ever more rapidly.

Scholarly Rigor. It is not sufficient for authors to demonstrate what they know; they must also show how they learned it and why their contribution is unique. Some form of systematically gathered evidence is required. Although a journal may publish theorems without proofs, it will want the author to point the reader to where the proof is published—possibly in an appendix to the article. For laboratory and field experiments, journals generally want sufficient detail that the reader can be assured that the experiment could be replicated in order to validate the results. The facts should include the limits of accuracy and the degree of precision, any failures, and information that supports the validity of the method used. Ethical standards as well as scholarly rigor come into play with documentation, as it is it necessary to credit all statistics and the words, thoughts, and findings of others. Authors are challenged to show that they have approached their work in a systematic way and that they have built on the work of others to expand the knowledge base. Accurate bibliographic citations also direct readers to sources of additional information.

Types of Articles. In general, electrical and electronics engineering journals publish three types of articles: application articles, research articles, and review or tutorial articles. Most journals also include letters to the editor, some of which may be quite substantive, and some have different departments, such as commentaries (opinion pieces), book reviews, and interviews.

Application Articles. Many journals encourage these practice-related papers that demonstrate how an application can be used. Authors must supply a sufficient level of specificity so that the results can be replicated.

Research Articles. Authors are expected to describe the problem that prompted the research and point out the gaps in current knowledge. They must describe their approach to solving the problem and detail the methods they used in their research. Using the data they gathered, they must analyze the results, tie them to the gaps they noted earlier, and cite implications for future work.

Review or Tutorial Articles. Review articles analyze the state of knowledge in a certain aspect of a field of knowledge, summarize what is known about it, and explain why it is important. If the work is highly theoretical, the author must be as specific as possible about its relevance. Some journals require that a substantial portion of any paper be tutorial in nature. That is, the author is expected to provide early background material, a summary of the state of the art, and an evaluation of how the current project contributes to the knowledge in the field.

Components of a Journal Article. At the most basic level, all journal articles, regardless of their type, must have a beginning, a middle, and an end. In the beginning the author sets the stage, defines the problem, and describes the purpose of the article. At the end, the author summarizes the article, provides implications, and points to other work. The middle is somewhat elastic and varies with the subject and type of article. A title and an abstract are also requirements for journal articles.

Title. Journal guidelines generally call for titles that are descriptive, compelling, and as short as possible. Even if they have a tendency to try to tell the whole story in the title, authors have two good reasons to consider the guidelines carefully. First, reviewer reaction to the title can influence recommendations for publication. Second, once an article is published, a well-chosen title will lead users of tables-of-contents services and other automated databases to find the article more easily; hence, it will increase the potential for wide readership.

Abstract. Nearly all journals require that authors submit an abstract that describes in brief what their article contains. Abstracts published with articles are helpful to readers in determining whether they need to read the entire article. The abstracts are also published in various abstracting and indexing services that lead other readers and scholars, often from multidisciplinary audiences, to work on the same subject. In addition, the reviewers and editor take the quality of the abstract into consideration in evaluating the manuscript.

In journals in electrical and electronics engineering, abstracts are generally limited to about 150 words. They do not contain equations, figures, or tables. The object is to provide a succinct, accurate representation of the contents of the article. What was the problem? How was it studied? What were the results? Abstracts should cover the purpose, the problem, the methods, the results, and the conclusions.

Key Words. Many journals request that authors submit as many as 10 key words that will be published with the article and used to facilitate searches. To assist authors in assigning appropriate key words, IEEE maintains a thesaurus of key-word indexing terms that can be found at http://www.ieee.org/power. The ACM Computing Classification System, which many computer journals use, can be found at http://www.acm.org/class.

Introduction. Although the introduction is just one segment of the full text of an article, journal editors place such importance on a well-crafted introduction that it warrants special attention here. In the introduction, the author must set the stage for the article, describing its purpose and providing sufficient background that the reader understands the need for more knowledge on the subject and its significance. For a theoretical article, authors need to link their theory to familiar concepts. If the article is building on previous research, the author must delineate the strengths and limitations of previous studies. Authors proposing new techniques must make a strong case for the improvement expected.

Body of the Article. How the text of an article is organized depends on the type of article and its subject matter. Regardless of how the article is structured, the organization should be made clear to the reader through a series of subheads that form the bones of the article. An arrangement of primary and subordinate headings helps the reader understand the progression of the article. Some journals prefer that research articles follow the IMRAD (introduction, methods, results, and discussion) method of organization. Other journal guidelines suggest that headings should be descriptive of the specific content of the article.

Because many journals have stringent length limits, authors are compelled to focus on the most important aspects of the work in question. All components, including any illustrations, must advance the premises the author puts forth. At the same time, authors must take care to state clearly all assumptions on which they base their results, and they must explain any unusual symbols or terms. In the conclusion, the author summarizes the work, explains any limitations, describes the implications, and lays out plans for future work.

References. The reference list contains all of the information a reader would need to find the resource the author cited in the text. Consequently, each citation in the reference list includes the last names and initials of the authors, the title of the article or other publication, the name of the journal in which an article appeared, the volume number, the page numbers, and the year of publication. For books, references include the publisher's name and the city in which the publisher is located. Reference lists include only those documents that a reader could reasonably be expected to find. No ephemeral documents, such as personal correspondence or unpublished works, are included in the list, although they are cited in the text.

There are essentially two styles of bibliographic citations. In the name-and-date style, references are cited in the text with the author's last name and year of publication in parentheses, and all references are listed at the end of the article in alphabetical order of the author's last names. In the numerical system, the text contains a number in superscript, parentheses, or brackets; then the reference list at the end of the article is ordered as the references fall in the article.

Illustrations. Photographs, figures, tables, and other illustrations may add to the clarity of presentation. The danger lies in using three tables when one would suffice or adding figures for decorative rather than communicative effect. On the other hand, dense paragraphs of text with no graphic relief can be daunting to readers. Authors must judge what illustrations augment and clarify the information they are trying to convey.

Other Components. It is customary for authors to acknowledge the support and any contributions of colleagues who did not participate in the actual research or writing of the article. An acknowledgment section may also include a statement on any funding support. In addition, many journals request a brief author biosketch that generally includes the author's title, institution, mailing address, and email address.

Journal Submissions

How Authors Select Journals. Within the field of engineering, there more than 800 scholarly journals published in the United States (9). However, the degree of specialization is so great that most authors have a much narrower field from which to choose. Some authors, in fact, may work in such a specialized area that only one or two journals may publish their work. Others have a broader range of options and may have the luxury of considering a number of factors before they select a journal.

Mission and Audience. Good authors are avid readers of the literature in their field; consequently, they begin their search for a publishing outlet with a clear understanding of the likely journals. Savvy authors also scrutinize the journal Web sites and take careful note of the aims and scope statements as well as the descriptions of the audience the journal is trying to reach. Journals, for example, may seek descriptions of new techniques or products. They may want to publish data that will be useful to engineers or researchers concerned with circuits, materials, or software. Published journals demonstrate the subject matter and level of writing the journal has accepted to date. The Web sites and published author guidelines, which may include

announcements of special theme issues, give further clues about what the journal editor and editorial board are seeking.

Sometimes authors can consider whether they wish to reach a broader, more generic audience, which is likely to be larger, or whether they want to publish for a specialized, perhaps very technical audience, which is likely to be smaller. Authors may also consider what Day (10) described as the prestige factor. Disciplines generally identify prestigious journals by who the publisher and the editor are, who serve as members of the editorial board, and how rigorous the review process is. Often the journals considered prestigious are those with lower acceptance rates. An easier test for authors is to determine which journals have published the articles they consider important. The journals that published the works the author is citing in this new article are likely candidates.

Odds of Acceptance. In some disciplines and specialties, it is easy to obtain average acceptance rates for various journals because they are published either in the journal or in guides to journals in the field. The size and frequency of the journal are other indications of the odds of acceptance, particularly if the journal maintains a short lag time from acceptance to publication. The quarterly journal that contains 128 pages can publish far fewer articles in a year than the monthly journal that has 224 pages.

Time Factors. Authors experience lag times in their quest to get into print in three areas: (1) the time it takes to review the article: (2) the time it takes them to revise the article according to the reviewers' comments; and (3) the time from acceptance to publication. They have influence only on the second factor. In general, journal guidelines cite review times ranging from two months to six months. The longer time is probably related to multiple reviews, sometimes requested serially when the editor requires an additional review to make a decision, as well as to reviewers being slow to return their evaluations. IEEE (11) ecifies that editors should ensure that reviewers return comments and opinions within 30 days maximum.

In looking at lag times for the 151 articles published in the *IEEE Transactions on Geoscience and Remote Sensing* in 1997, Raney (12) found that the average time from submission to publication was 15 months, 10 months of which was consumed by review and revision. He noted that a scan of other similar journals revealed similar lag times. Many journals now publish the submission and review time history with articles. By reading these footnotes for a journal of interest, an author can easily estimate an average lag time.

Access. In the highly technological field of electrical and electronics engineering, assuring multiple points of access to journal articles is not such an issue as it may be in other fields. However, there are still variations in the level of access journals offer. Authors will look first at where the journal is abstracted and indexed. Most journals publish that information in their issues and list it in their author guidelines. If the journal is not published in electronic form, the author will consider whether tables of contents and abstracts are published online. Access through document delivery services, such as Bell & Howell Learning Information's ProQuest, INSPEC from the Institution of Electrical Engineers (http://www.umi.com/hp/Features/Inspec), UnCover (http://uncweb.carl.org), or the Canadian Institute for Scientific and Technical Information (*CISTI*), (http://www.cisti.nrc.ca/cisti/docdel/docdel.html), is another consideration. Publishers also offer access through their own systems. For example, ACM maintains a library of full-text articles in the *ACM Digital Library* (http://www.acm.org/dl). The *IEEE/IEE Electronic Library* includes all IEEE journal articles, conference proceedings, and standards published since 1988. Articles in journals published by John Wiley & Sons are available through Wiley Interscience (http://www.interscience.wiley.com), and those published by Elsevier through Elsevier's ScienceDirect (http://www.sciencedirect.com). Providing linkages from one reference to another across publishers is likely to be an increasingly important aspect of access for the author and the reader.

Difficult Decisions. Sometimes an author must make a choice between timeliness and prestige, or even quality. For example, electrical engineers often must choose between presenting their work at a conference and writing a journal article. The conference is more immediate, it offers the opportunity to interact with colleagues and get instant feedback, and it may assure the author of a trip to an enjoyable location. In addition, the criteria for conference presentations are generally less rigorous than journal criteria. On the other hand, proceedings often do not receive the same level of editorial and quality control attention that journal articles

do. The audience is more restricted, and the proceedings usually are not included in abstracting and indexing services. So the author may sacrifice greater professional recognition for "instant gratification." To obtain both immediacy and prestige, the author must invest the effort to create two sufficiently different products to meet the journal requirement for originality.

Requirements for Submission. There are four components to the submission of a scholarly article in electrical and electronics engineering. They include copyright transfer, paper copies of the manuscript, an electronic file, and illustrations. For engineers working in corporations, company approval is a fifth component.

Copyright Transfer. Journal publishers require that authors transfer their copyright to them before they will review a manuscript. Although the copyright forms vary from publisher to publisher, in general the author affirms the following:

- Transfer of copyright
- Originality of the work
- Authorship.

If several authors are involved, either all authors must sign or one author must attest to having the authority to sign for all. If the article is not accepted, the agreement is considered null and void, and copyright reverts to the author.

Journals often publish their copyright transfer form in the journal. In addition, all of the major publishers of electrical and electronics engineering journals post their forms on the journal Web sites.

Paper Copies. Journals still request paper copies, even though electronic files are required. The number of copies varies from journal to journal, ranging from two copies to six. Specifications for paper copies include double-spaced copy, generous margins (one inch to one and one-half inch margins on all sides), and clear readable fonts. Most journals request a cover sheet or title page that includes the title of the paper and the names and addresses of authors. The abstracts and key-word paragraphs are separated from the body of the article and immediately follow the cover sheet. If a list of symbols is required, the list follows the abstract. The text of the article is next, and following it the references. Tables and figures are provided separately. Authors should also include acknowledgment of any grant or other financial support of the work, as well as a note on any conference presentations that preceded the writing of the paper.

Electronic Files. Although some journals request electronic files only upon acceptance, many request them at the point of submission. Some journals accept email (generally only once the editor has requested it), but many request that authors send disks. If manuscripts contain extensive mathematics, journals often request that files be sent in the TeX, LaTeX, or troff programs. Some journals accept files in Word or WordPerfect; others request that all files be sent in ASCII. Many journals specify that the following should be avoided:

- Page layout software (such as FrameMaker, PageMaker, Quark, or Ventura). ASCII is generally preferred.
- PostScript files
- Special macros. Standard program codes are preferred.

Just as different components start on separate pages in paper copies, the electronic version should include separate files for the various elements, such as abstracts, body, references, illustrations. It is particularly important to publishers that graphics be separated from text.

Many journals provide templates to help authors prepare electronic files. For example, Springer offers a template for its preferred Word program at http://www.springer.de/author/index.html. Authors can obtain an IEEE LaTeX style file by emailing help@ep.ieee.org. Files should be labeled according to journal instructions, most of which can be found on journal Web sites.

Illustrations. Journals have specific requirements for graphic widths; authors should check guidelines to obtain specifics. Most journals request that graphics be prepared using specific fonts. Because illustrations

must be camera-ready, they constitute an exception to the software to be avoided. For example, IEEE (11) asks that all graphics be submitted in PostScript, Encapsulated PostScript (*EPS*), or Tagged Image File Format (*TIFF*). Authors need to know whether a journal will print in color or black and white in order to submit the appropriate file. It is likely that most line drawings will be black and white.

If an author is using photographs, they should be glossy prints with no screens. Most journals will not accept laser prints as replacements for photographs or gray-scale graphics. Because graphics probably will be reduced, the lettering and other details should be large enough to be legible when the graphic is reduced to fit the column or page width of the journal. Journals request that authors put captions in the file, not on the artwork.

Corporate Sign-off. Approval for public release of information is required before an author can submit an article, and multiple sign-offs may be necessary. For example, the company export approval officer may review the article for infringement of restrictions on export of technical information, because most journals have international distribution. If the work was funded by an external customer, the customer's representative must approve the article; and if the work is related to any classified government work, the company security officer will be involved.

Rights and Responsibilities

The issues of who owns what and how materials may be used have become more complex in the digital age, as technology has made it easier to transfer or copy materials. These complexities may increase what Grycz (13, p. 73) described as the tension between the author who wants the widest distribution possible and the publisher who "must be concerned with the economic viability of publishing as a business."

Current copyright law is encoded in the Digital Millennium Copyright Act (14) approved by the United States Congress and signed by President Clinton in October 1998. This law, the first update of US copyright law since 1976, implements two international treaties: the World Intellectual Property Organization Copyright Treaty and the World Intellectual Property Organization Performances and Phonograms Treaty. The law, which had been vociferously debated between publishers and librarians, adds protection for online publications, defines penalties for infringement, and includes protection from huge liabilities for innocent infringement.

Journal Rights. By law, the author owns copyright automatically from the point of creation. However, all electrical and electronics engineering journals require that authors transfer their copyright to the publisher as a condition of publication. If the rights belong to the author's employer, journal publishers either assume that the author is empowered to sign the copyright transfer, or they require that an official of the employer sign the form. In general, rights are interpreted to mean the right to reproduce and distribute the work in any media, in any language, and in any part of the world. In other words, except for the rights that the publisher specifically cedes to the author, the publisher owns all rights. Publishers note that they must control rights in order to be assured that free distribution will not erode their financial stability and hence their ability to continue publishing. Further, they believe they are best equipped to ensure that t author receives appropriate attribution and that the work is not cannibalized.

Author Rights. Transferring the copyright does not affect patents or trademarks. The IEEE copyright transfer form (15) specifies that "Employers (or authors) retain all proprietary rights in any process, procedure, or article of manufacture described in the work." Among the retained rights a publisher may grant to the author are the following:

- Right to post on the author's Web site, provided it is not a commercial venture
- Right to use all of the article in another work, such as a book, that the author edits or writes, without payment of a permissions fee

Table 1. NFAIS Categories of Rights and Responsibilities for Databases

Responsibilities	Rights
Accuracy—includes factual accuracy, integrity, quality, readability	*Integrity*—maintain factual accuracy and readability
Signature—maintain identities	*Identication*—author, publisher, and distributor identied
Terms—regards any special terms governing use and reuse	*Conditions*—depending on the party, set or understand the conditions that govern use
Value—worthy of publication and distribution	*Remuneration*—set price and re ceive payment or other compensation
Attribution—identify sources and owners	*Attribution*—depending on the party, be identied as a source or use common facts with attribution
Permission—obtain or grant all appropriate permissions	*Permission*—expect prompt replies to requests
Security—respect rights, including privacy	*Privacy*—relates to restriction private information and access to aggregate informatio

Adapted with permission from National Federation of Abstracting and Infc tion Services (16).

- Right to make copies for distribution within the author's place of employment
- Rht to make oral presentations.

In any instance in which the published article is reproduced, publishers require that the copies include their copyright notice and a full bibliographic citation. Some publishers require that the article posted on the author's Web site be linked to the publisher's Web site for ordering information. Generally, publishers will permit any distribution of an accepted article only after official publication.

Responsibilities. All parties in the scholarly endeavor have responsibilities to respect and protect intellectual property rights. The National Federation of Abstracting and Information Services (*NFAIS*) (16) has identified a series of rights and responsibilities for authors, producers, distributors, and users of database products (see Table 1).

Author Responsibilities. Authors are expected to submit a manuscript to only one journal at a time. Considering the time the review process consumes, many authors chafe at the restriction; however, there are two good reasons for it. First, the practice significantly reduces the potential for one journal inadvertently to violate another's ownership. Second, editors have reasonable assurance that they will be free to publish an article in which they invest considerable time and expense for the review process.

As noted earlier, authors are expected to credit the words, thoughts, and findings of others and reference all statistical data. Careful recordkeeping may be required to avoid inadvertent plagiarism. Authors must also

secure permission for the use of any tables or figures. Permission from the copyright holder is also required for any lengthy quotation; some publishers now require permission for the use of 250 words or more.

The decision of who should be listed as an author on a publication is an ethical one. Only two roles qualify someone to be identified as an author: The person either made a substantive and major contribution to the work that is described in the article, or wrote a major section. Being head of a department in which the work was completed or advising a graduate student or new professor does not entitle an individual to be listed as an author.

Editor and Publisher Responsibilities. Editors must assure that manuscripts receive fair, objective reviews within reasonable timeframes. They must make every effort to ensure that the author's work is protected throughout the process from receipt to publication and distribution. Consequently, they must hold reviewers responsible for maintaining confidentiality and providing unbiased reviews.

When a manuscript is being prepared for publication, the publisher has an obligation to give the author an opportunity to review edited copy and to update the article if there has been a substantial time lag between acceptance and publication. After a manuscript is accepted, publishers have an obligation to ensure that potential readers have access to the published work. Publishers must protect the author's work in all copying and document delivery agreements so that the work is always attributed properly. An increasingly important issue is the responsibility of the publisher to preserve the work so that future researchers and practitioners will have access to it.

Reader Responsibilities. Readers include authors and editors, who have a vested interest in maintaining the integrity of published materials. All readers have a responsibility to attribute works appropriately and to request permission to republish any illustrations or lengthy quotations. They also have a right to make copies under some circumstances. With the Copyright Act of 1976 (17), legislators established the doctrine of *fair use*, which was intended to balance the rights of the copyright owner with the benefits to society of the free distribution of ideas. Under Section 107 of the law, materials may be used in limited ways for purposes such as comment, criticism, parody, news reporting, teaching, scholarship, and research. The law, rather than strictly defining fair use, set forth four factors that can be used to determine fair use. They are

- Purpose and character of the use
- Nature of the copyrighted work
- Amount and substantiality of the portion used in relation to the copyrighted work as a whole
- The effect of use on the potential market.

Thus, someone can quote 100 words of a 10-page article with attribution, but cannot use one line of a poem without asking permission. The Digital Millennium Copyright Act applies fair use to online products as well.

Fair use was debated hotly even before the advent of online journals and Internet access. In the 1990s, the debate intensified, with information providers on one side fearing totally free access that could destroy their viability, and librarians and their patrons on the other alarmed at increasingly high costs and the potential of making multiple payments for the same content. Digital networked environments in libraries and academic institutions and computer-assisted distance education raise new issues related to copyright. Can I make a paper copy of a digital file? Can I distribute copies to the class I am teaching? Can I email the file to a colleague? Can I post it on my Web site? Why cannot I buy an electronic product and send it to a colleague after I've used it, if I can loan or give away a book I purchased with no problems? Nearly everyone agrees that any reader has the right to make a first generation copy for his or her own personal use. The classroom use is probably acceptable if the professor found that article shortly before the class and does not reuse it on a regular basis. The reader should probably provide access information to a colleague, rather than the actual document. And it's likely that no one would agree to posting a published document on a personal Website without express permission.

The mere fact that one gives a product to someone rather than selling it to them does not mean that copyright is not violated.

Concerns about maintaining the current doctrine of *first sale*, which permits buyers to distribute a purchased product in any way they choose, in a digital environment may be resolved only with emerging technologies. The differences between print products and electronic products and how rights are handled for them are subjects of a debate that is likely to continue well into the twenty-first century.

Peer Review

In its simplest form, peer review occurs when one colleague asks another to read and comment on a paper in draft. At its most elaborate, peer review comprises a highly systematized set of protocols for evaluating and selecting papers for publication. The complexity of peer review increased as the sciences grew more complex. Whereas editors of early scientific journals appear to have made publication decisions on their own, most editors in the late twentieth century would hesitate to evaluate the range of papers they see without having advice from subject experts. Sometime in the mid-nineteenth century, the societies that were publishing the major scientific journals, such as the Royal Society of London and the Académie Royale de Médecine, began to develop mechanisms for peer review. In the United States, as funding for science and technology grew, the need for selection criteria for grants and publications increased.

Purpose. Peer review is first a gatekeeping function. An editor asks peers of the author, generally called referees or reviewers, to comment on the originality and significance of the author's work and to advise the editor if the work warrants publication. Some of the criteria reviewers may be asked to use include validity and accuracy of results, evidence that supports the author's conclusions, and adequate reference to previous work. Given that the purpose of primary journals is to provide a reliable record of knowledge, this gatekeeping function is critical.

Second, the process is intended to improve the literature and provide assistance to authors. Reviewers generally are asked to write comments to the author, detailing as explicitly as possible how the paper might be improved. For example, the author may have overlooked important contributions of other authors in the field, and the reviewer will supply references. There may be errors in computation or faulty use of methodology. Perhaps the abstract does not accurately represent the content of the paper. The reviewer may have searched in vain for a statement of purpose. Or the presentation and the language used may need improvement. Reviewers are expected not just to point out problems, but to offer some suggestion for how the author might resolve the problem.

How the review is structured is generally the editor's prerogative. Some editors provide very specific guidelines to reviewers. Others give no direct instructions and ask only that the reviewer provide a critique and a judgment on whether the manuscript warrants publication.

Process. When a manuscript arrives in the editorial office, it usually is first screened to see if it meets some basic criteria, such as being appropriate to the mission and scope of the journal or meeting length limits. The screener may be the editor of the journal or editorial staff depending on the journal. Next the manuscript is entered into the journal records. Beebe (18, p. 161) noted that the attention to detail required to produce high-quality journals begins when the manuscript arrives. "From that point, the person responsible must be able to tell exactly where the manuscript is in the process and what steps at what times it has gone through to get to that stage." Automated systems that generate control numbers and track manuscripts, reviewer responses, and editor decisions are a must for any journal that receives a substantial number of manuscripts. These systems generally will also produce a list of suggested reviewers for a manuscript based on key words and reviewer availability.

The Reviewers. Journal referees are subject experts, and most journals require that they be published authors. For primary journals all reviewers are volunteers who provide services without compensation, al-

though many reviewers say the knowledge they acquire from reading the work of their colleagues is more valuable than money. Some corporate journals offer ahonorarium to external referees.

Reviewers are bound by strict rules of confidentiality. They are expected to use the content of the papers they review only to evaluate it for possible publication. They may not cite the work, use it for teaching, or build their own work around it until it appears in print. Reviewers are asked to provide unbiased, objective evaluations and to offer constructive, helpful comments to help the author improve the work. Further, they are to do so within a fairly short time. IEEE guidelines for editors (http://www.ieee.org/pubs) state that reviewers must agree to return their comments and opinions in 30 days or less.

Types of Reviews. Reviews may be categorized as *double-blind, single-blind*, or *open*. In a double-blind review, the author does not learn the identity of the reviewer and the reviewer does not know the author's name. In a single-blind review, the reviewer's identity is masked to the author, but the reviewer is told who the author is. In an open review, both author and reviewer are known to each other. Proponents of double-blind reviews believe that strict anonymity precludes bias and improves the quality of the review, whereas supporters of open systems believe that reviewers write more helpful, less judgmental reviews when they are signing their names to them. Open reviews are the least common in all disciplines, although there appears to be some increase in open reviews. For example, the *British Medical Journal* now places some submissions (not including those that have direct implications for health care) on its Website (http://www.bmj.com) for open comment at the same time they undergo traditional peer review.

For the most part, however, reviews tend to be masked in some way. Some journals in electrical and electronics engineering practice double-blind reviews, and others use the single-blind process.

Criteria. Editors state their criteria in various ways, but overall the general criteria are the same. They include the following:

- *Relevance to the Journal.* For some journals, this is the key criterion. If the content does not mesh with the mission and scope of the journal or if the reviewers believe it would not be of interest to the journal's readers, the manuscript is likely to be rejected.
- *Significance.* A publishable manuscript is expected to contribute to building knoedge in the field.
- *Originality.* Primary journals publish only new work.
- *Technical Quality.* Journals wish to publish only those articles that are technically sound.
- *Quality of Presentation and Writing.* Journals look for clear presentation and a writing style that is free of jargon and redundancies.
- *Relationship to the Literature.* Authors need to demonstrate that they are aware of and are building on the work that other authors have accomplished in the field. Other criteria vary with the type of article. For example, reviewers of a research article will look for sound methodology, appropriate study design, and high-quality analysis.

Most journals provide their reviewers with either a formal rating sheet or written guidelines for reviewing manuscripts. As is true in most disciplines, there appears to be little formal training for reviewers or editors of electrical and electronics engineering journals.

Reviewers are expected to recommend a disposition for the manuscript they review. Among the possible fates are the following:

- Accept as is.
- Request minor changes.
- Request major changes.
- Shorten for publication as correspondence.
- Refer to another journal.
- Reject.

It is the editor who makes the decision that will be transmitted to the author. When the reviewers are in general agreement, the editor's decision may be easy (unless he or she disagrees with the reviews). However, when faced with conflicting reviews, the editor must either decide which review to follow or ask for further reviews, which may also be contradictory. Journal guidelines may provide for an author rebuttal process, as the IEEE guidelines do (11). In the IEEE process, an author may submit a "suitably worded" argument against the criticisms of the reviewers and the subsequent editorial decision. The argument and responses from reviewers give the editor additional information on which to base a decision. The ultimate decision, however, is the editor's.

The editor also determines what the author will receive with the decision. Some editors always send reviewer comments as they were received. Some edit them, and some provide only a summary of the comments. And in some instances, an editor may deliver a decision without sending any comments from the reviewers.

Factors other than quality and significance may influence a decision on publication. Some journals will publish several articles on a subject as long as each offers some new approach. However, journals that emphasize breadth may decline to publish a manuscript because it has already published or accepted another on the same topic. In addition, some journal editors seek different types of balance, such as balance between theoretical and applied articles, or between academic and corporate papers, or between domestic and foreign authors.

Evolution of Peer Review. Peer review has come under heavy criticism over the years. Complaints include bias, other breaches of ethics, delays in publishing important information, and a variety of other offenses. The biomedical field, prompted by several cases of fraud in the 1980s, convened three international congresses on peer review in the 1990s, the third taking place in Prague in September 1997. Miller and Serzan 19 called for the establishment of standards for refereed journals, and they suggested a number of procedures to improve the process of peer review, including increasing the number of screeners and publishing evaluation guidelines.

Providing clear guidelines to reviewers and conducting training would likely improve the process as well. Regardless of the flaws in the system that reflect human frailty, peer review is the method by which journal articles find their way into published status. In the early and mid-1990s, authors in various fields proclaimed that the Internet provided the opportunity for self-publication and market evaluation; hence publishers and reviewers were no longer needed. By the late 1990s, the clamors had subsided, and even the electronic preprint servers were considering an evaluation process. Peer review will undoubtedly continue to evolve as it has over the past 150 years, but it will likely not be replaced by self-publication.

Production Process

Preparation of Copy. Using the author's final submission, the publisher will prepare the copy for reproduction and distribution. Publishers who still employ copyeditors will improve the language and organization to make the content more accessible to readers. Among the editor's tasks are to correct grammar, spelling, and punctuation, and to check consistency of words, abbreviations, and numbers. The editor will ensure logical organization and make certain that computations in tables are correct. In addition, the editor will verify that references in the reference list correspond with those in the text and call any discrepancies to the author's attention. Often, changes are made to conform to the style manual used for the journal.

The author will then receive edited copy, along with queries to be answered. Although online editing is increasingly common, some copyeditors still work with paper copies. Authors are expected to review edited copy carefully, answer all queries, and complete any missing tasks such as outstanding permissions. This clearance process is generally the authors' last opportunity to make changes without cost to them; consequently, they should review the copy with great care. Graphics can be particularly troublesome. Because authors often submit art that cannot be used as is, the publisher may rework the graphics and edit captions on

figures and charts. Wiley distributes guidelines for checking copyediting and proofreading book manuscripts (www.wiley.com/authors/guidelines) that describe the clearing process.

This process is not uniformly used. Many journals in the 1990s no longer copyedit manuscripts. Instead the publisher expects the author to put the polished article into final form, if not the actual format. And some of the journals that do copyedit do so in a fairly cursory fashion.

When the edited manuscript is in final form, it goes into typesetting, and it is formatted to fit the appearance of the journal. All of the elements—title, author name, abstract, key words, references, and so forth—are set according to a standard template. Tables and illustrations are incorporated into the text. Mathematical equations and chemistry are set in the fonts dictated by the journal template. This typeset copy, which will also receive page numbers for a printed journal, is then proofread, and corrections are made for typographical errors.

Tagging. If journal articles are to be distributed in an electronic medium, they must be coded with the information that is necessary to process them. The electronic codes used for typesetting have typically been proprietary; consequently, they were not suitable for enduring delivery and linkages across various platforms. The solution was to create *generalized* markup languages that are independent of processes and platforms.

Many readers are familiar with HyperText Markup Language (*HTML*), which was designed to send tagged information over the Internet to different computers with different software (20). *HTML* transmits quickly and is simple enough to learn that beginners can use its software tools to set up their own Web sites. The disadvantage of *HTML* is that it has a weak format capacity. Because materials are displayed as each browser determines, there is no uniform delivery of design. Further, *HTML* is not sufficiently robust to support the creation of secondary and parallel materials.

As a consequence, many publishers turn to Standard Generalized Markup Language (*SGML*), which is a metalanguage and parent to other languages such as *HTML*. For its journal, the publisher creates a *document type definition* (*DTD*), which defines the logical organization of the document and describes the contents, order, and names of each element. Tags then identify the start and end of each element. *SGML* is a powerful, robust language that is completely portable, so it supports potential derivative works.

Although *SGML* was established as a standard (ISO 8879) in 1986, its use did not become widespread until the mid-1990s. Publishers still introduce *SGML* tagging at different points in the production process. Some tag the content at the editing stage so that *SGML* supports either print or electronic products, whereas others add the tags after they have completed all other processing.

Subscribers expect greater functionality as well as increased speed of delivery from electronic journals; consequently, special processing is required. Although early journals were delivered on CD-ROM, the trend in the late 1990s is clearly toward Web-based products. The IEEE statement on transition to electronic distribution (21) noted that " . . . posting material on World Wide Web servers in formats compatible with the most widely-used browsers is likely to be the best way to reach member and nonmember customers for the foreseeable future."

Many publishers are coding journal articles in *SGML*, then deriving the *HTML* files needed for online delivery and linkages. Because readers prefer the look and feel of material that replicates the printed page, publishers often put their articles in a Portable Document Format (*PDF*) file. This platform-independent format, produced by Adobe Systems as a derivative of its PostScript pages description language, allows printing in full PostScript and searching by keyword. Documents in *PDF* retain all original formats, fonts, and layouts of the print product. Although some publishers choose one format over another for a publication, Kasdorf (22) argued that both *SGML* and *PDF* are important for disseminating the same information in different ways.

To speed up publication, publishers are beginning to post articles to online journals in advance of their print products. For example, the American Chemical Society (*ACS*) introduced a program they call As Soon As Publishable (*ASAP*), in which articles are posted as soon as they have gone through the review, editing, and author-proofing procedures (23). This speeded-up process that treats articles individually, instead of in

batches slated for a specific volume and issue, creates particular project management problems for a publisher, especially when the articles are also gathered in a print issue.

Paper Journals. Technology has also changed print production processes quite dramatically. In the 1970s, graphic artists still cut up long galleys from the typesetter to paste up pages with rubber cement. The printer then photographed the pages, made plates, and printed the journal from the plates. In the 1980s, desktop publishing systems evolved, and publishers sent camera-ready copy on resin-coated paper, produced by computer, to the printer. In the 1990s, printers receive journal copy on disks, and even emails, from which they print the journal. High-speed presses and binders speed the process further. Journals then go to a mailhouse, where labels, produced from a file sent electronically from the publisher, are attached to the journal itself or the package in which it is placed.

Distribution

Once the journal is completed—whether that means coded and ready for electronic transmission, mastered on CD-ROM, or printed and bound—it must be delivered to the subscribers and readers. The processes of delivery and payment vary significantly for print and electronic journals.

Delivery of Print Journals. Printed journals must go into a mail delivery system. Most domestic US journals are sent via the United States Postal Service, either second class or third class. Consequently, delivery in the United States can take two to three weeks from the time the mailhouse delivers the journals to a postoffice. Journals destined for other countries travel via several different services, which generally combine airlift overseas with distribution in the in-country mail system.

Libraries check journals in, catalog them, and put them in a reading room for current issues. Then when a volume is complete, the issues are bound and shelved in the periodical stacks. They may remain in stacks for an indefinite period, or they may be pulled for off-site storage, especially if the library purchases the journal in microform. Readers find the journals through the library cataloging system.

Pricing of Print Journals. Print journals vary significantly inrice, depending on the discipline. However, the pricing scheme is generally the same. Institutional subscriptions are priced at a substantially higher rate on the theory that they serve a body of readers, rather than one or two. Societies often provide one or more journals to members as a part of their membership fee and offer a discount on other journals as well. In addition, many societies give students or new professionals an even greater discount. Nonmember individual subscriptions are priced between the member and the institutional rate.

Delivery of Electronic Journals. Once the electronic journal is ready for delivery, subscribers obtain access either through a password or at a uniform resource locator (*URL*) or internet protocol standard (*IPS*) address. Libraries much prefer addresses so that they do not have to issue and track passwords for what can be thousands of users. Often companies and institutions invite users to establish profiles so that they can get alerts when an issue or article that might interest them is available. Although some journals are available on CD-ROMs, particularly collections of issues or journals, libraries prefer to obtain serial literature on the World Wide Web. Not only do CD-ROMs cause complications because of overloaded jukeboxes, they also tend to "walk" away easily.

Pricing of Electronic Journals. Pricing has been extremely controversial, as publishers try to sort out business models that will enable them to assure stakeholders a return on the substantial investment they make in developing electronic products. Among the models are the following:

- *Pay for Search.* The user pays for any access to the material, even for searching.
- *Pay for View.* The user searches free, but must pay for any content actually called up from a bibliographic citation.

- *Licensing.* The institution negotiates a site license, which may include print and electronic publications and specifies unlimited searching and printing for a set fee.

These models are still in flux, as publishers and libraries continue to discuss not only method of payment, but the level of payment. Walker (3) proposed that all subscription fees of any kind be eliminated and the production and archiving of journals be financed with author page charges. Given that most journals set optional page charges, based on the author's ability to pay (generally a function of whether a grant will cover them), it is unlikely that this proposal will come to pass in the near future.

One of the issues in pricing electronic journals is the definition of what constitutes a single site. Is it one entity? one campus? one building? The advent of institutional and corporate intranets has made the question much more complex. The enforcement of limited access is further complicated by multicompany, badgeless working environments. These issues, along with many other details of pricing, are still to be resolved.

Access and Archiving

If primary journal articles are to serve as an unbroken record of verified research, potential readers and researchers must be assured that they will continue to exist in a usable form. They must also be certain that readers will have access to the literature and that they will have some roadmaps to help them locate what they need. Thus the issues of how we maintain access and how we preserve the array of information are critical ones.

Abstracting and Indexing Services. Abstracting and indexing services provide the chief form of map to the professional literature. Scientific information is so voluminous in the late 1990s that searching for any specific content can be a daunting task. To do their work, researchers need help in sifting through the flood of information and summarizing precisely what they need. Abstracts provide sufficient information to allow researchers to evaluate the utility of articles for their purposes; the index terms attached to one abstract may provide clues to where additional information on the subject may be found. The following are among the many abstracting and indexing services that publish content related to electrical and electronics engineering:

- Cambridge Scientific Abstracts
- Current Contents/Engineering, Computing, & Technology (ISI)
- Engineering Index
- Fluid Abstracts and FLUIDEX
- INSPEC
- Mathematical Reviews
- SciSearch (ISI)
- Shock and Vibration Digest
- Statistical Theory and Method Abstracts
- Telecommunications Abstracts

Although abstracting services online or on CD-ROM provide easy searching to narrow access to specific information, many readers still prefer to browse. Consequently, paper indexes still exist.

Access to Single Articles. Instead of maintaining shelves of journals that may be read at some point (the *just-in-case* model), individuals as well as libraries are finding that purchasing articles as needed (the *just-in-time* model) is cost-effective. The options generally are interlibrary loan, commercial document delivery, and internal document delivery. Often libraries can acquire a copy of a journal article from another institution through interlibrary loan.

Faculty and students in many institutions can now search the UnCover database, which supplies document delivery by fax, and order journal articles. Having conducted studies that demonstrate substantial savings from canceling low-use journals, many libraries now permit their clientele to order articles from journals the libraries do not own without mediation from the librarian. Institutions are also using Bell & Howell Learning Information's ProQuest.

Some libraries have experimented with *online public-access catalogs* (*OPACs*). To create the catalogs, librarians scan tables of contents, pull out bibliographic information for the articles, and load the data into an online file. Adding *SGML* tags creates a searchable database. Then patrons can order articles from the internal database.

Reprints and Preprints. Throughout the history of journal publishing, it has been customary that published authors have an obligation to share their work with others. That sharing may include original data or other materials, or it may mean giving someone a copy of the actual published work. Many scholars collect copies of articles as references for their own work or to keep up with advances in their field.

Publishers give authors an opportunity to order reprints of their articles when they approve their edited manuscripts or page proofs. For many years it was customary for publishers to also provide a set number of reprints free; however, many cost-conscious publishers have abandoned the practice. Who pays for copies has varied over the years. In the eighteenth century authors, anxious to share their work as soon as possible, arranged for printers to make copies of their proofs so that the authors could distribute them in advance of publication. Knight [as reported in Wells (24)] suggested that these were the first preprints. Today authors often post their preprints to their Web server until it has been accepted for publication. Policies on posting copies once the article has been published varies from publisher to publisher. ACM permits authors as part of their retained rights to post their published article to their own servers and even make changes to it (25). IEEE (26) also permits authors or their companies to post IEEE-copyrighted material on their sites.

Identifiers. Assuring access over time may become tenuous if we do not develop new means of identifying individual articles to augment the International Standard Serials Number (*ISSN*) that identifies specific periodicals. Regular users of the Internet, for example, have often discovered the frustration of changes in a *URL*. Payette 27 noted that *URLs* are addresses masquerading as identifiers and called for moving beyond the *URL* as an identifier. She noted that the Internet Engineering Task Force, which is the standard-setting body for Internet development, has created a *uniform resource name* (*URN*) that would be a "globally unique, persistent identifier." The URN incorporates three main components: (1) a naming scheme; (2) a resolution system; (3) registries.

Using the *ISSN* as a base, the Serials Industry Systems Advisory Committee (*SISAC*) created a code that identifies an issue of a periodical and an article. The *serials item contribution identifier* (*SICI*), which is a string of letters and numbers, includes several pieces of information: the issue date (chronology), volume and issue numbers (enumeration), location number, title, standard version number, and record validation character. The American Nationals Standards Institute approved it as a standard (Z39.56) in 1991.

Three other systems are of note. Online Computer Library Center (*OCLC*) has created a *permanent uniform resource locator* (*PURL*) that uses an intermediary database to find the latest location. Using the same three components as the URN, the Handle System was developed by the Corporation for National Research Initiatives (*CNRI*) to create, administer, and resolve unique identifiers. In addition, the Association of American Publishers has created the *digital object identifier* (*DOI*) to deal with the challenges of selling and managing copyrights for digital publications. The *DOI* enables a publisher to identify fragments of an article, such as a table, a figure, or even a paragraph.

Archiving. Archiving is a systematic approach to preserving materials so that they can be retrieved and used by readers no matter what conditions exist in the future. Storing journals in boxes in warehouses is one method of archiving. Unfortunately, we have discovered that acid paper turns brittle, heat and moisture destroy journals, and rodents or insects may make meals of them.

Paper is a fragile medium, yet it may be more lasting than many electronic products. In addition to all of the natural, organic, and chemical dangers posed to paper products, electronic media face other threats. Obsolescence is a major problem. If the hardware and software that deliver the electronic journal are no longer operational and available, the journal cannot be read. Electronic products can be altered so easily that dynamic data constitute another concern. Regardless of whether changes are made accidentally or on purpose, whether they are made with good intentions or fraudulent ones, the result is the same: the original material is lost. All the aspects of electronic publication that offer such exciting new opportunities for interactivity and linkages pose serious challenges to preserving an unchangeable archive. Although the problems have not been resolved, it is clear that materials must be preserved in a format that is independent of process and platform and that archivists must be prepared to migrate information from one medium to another in the future (28).

Library Roles. Traditionally, libraries have been expected to ensure the preservation of published works. Because libraries fulfilled this expectation, many publishers did not even maintain their own archived set of published documents and destroyed their inventory of back issues after a short time. Most provided a complimentary subscription to UMI (now Bell & Howell Learning Information), so that microfilm versions were available.

In the 1990s, however, the roles and expectations began to change. Faced with declining or static budgets, rising costs, storage problems, and the enormous difficulties of dealing with fragile documents, librarians sought help with the function of preservation. Librarians also noted that licensing agreements for electronic products generally vest ownership with the publisher, not the library. Consequently, the products are not theirs to preserve.

That is not to say that librarians are not working on the issues of preservation and access. These are concerns for all libraries, and many major projects underway. For example, the Cornell University Library completed a study in 1997 funded by the National Endowment for the Humanities to test and evaluate using imaging to produce computer output microfilm that meets national standards for preservation (29). This project was a complement to a study at Yale University converting microfilmed brittle books to digital format. The Research Libraries Group also has a committee working on models and guidelines for archiving digital informatn (30).

As the twentieth century comes to an end, publishers are joining librarians in working to ensure that scientific and technical information will continue to be available. Dementi (31) noted that items that are well used are the most likely to be archived and migrated to new media, so the risk of their being lost is minimized. The challenge will be to preserve important information that is used less frequently. Despite the problems faced in archiving materials, emerging technology offers hope for preserving the whole body of literature.

Conclusion

For more than three centuries, the journal article has served as the chief means of scientific and professional communication. No other form of publishing delivers its level of originality, rigor, and substantiation. Changes in technology have resulted in changes in presentation and have facilitated delivery in different media; however, the basic attributes and process remain unchanged. There is a trend toward databases of information that incorporate journals from many different publishers and disciplines, as well as nonprimary material. This trend is likely to increase.

Some thoughtful observers suggest that journal articles may no longer be the chief means of first communication of scientific information. The iterative process of drafting, revising, submitting, and revising again before an article reaches production takes more time than scientists may find acceptable for breaking news. Consequently, they may use conference presentations, trade publications, preprint servers, electronic discussion groups, and other means to share their discoveries initially. Having participated in an extensive dialogue, they will then write formal journal articles to assure that their work remains a part of the knowledge base.

Because of its rigorous process and the expectation that it will be preserved, the primary journal article is likely to remain the most relied-upon source of scientific information for some time.

Note. This article contains many *URLs* for Web sites. These were accurate as of April 1, 1999, but they are subject to change. Most commonly, Web-site owners redesign their sites and create new internal addresses; consequently, using the base *URL* may bring the searcher to the home page with pointers to the specific content sought.

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