4-1998

Designing the Future of Electronic Journals With Lessons Learned From the Past: Economic and Use Patterns of Scientific Journals

Carol Tenopir
University of Tennessee - Knoxville

Donald W. King

Recommended Citation

Carol Tenopir and Donald W. King. "Designing the Future of Electronic Journals With Lessons Learned From the Past: Economic and Use Patterns of Scientific Journals." In Proceedings of the Socioeconomic Dimensions of Electronic Publishing Workshop. Santa Barbara, CA: 1998 IEEE Advances in Digital Libraries Conference, April 1998. Pp. 11-17.

Designing the Future of Electronic Journals With Lessons Learned from the Past: Economic and Use Patterns of Scientific Journals

Carol Tenopir and Donald W. King
School of Information Sciences
University of Tennessee
804 Volunteer Blvd.
Knoxville, TN 37996 USA

Abstract: Studies of thousands of both university and non-university scientists demonstrate the importance of scholarly journals to their work. Amount of reading has remained high and scientists who read more are more successful. Readings have shifted from personal subscriptions to more readings from library-provided journals. Personal subscriptions have gone down from 5.8 subscriptions per scientist in 1977 to about 2.9 subscriptions. The drop is due to the rising prices of subscriptions, prices that have increased beyond inflation rates. Processing costs decrease some with electronic journals, but the high fixed costs associated with creating scholarly journals are the same for print or for electronic. The costs associated with some value-added features of electronic journals are high.

I. Introduction

This paper summarizes a series of studies performed by King Research and the University of Tennessee, School of Information Sciences [1, 2, 3, 4]. These studies provide trends concerning scientific scholarly journals dating back to 1960 including publishing (cost and number of journals, articles, pages, citations, etc.), authorship (number of authors/authorships, cost, revisions, time, etc.), readership (number of articles read, distribution of reading, cost, means of identification, sources, photocopying, usefulness and value of information, etc.), pricing (by type of publisher, sensitivities of personal and library subscriptions), library services (number of readings by type of service, service attributes, importance and satisfaction ratings, service costs, etc.), and interlibrary borrowing/document delivery (number of articles obtained and provided, cost, attributes of service, etc.). The studies involved surveys of 12,668 scientists (and over 8,000 other professionals, not discussed here) tracking a sample of scientific scholarly journals from 1960 to 1995 and in-depth cost studies.

Below we summarize data concerning the viability of scholarly scientific journals. We examine trends in authorship and the use, usefulness and value of scientific scholarly journals that are likely to influence electronic publishing. We also discuss two factors that have led to the current high journal prices. Most journals have relatively high fixed costs and a low number of subscribers. Thus, commercial and professional society publishers must charge much more than production and distribution costs in order to recover the fixed costs. Secondly, inflexible pricing strategies have led to personal subscriptions dropping in half. As a result, publishers have lost billions of dollars in annual revenue, which was recovered by raising prices to libraries at a rate much higher than inflation. They were able to do this because library subscriptions are much less sensitive to price changes [2]. Thus, pricing strategies have led to publishers losing revenue, libraries paying more for less, and scientists paying more in their time to obtain articles. We explain how reading patterns and pricing can affect publishing in the future.

II. Are Scientific Scholarly Journals Worth Saving in an Electronic Era?

A. *Authorship of Scientific Scholarly Journals*

The number of scientific scholarly journals and articles published per scientist have both decreased from 1975 to 1995. However, the number of authorships has increased due to an increase in number of authors per article. An increase in number of articles per journal and article sizes shows that the number of pages published per scientist has increased [1, 2]. The number of U.S. published journals increased from 4,175 in 1975 to 6,771 in 1995 (a 62% increase), but the number of scientists more than doubled during that time. U.S. scientists published 312,200 articles in U.S. and non-U.S. journals in 1975 and 577,100 in 1995, representing a decrease of about 15% in average number of articles published per scientist (i.e., about 2.64 million and 5.74 million in 1975 and 1995 respectively.) However, the average number of pages published per scientist has increased almost 70%. The number of authorships per scientist has also increased. For example, scientists in universities averaged authoring or co-authoring about one article per scientist, but this number increased to 2.1 in 1995. Authorship seems to be shifting further to university scientists (62% of all articles in 1975 to 75% in 1995).

0-7803-5101-0/98/$10.00 © 1998 IEEE

B. Use of Scientific Scholarly Journals

Recent surveys show that scientists continue to read scientific scholarly journals extensively. Scientists at the University of Tennessee read an average of 188 scholarly articles per scientist per year and scientists in six companies and government agencies read an average of 96 scholarly articles. While these results reflect statistical surveys from self-selected organizations, they are similar to two national surveys of scientists performed for the National Science Foundation in 1977 and 1984. Table I gives results of our readership surveys done from 1977 to 1997.

TABLE I
SCHOLARLY ARTICLE READINGS PER SCIENTIST PER YEAR BY UNIVERSITY AND NON-UNIVERSITY SCIENTISTS:, 1977-1997

	Year(s)of Observation (n=12,668)			
	1977	**1984**	**1985-1990**	**1991-1997**
University	150	172	------	188
Non-University	90	99	90	96

Sources: [1,3, 4]

Amount of reading of articles appears to be constant in non-universities and may be increasing in universities. While scientists in universities tend to read more than scientists elsewhere, the total amount of reading is far greater outside of universities than by university scientists because most scientists work elsewhere.

The sources of journals read by scientists have changed over the years. Currently scientists read at least one article from an average of 16 journals. They personally subscribe to an average of 2.9 journals (mostly as society members) and read an average of 19 articles from their journals (or about 55 readings total). In 1977 most reading was done from personal subscriptions (5.8 subscriptions per scientist), but now less than half of the readings come from this source. Now most readings come from libraries and shared office or departmental collections. Library journals in libraries studied average nearly 140 readings per journal (for a year's subscription). However, both individual reading and collective reading of library journals are highly skewed. That is, a few journals are highly read and many journals are infrequently read. For example, about 44% of journals are read 1 to 5 times by scientists, but 5% are read more than 25 times. Abundant evidence shows that scientists subscribe to journals that they frequently read and are not too expensive and use other sources such as libraries for journals infrequently read by them [2].

The library journals also have a highly skewed distribution of reading. About 30% of the journals have fewer than 25 readings, but 7% have over 500 readings. Both university and non-university libraries tend to subscribe to frequently read journals, but rely on interlibrary borrowing or document delivery to obtain copies of articles from infrequently read and expensive journals. Thus, determination of which journals to acquire is based partially, at least, on price and frequency of reading in libraries.

Scientific scholarly journals are read over a long period of time following publication (very much like a nuclear decay curve). For example, about 60% of readings by university scientists involve articles less than 9 months old, but about 7% of the readings are from articles over 12 years old. The readings of non-university scientists are from newer articles (67% less than 6 months old and 2% from articles over 12 years old). The older readings tend to be much more useful to research and teaching. Most of the readings of articles less than 6 months old come from personal subscriptions (over half), but nearly all articles over 2 years old come from library copies (over 85%).

Among fields of science, the average number of readings per article is estimated to be about 500 to 1,500 readings per article depending on the field. A typical journal has over 100,000 readings but, again, the distribution of readings is highly skewed.

C. Usefulness of Scientific Scholarly Journals

In all organizations the amount of scholarly journal reading is much more than any other type of document. Journals are read more than other types of publications because they cover a range of topics, there is an attempt to maintain content quality, the information is relatively current, and they can be read for a variety of purposes. Some of the reading is said to be done to keep current or for continued learning, which is why much of the reading takes place within 6 months following publication. However, many of these articles are read again later for scientific research or teaching purposes. Most non-current readings are done for research or teaching purposes and there is substantial evidence of the usefulness and value of the information obtained for these activities. For example, one-third of the relevant readings by university scientists are said to be essential to their teaching and even more are essential to their research. Non-university scientists rated the importance of the information read highly for every activity performed by them, and, in fact, when compared with five other resources (e.g., laboratory instrumentation, computing, receiving advice from colleagues, libraries, and support staff) the information in journals is rated highest among the resources for most activities and second highest in the others.

In both universities and non-universities, scientists whose work has been recognized through achievement awards and other forms of special recognition tend to read more than non-achievers. In universities, those whose teaching has been recognized read about 26% more articles than others and for research recognition the scientists read about one-third more articles. In non-universities, the amount of reading by "achievers" is even higher (i.e., 53% more

articles). In one company, 25 persons who were considered particularly high achievers read 59% more articles than others did and 52% more than cohorts who have similar fields of specialty, equivalent degrees and years of experience. This does not necessarily suggest cause (reading) and effect (achievement), but those who achieve should not be denied this important resource.

One reason that scientists read to keep current is that the amount of recorded scientific knowledge doubles about every 15 to 17 years. Thus in 1997, all the knowledge recorded throughout history up to the early 1980s has now doubled and will double again in 15 to 17 years. This means that when scientists graduate from college they will have been exposed to only a fraction of new knowledge that will be created during their careers. In fact, that knowledge base is only about one-sixth of the new knowledge that scientists must master during their careers. They must read or be left behind in their research and teaching.

D. The Value of Scientific Scholarly Journals

There are two aspects of value of the information in scholarly journals that are examined here: the purchase value and the use value [5]. The purchase value is what users are willing to pay for the information and use value reflects benefits gained from the use of the information. The two values can vary considerably from product to product. For example, air has low purchase value and high use value, whereas gems have high purchase value and low use value. The purchase value of information provided by scientific scholarly journals has two components: the money exchanged for subscriptions and the time of scientists expended in obtaining and reading the information. University scientists observed in our surveys average purchasing 3.9 subscriptions per year per scientist and non-university scientists average 2.6 subscriptions, but they spend much more in their time than the price paid. For example, university scientists average 182 hours per year reading the articles and non-university scientists about 12 hours obtaining and 121 hours reading the articles. Putting a reasonable hourly rate on scientists' time suggests that the price paid in their time is far greater than the subscription prices (even though these prices are hidden because most are journals obtained through society membership). Since scientists' time is a scarce and valuable resource, their willingness to expend it on information found in articles is an indicator of its value to them.

The use value is examined through several measures. Nearly all university readers (95%) indicated some favorable outcomes observed from samples of readings. Two-thirds of the readings are said to have improved the quality of teaching, research or other activity for which the article is read. The scientists also indicated that reading helped them perform the activity better (33% of readings), faster (14%) or saved time or money (16%).

In non-universities, about two-thirds of the readings are said to have improved quality, with ratings of quality (1 to 7) increasing from an average of 4.04 to 5.82 following the readings. The readings also resulted in performing activities faster (32% of readings), helped reinforce hypotheses or confidence in work (42%), initiated ideas for research (26%), broadened options (23%) or narrowed options (6%) concerning research. Five indicators of productivity were derived where outputs were number of formal records of research (e.g., lab notes), number of consultations, number of presentations, number of written proposals or plans, and number of formal publications written. Each output measure was divided by appropriate amount of time spent (e.g., doing research). The five indicators are all found to be correlated with amount of reading (i.e., statistically significant in each case). Another indicator of use value is scientists' perception of savings achieved as a result of reading articles. About 26 % of the readings are said to result in savings in time or other resources and the average savings are about $300 per reading (including those in which there are no savings).[1] Savings are said to result from avoiding having to do some primary research; stopping an unproductive line of research; or modifying research, analysis or engineering design; and so on.

E. Implications of Use, Usefulness and Value of Journals

There is abundant evidence of the continued authorship and extensive readership, usefulness and high value of scientific scholarly journals. Thus, future journal systems should strive to ensure that favorable attributes of the current system be maintained and, perhaps, improved upon. Such attributes include high content quality, currentness, accessibility, availability and reasonable cost per reading. However, evidence also suggests that there is tremendous variability in use among organizations, among scientific disciplines and journals covering the disciplines, among journals read by individual scientists, among library journals read collectively by scientists, and, similarly, among individual articles. Articles also appear to be read over a long period of time following their publication. All of these wide differences must be accommodated.

Perhaps the greatest advantage of emerging technologies is to provide an even greater flexibility to serve smaller and smaller niche audiences (in and out of universities) and satisfy more discrete information requirements. However, in order to do this there must be drastic changes in pricing strategies that can meet the economic needs of publishers,

[1] The average does not imply a typical saving since some readings have no savings and only a few readings (1 or 2%) account for nearly all the savings.

libraries, readers, and library funders. As shown in the next section, there is evidence that past pricing strategies have led to a lose, lose, lose, lose situation for these four participants.

III. WHY ARE JOURNAL PRICES SO HIGH?

A. Scientific Scholarly Journal System Costs of Resources

Libraries are experiencing a very difficult situation because spiraling prices have meant that they are paying more for fewer journals and this picture dominates discussions among publishers and librarians (and scientists). However, it is useful to examine resource costs of the overall journal system involving authors, publishers, secondary services, libraries, and readers. One systems view ignores moneys exchanged, but rather focuses on the total resources (i.e., labor, equipment, facilities, etc.) expended in the journal system (normalized by number of scientists). This is the true cost to society or the scientific community.

It appears that the cost of resources used to write articles is increasing some, but not appreciably; total publishing costs are moderately up; library journal processing costs are down because fewer journals are acquired, but costs of obtaining separate copies of articles is up, so that overall costs of resources are down some (again ignoring exchange of moneys); costs of resources applied to secondary services are thought to be up some (but this has not been confirmed); and the costs to readers has increased appreciably because of the additional time they (or someone on their behalf) expend in going to libraries to obtain articles that they read. Thus, total costs per scientist of resources applied in the overall system has increased, but not appreciably so. The resource costs are shifting some among the participants.

On the other hand, publishers are losing subscribers and have less revenue, libraries are paying more for fewer journals, readers are paying more in their time per reading, and library and reader funders are getting less for their expenditures. Evidence suggests that this may in part be due to past pricing policies.

B. Two Reasons Scholarly Journal Prices Are So High

There are two compelling reasons that scholarly journal prices have become so high. The first reason is that scholarly journals are characterized by very high fixed costs and a relatively low number of subscriptions to cover these costs. In fact, the current median number of journal subscribers is about 1,900 subscribers (down from 2,900 in 1975), yet the unit cost per subscription does not begin to level out (at about $100) until there are at least 5,000 subscribers. Below that amount, typical costs are about $840 per subscription at 500 subscribers, $440 at 1,000 subscribers and $200 at 2,500 subscribers. This problem is exacerbated by the fact that subscription prices have increased at a rate far higher than inflation, causing a reduction in number of subscribers, and hence, higher subscription prices. Below we briefly describe publishing costs and how lack of price differentiation between personal and library subscriptions has led to spiraling prices.

C. Publishing Costs of Scholarly Journals

We have derived a publishing cost model for print journals consisting of cost parameters (e.g., number of pages, issues, subscriptions, etc.) and cost variables (e.g., editing cost per page). The cost parameters for scientific scholarly journals (1960-1995) were observed from a sample of journals and cost variables were estimated for the years 1975 and 1995 from data found in the literature. The cost model for paper journals consists of five components: first copy article processing, non-article processing (e.g., covers, tables of contents, editorials, letters, book reviews, etc.), production (i.e., printing, binding, etc.), distribution (i.e., wrapping, mailing, etc.), and support (e.g., administration, promotion, finance, etc.). The model is not described here, other than to provide typical total costs using average cost parameters and cost variables.

For most scientific scholarly journals the article and non-article processing and support costs dominate total publishing costs. These fixed costs of a typical journal total about $400,000 and production and distribution costs come to about $40 per subscriber. This means that the publisher must charge $840 per subscription for 500 subscribers and $80 for 10,000 subscribers in order to recover costs. Looked at in this way, the price approaches an asymptote at the production and distribution cost ($40 per subscription).[2] This model helps explain why some journals must charge a high price, while others can charge much less. Scientific journals tend to cover disciplines that have a wide range of sizes (i.e., hundreds to hundreds of thousands) and, thus, a wide range of subscribers and prices. Incorrect pricing can lead to very large losses when the fixed costs are so large. For example, if the journal with costs above charged $200, but had only 1,000 subscribers the publisher would lose $240,000. In fact, the price and demand relationships are such that the downside risks tend to far outweigh the upside gains.

[2] Actually, there are fixed and variable costs within the production and distribution components making the results above slightly incorrect.

D. Price and Demand Sensitivities

Journal prices have generally increased at a rate faster than inflation since 1960 [1, 2]. However, the rate of increase was greater from 1975 to 1995 than before. The average subscription price in 1975 was $39 and $284 in 1995--an increase factor of 7.3 or 2.6 in constant dollars. Part of the increase is attributable to increase in journal size, number of issues published and other cost parameters [2]. However, the size increase and inflation together account for only half of the price increases. Cost of publishing resources such as paper, labor, capitalization of equipment and so on can also explain some of the increases, but not nearly as much as observed.

The accelerated price rises began in the late 1970s, triggered by inflation, fluctuating foreign exchange rates, and other factors. As a result, personal subscriptions particularly began to decline because of their high sensitivity of demand to price changes and, thus, revenues dropped precipitously. To recover revenue and cover costs, publishers increased prices to libraries where demand is much less sensitive to price changes. As personal subscriptions dropped, readers shifted to libraries as their source for much of their reading. Personal subscriptions dropped from 5.8 subscriptions per scientist in 1977 to about 2.9 in recent years. In universities in 1977, 25% of readings were from library-provided journals, which increased to 54% in 1995. Elsewhere, these proportions were 10% in 1977 and 37% in 1995. This was done at a sacrifice in readers' time required to visit libraries more frequently. Because prices increased at an accelerated rate to libraries, they began to cancel duplicate subscriptions and rely much more heavily on interlibrary borrowing and document delivery to replace expensive and infrequently read journals. Considering that there were about 5.7 million scientists in 1995 and they subscribe to an average of 2.9 fewer journals, there has to be an annual loss of billions of dollars in revenue that had to be recovered from library subscriptions.

To explain how price sensitivities occur with personal and library subscriptions [2], we developed cost models of alternative ways of obtaining articles: (1) readers subscribing or using the library, and (2) libraries purchasing or relying on obtaining separate copies. For both readers and libraries at a given price (and processing costs) one can establish a breakeven point of amount of use/reading below which it is less expensive for a reader to use the library (or a library to obtain separate copies) and above which it is less expensive to subscribe (as a reader or a library). Thus, over a range of prices one can establish breakeven points for personal subscriptions and for library subscriptions.

Using the distribution of reading by scientists and reading of library journals, one can establish the number of journals affected by increasing prices. For example, at a personal subscription price of $50, typical scientists should subscribe to about 10 of the 16 journals in which at least one article is read. Increasing the price to $150, scientists should subscribe to about one journal. Thus, amount of reading of individual journals by scientists is very important in determining the sensitivity of demand to price changes. On the other hand, the amount of reading of library journals is much higher and, as a result, demand is much less sensitive to price changes. Applying breakeven points, at $100 most library-provided journals read by users (87%) should be purchased. Increasing prices from $100 to $250 would only affect about 11% of the journals (i.e., 76% should still be purchased) and even at $1,000 nearly half should be purchased.

As an example, if personal and library subscription bases are 2,500 subscribers at $150, a price increase to $250 would decrease number of personal subscriptions to 719 (a loss of 1,781 subscribers) and library subscriptions would only drop to 2,284 (a loss of 216 subscriptions). This is why price increases over the years have severely affected personal subscriptions and why publishers have been able to increase library prices at a greater rate than inflation and still have the library market remain without dramatic decreases.

E. Costs of Electronic Journals

Electronic journals today are still a relatively small percentage of scholarly journal publications, but change is coming quickly. Two types of electronic journals are replicates of paper journals. Some publishers duplicate the journals in parallel (i.e., both electronic and paper). A few publish electronic journals that replicate the features of print journals. A third type of electronic journal includes enhanced features which add value to traditional journals. Totally electronic journals save in costs of reproduction and distribution (typically about $40 per subscription) and some costs associated with paper issues such as non-article processing of issue covers and other information. However, these savings are partially offset by electronic storage, software and, typically, higher labor costs. It appears that the costs of totally electronic publishing are less than paper, but not appreciably so.

The reason for this is that most activities that are performed are common to both media. The same is true for non-article processing for information that is common to both media and for support activities and costs. The major difference is in production costs in which paper production is replaced by electronic storage for online access or disk production for CDROM. Paper distribution is also replaced by online or CDROM distribution, thus electronic production and distribution costs are much lower than paper costs. However, these costs represent a relatively small amount for low circulation journals (i.e., those serving small disciplines).

Parallel paper and electronic publications typically cost more than paper alone because of systems-related costs. However, again these additional costs are not appreciable. The literature gives numerous examples of low costs of article processing for electronic journals. However, it is not clear that all costs are included in these figures, including costs of preparing intellectual content, computer and telecommunications infrastructure costs, and storage costs. Furthermore, most of the costs are for small journals. We have re-examined 1970/1980s data and found that unit cost of small journals are less than larger journals (contrary to the notion of economics of scale). Evidence suggests that the fixed costs per article tend to be relatively low for small journals, higher for larger ones and lower again for very large ones.

The wide range of value-added processes that may be offered with totally electronic journals will cost more. To begin with, publishers will be able to provide a database of journals, single journals, individual articles, or parts of articles. Various levels of information can be made available on examination, including titles, abstracts, reviews of the article, accompanying data, appendices, and so on. Sets of articles can be sent automatically to users, based on profiles of readers' interests. Quality of older articles can be rated by citation counts of authors (before or after publication), ratings made by readers, or ratings made by a panel of referees. Multimedia (including sound, motion, extended graphics, etc.) and interactivity (between readers and data, readers and readers, readers and authors, etc.) are all features added to electronic-only journals. Since any changes will affect costs, information and service attributes, and use, pricing strategies must be established for each.

The cost savings to buyers of electronic journals that have about 500 circulation is certainly less than 5%. Yet journals of 10,000 circulation could involve savings of about 50% (if savings were passed on to subscribers.) It is useful to examine these costs in terms of individual buyers (readers or libraries) and the extent to which the journals are read.

Choices between paper and electronic journals depend to some degree on price (circulation) and frequency of reading. Assume that a 5,000 circulation journal is priced at $120 and it costs readers about $11 to process and store the journal. The cost per reading varies by number of readings as follows: 10 readings--$13.10 per reading, 25 readings--$5.20 per reading, 50 readings--$2.60 per reading. Some journals are priced this low and are frequently read by individuals. It makes sense to provide such a journal by subscription to the frequent readers and provide electronic separate copies for the infrequent readers (ordered by them or their library, if the article is not easily located.)

Again, assume that a library purchases the $120 journal (5,000 circulation) and incurs processing costs of $68 and per use cost of $1.34 [2, 3]. The cost per reading would be as follows: 25 readings--$8.90 per reading, 100 readings--$3.20 per reading, 250 readings--$2.10 per reading. At this low price, it may be hard for electronic journals to compete on a cost per reading basis for highly read library paper journals.

These low costs are what must be considered in comparing electronic and paper access to traditional journals. It well may be that large circulation journals will continue to have a niche that serves scientists who thoroughly read the journal, even considering favorable attributes of electronic publishing.

A 500 circulation journal might be priced at about $840. It would cost a reader the following to subscribe: 10 readings--$85.10 per reading, 25 readings--$34.00 per reading, 50 readings--$17.00 per reading. Here, it might be less expensive to use electronic access over most feasible number of readings. With library subscriptions the comparable costs are: 25 readings--$37.70 per reading, 100 readings--$10.40 per reading, 250 readings--$5.00 per reading. Depending on electronic access costs, it may be less expensive for most libraries to obtain electronic access. Thus, there is little economic incentive to publish small circulation journals in paper, if electronic access costs are low enough.

Success in the future will also depend in part on inexpensive access to separate copies of articles and ability to easily identify and locate needed articles (using traditional bibliographic databases).

IV. Conclusions

Readership and other studies have shown that scholarly publishing and readership are characterized by a series of highly skewed distributions including readership audiences (i.e., disciplines) among journals; individual scientists' readership among journals; library journal readership; age of articles read; and number of journals provided among publishers. These distributions lead to wildly diverse needs that can best be satisfied by subscriptions to combinations of electronic and paper journals, complemented with electronic distribution of separate copies of articles. Overall system costs to publishers, libraries and scientists are minimized by a combination of media. In general, journals with small audiences probably should ultimately be electronic only with subscriptions complemented with separate copy distribution. Journals with larger audiences should publish in parallel, at least in the near future, also with separate copy distribution.

Pricing policies need to be reexamined with electronic publishing. Site licenses appear to make sense for universities and other large organizations–particularly if the licensees are given flexibility to distribute articles in an optimum manner in their organization. The wide range of sizes of research organizations outside of universities (characterized by hundreds of thousands of small, high tech companies) suggests price differentiation based on

organization size or readership. Precedence based on size has been established by the Copyright Clearance Center for royalty payments. Price differentiation can also apply to individual subscribers. Price differentiation will be necessary for value-added customization made possible with electronic journals [6, 7].

Ideally, site licenses with special libraries would be based on a fixed amount that makes all journals provided by a publisher available to the organization served by the library. The special library would then pay a nominal amount for paper distribution or electronic access in a manner that minimizes costs to the library and its users. Paper distribution could be made to current periodical rooms, department collections and individuals when there is a sufficient amount of reading to make it less expensive than electronic access. Electronic access would be made available for infrequently read materials and older articles (since binding and shelving should no longer be necessary). Advantages include minimizing organization costs, reducing internal electronic communication congestion, and avoiding excessive reading on the screen. Disadvantages include establishing an equitable fixed availability fee and some budgeting uncertainty, although existing document delivery also has this element of uncertainty.

Unfortunately university environments are sufficiently different to make such a plan unwieldy. University libraries serve a broader user base (faculty and staff, students, and external users) with a wider range of information needs and with more fields of interest. An exception might be when consortia are formed and availability fees can be negotiated by the consortium.

Differential pricing policies based on the unique characteristics of each environment are likely to remain necessary and desirable for electronic scholarly journals. Scholarly journals are likely to be available for quite some time in print only, electronic only, and a combination of electronic and print. From both a cost and use standpoint this mixture makes sense.

ACKNOWLEDGMENTS

This study was funded in part by a Special Libraries Association Steven I. Goldspiel Research Grant.

REFERENCES

[1] D. W. King, D. D. McDonald and N. K. Roderer, *Scientific Journals in the United States: Their Production, Use and Economics.* Stroudsburg, PA: Hutchinson Ross Publishing (Academic Press), 1981.

[2] C. Tenopir and D. W. King, "Trends in scientific scholarly journal publishing in the United States," *Journal of Scholarly Publishing*, vol. 28 no. 3, pp. 135-170, April 1997.

[3] J. M. Griffiths and D. W. King, *Special Libraries: Increasing the Information Edge.* Washington, DC: Special Libraries Assn., 1993.

[4] C. Tenopir and D. W. King, *The Transformation of Scholarly Journals: 20 Year Tends in the Economics, Use and Information Seeking Patterns of Scientific Print and Electronic Scholarly Journals.* Washington, DC: Special Libraries Assn., 1998 (in process).

[5] F. Machlup, "Uses, value and benefits of knowledge," in *Knowledge: Creation, Definition, Utilization.* Sage Publication, Inc., 1979.

[6] H. R. Varian, "Differential pricing and efficiency," *First Monday*, vol. 1, no. 2, 1996. <http://www.firstmonday.dk/issues/issue2/different/>. Accessed 9 April 1998.

[7] D. W. King, "Some economic aspects of the Internet," *Journal of the American Society for Information Science*, in press.