

The Transition to an Electronic Journal Collection: Managing the Organizational Changes

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Abstract

In 1998, the W.W. Hagerty Library of Drexel University made migration to an electronic journal collection as quickly as possible a key component of its strategic plan. With the year 2000 renewals, Drexel's journal collection consists of 953 print subscriptions and 4,951 electronic journals. A dramatic change in budget allocation and staff workload is the most immediate impact on library operations, but space, equipment, and even supply needs have been affected. Some of these changes were obvious and predictable; others, such as a sizeable increase in the need for skilled professional staff, were not. Almost no area of the library has been left untouched.

Introduction

Much has been written about the economic impact of electronic publishing on publishers. There has also been considerable discussion of library costs associated with the various methods of purchasing electronic publications and the corresponding licensing agreements. This paper addresses issues that heretofore have received little attention in the literature: identifying and managing the organizational impact of the transition from a print to an electronic journal collection in a university library.

In 1998, the W.W. Hagerty Library of Drexel University made migration to an electronic journal collection as quickly as possible a key component of its strategic plan. Staff and faculty saw this as both the quickest, most cost-effective means of improving an inadequate journal collection, and a way to make the collection more accessible. If a journal is available electronically, **only** the electronic version is purchased; the only exceptions are (1) when the electronic journal lacks an important feature of the print version (e.g., advertisements in business and fashion journals) and (2) when the journal is part of the browsing collection (e.g., *Scientific American* and *Newsweek*). With the year 2000 renewals, Drexel's journal collection consists of 953 print subscriptions and 4,951 electronic journals. A dramatic change in budget allocation and staff workload was the most immediate impact on library operations, but space, equipment, and even supply needs have been affected. Some of these changes were obvious and predictable; others, such as the substantial increased need for skilled professional staff, were not. In brief we set out to change the format of the journals from print to electronic, and it quickly became apparent that we were forcing fundamental changes in library operations. Almost no area of the library has been left untouched.

Issues relating to managing the transition to electronic collections, the impact on operations and costs, and the effect on those who will use electronic information are at least as important as the technological issues facing libraries. A common assumption is that converting library journals to digital format will improve service and lower cost, but this is yet to be proven. Understanding the costs associated with the library model for delivering digital information has now become a requirement for library survival since in the digital world, as opposed to print, the library has many viable competitors.

Background

Until very recently, the major barrier to developing a large-scale collection of journal articles was insufficient availability. Now electronic journals are rapidly becoming available via the World Wide Web, the electronic delivery mechanism of choice for most academic libraries. Over the past two years, many scholarly publishers, including societies, have introduced electronic access to their entire range of journal titles. We now have the critical mass of content necessary to make a real difference. Most scholarly publishers in science and technology and major publishers in other fields either have made their journals available online or have plans to do so.

The majority of librarians and publishers seem to feel that the transition from print to electronic journals will, and should be, gradual. Odlyzko (1) predicts that traditional scholarly journals will disappear in ten to twenty years, a less conservative estimate than most. He believes that print journals will be replaced with not just electronic equivalents, but with electronic alternatives that will be different from current scholarly journals. We believe the first-stage of the change, publishing an electronic equivalent, will occur even more quickly. History provides some evidence to support this view. The first remotely accessible databases came online in the late 1960s. Dialog became the first

commercial online service in 1972, and by 1975 there were 300 publicly accessible online databases. Nineteen eighty saw both the introduction of the first portable computer and "front end" software designed for end user searching. In 1984 the commercial networks TYMNET and TELENET offered 2400-baud service for public access to databases. End user searching took off in 1985 when the first commercial CD-ROMs rang the death knell for the "time clock" charging model of online services. By 1988, 3,893 online databases were available from 1,723 database producers and 576 online services. (2) Thus, indexing and abstracting services transformed themselves in about twenty years. This happened without the benefit of ubiquitous local area networks, the friendly Web interface and personal computers on the desktops of virtually all consumers of scholarly information and in the homes of one-third of all Americans. It took the remarkable technological developments of the '90s and another ten years for libraries to align with these changes and for users to take full advantage of them.

We now work in "Internet time." While some full-text has been available since the early 1980s, publishers only began in earnest making full-text of scholarly journals available in 1997. With new developments announced daily, it appears that most of the electronic availability problem (for journals) will be solved in another two to three years. The transformation is inevitable and will be fast. The publishers will have done their part. Should libraries wait for several more years to catch up? Our answer is "no." The advantages of the electronic model are so compelling that Drexel is implementing it as fast as possible.

Organizational readiness, important in any successful organizational change, has been critical to the ability of the Drexel Library to move so rapidly to a new model. These factors are:

- On the whole, the students and faculty are highly computer literate.
- The new President of Drexel University is an enthusiastic and outspoken advocate for electronic library collections.
- Drexel has the network infrastructure to support delivery of electronic journals. The Library and the entire campus were upgraded to a gigabit backbone in 1998. In terms of bandwidth, Drexel is also part of an elite group as a participant in Internet II and an early user of vBNS.
- The Dean of Libraries works closely with the Vice-President for Information Resources and Technology and is a full participant in Drexel University's information technology strategy.
- Faculty and students were dissatisfied with the Library's print journal collection. This collection had been reduced in the previous ten years due to a combination of high inflation in journal prices and a period of cost cutting at the University.
- Drexel has a growing number of online courses for distance education and recently established a campus in Delaware.
- The University committed substantial additional funding to the Library to improve the collections and services.

Drexel University is a technologically-oriented urban university rated Doctoral I in the Carnegie classification with strengths in engineering, computer science, information science and technology, design arts and business. Current enrollment is 10,000 undergraduates and 2,500 graduate students. Full-time faculty members number just under 500. The largest colleges are engineering and business, but students and faculty from Drexel's College of Information Science and Technology (IST) (recently ranked #1 for Information Systems and #9 for Library and Information Science by *U.S. News and World Report*) (3) are also a significant presence and a valuable source of advice and assistance.

All library services are centralized in the W.W. Hagerty Library, an attractive, stand-alone modern facility of about 100,000 square feet. The print collection is approximately 370,000 volumes. There are thirteen professional librarians, five systems staff and twenty-four support positions. In addition, the Library has seven Library Assistants, IST graduate students who work half time in the Library in return for a stipend and tuition remission. Library patrons utilize Drexel University's new gigabit wired network along with Lucent Technology's IEEE 802.11 local area wireless network standard for mobile laptops connecting at 8 Mbits/s. In addition, Public Access Workstations consisting of 100 Dell OptiPlex computers are available. The Library manages its own Web site and servers. This spring the Drexel Library will become the first library to complete implementation of the Oracle version of Innovative Interfaces, Inc.'s Millennium software.

The transition to electronic journals was initiated by the Dean of Libraries and had the unqualified support of the Associate Dean for Resource Management. Thus, there was no question of commitment within the highest levels of the organization, another factor necessary for successful organizational change.

Literature Review

Predictions of the demise of the library as a physical location have been a theme in the literature for many years. In 1994, Brian Hawkins called for the need to create a National Electronic Library immediately. His sense of urgency had to do with trends in library acquisition budgets through the 1980s and the fact that even though the most elite schools increased their budgets over that decade, their buying power for materials decreased by 27 percent. His position was that the obstacles for creating such an institution that emphasized access over ownership had more to do with "logistical, organizational, financial and legal" issues rather than technology. (4) Because so much progress has occurred on all these fronts in the past five years, especially in relation to electronic journals, libraries are now moving forward to the implementation of the journal part of the vision.

Friend made the case that economic models for evaluating the cost/benefit for electronic journal subscriptions are imperative and offered a tentative cost-per-use model for electronic journals similar to those traditionally employed to evaluate print journal titles. He identified the cost elements associated with making electronic journals available in a given library including: publisher payment, hardware, network and staffing costs. He then went on to discuss both the direct and indirect assumptions that are implicit in a valid economic model and the difficulties inherent in calculating the true value to the user. (5) The preliminary cost analyses we have conducted thus far at Drexel are based on a comparable approach. We identified the operational cost elements associated with journals in each format (print and electronic), including both startup and operational

components, and then looked at their contribution to the cost of maintaining journal collections in both formats. (6)

In a 1999 article, Odlyzko pointed out additional factors to consider when evaluating the impact of journal growth on libraries:

Journal subscription costs are only one part of the scholarly information system...Internal operating costs of research libraries are at least twice as high as their acquisition budgets. Thus for every article that brings in \$4,000 in revenues to publishers, libraries in aggregate spend at least \$8,000 on ordering, cataloging, shelving, and checking out material, as well as on reference help. The scholarly journal crisis is really a library cost crisis. If publishers suddenly started to give away their print material for free, the growth of the literature would in a few years bring us back to a crisis situation. (7)

Odlyzko's figure that the library's non-subscription (i.e., operational) costs are on average double the subscription costs was derived from the Association of Research Libraries statistics. (8) His is a macro level measurement that did not take into account, for example, the different processing costs for books and journals or library costs unrelated to the collections which might cause the figure to be over-estimated. On the other hand, ARL statistics do not report the considerable costs associated with constructing and maintaining library buildings, a factor which if added to Odlyzko's number would lead to a higher estimate of non-subscription costs. But even if off by a factor of 100 percent, Odlyzko's estimate is astounding to consider and points out the importance of looking at how these operational costs shift in the transition to an electronic model.

Using a life-cycle cost analysis approach, Lemberg demonstrated in his 1995 dissertation that the cost of providing documents in a digital form is less than the cost of storing and providing access to documents in paper format. He calculated the cost-per-document in the electronic format averaged \$2.78 as compared to a cost of \$17.20 per document for the print format for items retained over the same life cycle. (9) Projects like JSTOR, which builds journal backfiles, do address building-related costs. One of the JSTOR objectives is "To reduce long-term capital and operating costs of libraries associated with the storage and care of journal collections." (10) By guaranteeing online availability of backfiles, JSTOR not only makes these files more accessible but also allows libraries to discard old journal runs without decreasing service to their users.

The Electronic Libraries Programme (eLib), funded by the Joint Information Systems Committee (JISC) in the United Kingdom, is a series of major library projects investigating issues of digital library implementation and integration within existing libraries. Pricing models for electronic journal subscriptions, licensing agreements, and infrastructure requirements to provide access are themes explored in these projects. Each tends to be fairly focused in terms of the range of digital content and services offered. A specific goal of the electronic journal projects is "to develop organisational and management models" which can serve as a basis for future scaling-up initiatives. (11) Building on the findings of IMPEL (Impact on People of Electronic Libraries) and IMPEL2, researchers Banwell, Day, and Ray have conducted qualitative studies which investigate how to manage organizational change in the libraries carrying out eLib projects. They identified predictable changes and strategies for managing them. They

also produced a development matrix to be used as a benchmarking tool within individual institutions. (12) Many of the issues described in this study, such as developing a vision, communicating the vision, building information technology expertise within the library, and staff retraining, are the same as those faced by Drexel in its transition to electronic journals.

Halliday and Oppenheim conducted studies of the economic aspects of the digital library in the context of entire library organization. They looked at four different types of models from the various eLib projects based on distribution methods and content costs and concluded that further research is needed before a model to represent the entire digital library (in the context of a larger operation) can be developed. (13)

Bleiler and Plum surveyed all ARL libraries in the summer of 1999 to determine how libraries have structured themselves to identify, evaluate, purchase and publicize all types of networked information resources including databases, full-text, and e-journals. (14) They found a number of approaches, but that most commonly, reference librarians and subject bibliographers play the dominant roles. Even from examining only this subset of library operations impacted by acquisition of digital resources they concluded that: "Developments in computer technologies have irrevocably altered library operations" and "Networked resources have changed the way libraries operate, and growth in number and importance of these resources should push libraries even more into a cross-departmental, multi-channeled team."

Development of Drexel's Electronic Journal Collection Planning, Infrastructure and Communications

Library administrators first communicated their desire to migrate to an electronic journal collection via a strategic plan drafted in the spring of 1998. At that time, the Library provided remote access to only a handful of databases via TELNET and subscribed to one full-text collection. Staff completely re-designed the Library's Web site during the summer of 1998, placing major emphasis on the electronic resources section. Using funds from a substantial increase in the budget, Web-based versions of popular databases and several collections of full-text journals were made available on the new site by the fall of 1998. The total number of print journals at that time was 1,850 titles. For 1999 and 2000 the number of print journals was reduced to 1,475 and 953, respectively. Some of the reductions were made because of subscriptions to an electronic counterpart; the others were not renewed primarily on the basis of low use. Beginning in the fall of 1998, through 1999, and into 2000, we added electronic subscriptions as they became available, bringing the current total to 4,951 unique electronic titles. There is a 200-title overlap between print and electronic titles because of some publishers' requirements that we purchase print titles to receive the electronic counterpart. Our strategies to eliminate print in those situations are discussed below.

The Library developed the infrastructure required for the electronic collections in the summer/fall of 1998. To support the enhanced Web site we purchased a high speed Sun server and hired a Webmaster. The building was completely re-wired and eighty-eight new state-of-the-art public access computers installed. Twenty-seven of these computers are in an "information hub" near the reference desk, where most of the user support for the Library's electronic resources takes place. Thirty of the new computers are laptops that can be checked out by students for use with the Library's wireless network.

The Web-based electronic resources services were well established by the spring of 1999 when the Dean of Libraries "floated" her intention of preferring electronic versions of journals to print whenever possible for the year 2000 subscription renewals. After endorsement by the Provost, the Library Advisory Committee and the Council of Deans, the Dean presented the plan at a general faculty meeting. Negative feedback was surprisingly absent. The response from faculty of the two largest colleges at Drexel, engineering and business, was overwhelmingly enthusiastic.

Selection and Acquisition of E-Journals

Library staff began developing and refining selection methods for electronic journals in 1998. The selection/ordering process is a team effort involving professionals with subject knowledge, traditional serials ordering experience, negotiating expertise, and computer and technical skills. The selection process is much more complex than the one in place for print journals. The primary factors used to evaluate print journal subscriptions are content, cost, faculty requests, Journal Citation Index ranking, and importance to the collection. Electronic journal subscription decisions include additional factors such as: interface options, search features, display format (HTML and/or PDF), access restrictions, whether the journal is part of an aggregator's collection, the availability of a persistent URL, inclusion of color, and resolution of images. Additionally, whether the journal's articles are linked from one of our citation databases or from articles in other online journals, or have the capability of linking to other full-text articles are all part of the decision criteria.

The challenge is to manage and track all of these variables and to produce meaningful reports for the journal selection process. We need decision support tools at both broad and finer levels (e.g., publisher, vendor, subject and title levels), and we need to be able to analyze the costs related to our journal collections. At Drexel we are developing a local journal subscriptions management database to track not only the information about these additional selection variables but also to track other data needed in the decision-making process that we have not kept in a systematic manner before. This other data includes information about the requestors, available formats, use statistics by format, vendor, cost-per-title, and a record of decisions made concerning specific titles over time (including rejections). Our plan is ultimately to link this subscription management database to our online library system in order to have dynamic updating of use statistics for print, interlibrary loan transactions, and possibly electronic journal usage. One of the key features of this local subscriptions database is the integration of the formats in one place. This was essential in order to understand and compare the rapid changes we are making in the journal collections.

Another aspect of managing journals that is radically impacted in this rapid migration to e-journals is our relationship with our subscription agent that until now was based on the print format. Drexel is collaborating with Swets Subscription Service to explore a new role for the subscription agent (aside from an online journal service which we did not need since our electronic journal "holdings" already exceeded the SwetsNet service by several thousand titles). Swets is now our chief subscription agent for both print and electronic journals and understands that our goal is to move deliberately and aggressively away from the print format. We are working together to redefine and better understand their role in this process. What services can the subscription agent provide in this arena? The ordering process is similar but most definitely involves new elements, chiefly with respect to establishing access to the electronic journal. One of the most vexing problems is that publishers have many different procedures and arrangements for

access. Swets is working with us to facilitate and expedite this process. We are also exploring other needs related to the electronic journal format and experimenting with the capacity of Swets to provide services to us in this new way (e.g., requesting e-journal only pricing, developing a "claims" process when access is not turned on as expected).

The Library now provides access to 4,951 full-text electronic journals through agreements with over forty-seven content providers. (See the **Appendix**.) The list of vendors and services is accessible from the Library's electronic resources page. We are actively seeking agreements with all additional vendors who have relevant full-text material falling within the scope of the Library's collection policy.

Whenever possible, we are purchasing only the electronic version of a journal and canceling the corresponding print publication. When the publisher's policy requires purchase of the print journal in order to have access to the electronic counterpart, we try to negotiate a discount for the e-journal only. This has met with limited success so far but has the advantage of educating publishers about our needs. Because of the costs associated with receiving, processing, binding and storing print journals, the following strategies are under consideration for eliminating print when the Library has purchased electronic access:

- Discard the print journal when it arrives.
- Give the print journals to the Colleges for departmental collections or to circulate among faculty. (Unfortunately, most of the Drexel deans do not want the print journals.)
- Give the print journals to faculty who want them. (Because of the workload associated with working out an equitable policy for determining who should receive the journals, then developing procedures for distribution the issues, and problem-solving when something goes wrong we fear this may be more trouble than it is worth.)
- Intercept receipt of the print format at the distribution level. Swets is depositing the print copy of some of our bundled titles into their missing issues bank so that we do not receive the print format.
- Deposit the journals with a missing issues jobber.
- Keep the print journals in the current journal area for browsing, and implement one of the strategies described above rather than bind them.

For FY2000 we decided to keep most of the print equivalents in order to measure their use. This data will provide direction on the value of continuing the investment in storing and maintaining these journals. We are also evaluating the need to continue storing our JSTOR print equivalents. We have discarded nearly all the print indexes up to the date that the online database begins.

Drexel's decision not to maintain backfiles of print journals will seem cavalier, if not totally irresponsible, to those concerned with the archival role of libraries. Our position is that archival storage in most subject areas is not part of the mission of the Drexel Library. On a national, even international basis, archiving of old, little-used materials would be much more cost effective if done centrally (or in a few places for the security provided by redundancy). This is true for both electronic and print formats. We are willing to make the leap of faith that this will happen, and are ready to pay the cost of access to the archived materials when they are needed. In strategic terms, we believe

that our future environment will include a central archives that we will be able to use and are planning now as if that will be the case. There are several large national and international organizations addressing this issue. Among them are the Research Library Group (RLG) and OCLC (15) and JSTOR (16). It does not seem reasonable to deny our current students and faculty what we believe is a far superior service in order to be in a position to acquire and store print journals that will be used infrequently in the future and will not themselves last forever. Like most academic libraries, we are storing hundreds of feet of crumbling print journals that we will never convert to another medium for storage purposes.

Providing Access to Electronic Journals

Providing the appropriate tools so that users can identify the titles in the electronic collection and then connect to them has been an evolving process. Initially, we created HTML lists of titles arranged both alphabetically (one page per letter) and by several broad subject categories. Users who wanted to locate a specific title or find a particular issue could use the journal-by-title approach to link directly to the title or service. Those who wanted to browse the titles by subject could review the subject lists. This approach was less than ideal for several reasons. When the vendor provides a persistent URL for a journal title, we can link directly to the title. But often access was only to an aggregator's service; then users had to figure out how to search for the specific title or article they wanted. Moreover, each aggregator's interface is different, compounding the problem. There was no way for users to search for a particular title or title word without connecting first to the HTML page corresponding to the first letter in the journal title and then scrolling through that page. Moreover, manually maintaining the 200 or more static HTML pages, some very large, was labor intensive. It was necessary to add and delete titles frequently and each addition or deletion required changing both the alphabetic and the affected subject lists.

During 1999 we solved most of the workload problem by creating a local database to store the journal titles, vendors, URLs, coverage dates, and subject areas in one place. The HTML pages are generated dynamically each night. This reduced maintenance time significantly and allowed expansion of the number of subject areas from eight to approximately fifty. Soon users will be able to conduct a dynamic search of this journal database directly from a Web form to perform their own keyword search of titles, publishers, or combinations of subjects. Unfortunately, we do not have a solution to the problem caused by lack of durable URLs in aggregators' collections.

Staff delayed cataloging the electronic journals at first because of the dynamic nature of the collection as we were developing it. We intend to catalog the electronic journals that meet the subject level criteria of our collection development policy. This will allow users to search the online catalog to determine the full range of our holdings in either print or electronic format, and then to link directly to the electronic journal from the MARC record. Cataloging will begin as soon as we migrate to our new automated library system, Innovative's Millennium product running on an Oracle platform.

The chief reasons for cataloging electronic journals are integration and access. The MARC record is a highly developed standard for library materials. In addition to integrating access to both print and electronic formats, using the MARC standard allows full searching of the information contained in the bibliographic record (ISSN, title changes, series, etc.) and, most importantly, facilitates full application of the Library of Congress subject headings to these records. We plan to continue using the database

and envision that the opportunity to join the database and the catalog (and thereby continue to reduce maintenance and overhead costs) will be possible. We are developing our local databases on platforms that allow for future functional enhancements to our procedures such as electronic journal check-in for current issues, and are already discussing these ideas with vendors and programmers.

One of the obvious advantages of providing an electronic journal collection is that the format allows for access from multiple locations and even access to the same article simultaneously by multiple users. The Drexel community can use almost all of our electronic collection from their desktop in their office, from their dorm room or from home - anywhere they have an Internet connection. A handful of content providers still have requirements that present barriers to use, such as allowing access only from the Library or the campus, or requiring users to login with a password. We continue to negotiate with them to remove their restrictions.

Impact on Library Operations

Table 1 provides an outline of the major impacts we anticipated as a result of the migration to electronic journals. Library statistics, budget analyses, adjustments in staffing and simply an examination of our day-to-day experience show that almost no area of library operations has been left untouched by the migration from print to electronic journals. One clear conclusion can be drawn from this table. There is a decrease in the staffing needs, and thereby, in operational costs associated with maintaining print journal collections. Shelving, stack maintenance, support for photocopying, manual statistics collection, journal check-in, claiming, and binding are all reduced (seen mostly in the top of the table). However, these reductions are offset by increased staff time dedicated to journal selection and acquisitions, database and Web site maintenance, instructional programs and reference, and systems. The decreased needs are in areas like reserve desk staffing and shelving done by the Library's least skilled and lowest paid workers: students and entry level clerical staff. On the other hand, increased needs are predominantly in areas staffed by the best compensated staff: systems staff, professional reference and technical services staff, and administrators. Preliminary calculations indicate that the new costs associated with electronic journals are greater than the savings in the staff costs related to print journals.

(17)

Table 1
The Transition from Print to Electronic Journals:
Changes in Staffing and Other Costs

Department	Activity	Impact
Circulation/Access	Re-shelving Stack maintenance User photocopying Collecting use data	Reduced staffing Reduced staffing Reduced use & revenue Reduced staffing
Reserve	Article file maintenance Article checkout Maintaining e-reserves	Reduced staffing Reduced staffing Increased staffing
Technical Services	Print journal check-in E-journal acquisitions Claiming Binding Binding Cataloging print Cataloging print Cataloging e-journals Cataloging e-journals Catalog/e-journal list maintenance Print subscriptions Electronic subscriptions	Reduced staffing Increased staffing Reduced staffing Reduced staffing Reduced bindery costs Reduced staffing Reduced OCLC charges Increased staffing Increased OCLC charges Increased staffing Reduced costs Increased costs
Information Services	Reference at desk Instruction/Promotion Preparing documentation Journal selection	Increased staffing Increased staffing Increased staffing Increased staffing
Document Delivery	Faculty copy service Interlibrary loan - Borrowing Interlibrary loan - Borrowing	Reduced staffing Reduced staff costs Reduced vendor charges
Systems	Infrastructure purchase Infrastructure maintenance Infrastructure maintenance Negotiating contracts Setting up access Developing decision support tools Collecting use data Printing	Increased equipment costs Increased staffing Increased contract costs Increased staffing Increased staffing Increased staffing Increased staffing Increased staffing Increased costs & revenue
Space Utilization	Occupying space	Decreased space needs
Administration	Managing the change Attention to decisions Budgeting	Increased staffing Increased staffing Increased staffing

This print to e-journal "experiment" is not the only change taking place in the Drexel Library or at the University itself. Undergraduate enrollment has increased by about 10 percent per year over the past four years. The Library is in a rapid development stage overall. In the past two years there have been major improvements in the physical facility, an almost complete upgrade of the technology, changes in the key administrative and professional positions, substantial policy changes, service improvements, and a large infusion of funding to improve the monograph collection. As explained below, when we examined our statistics, some of these factors counterbalanced the changes we expected from the transition to electronic journals. Most importantly, the Library's gate count is growing due, we believe, to rising enrollment combined with all the improvements. We expect that this higher level of library use in general would lead to some increase in all use measures.

Circulation/Access: Shelving and photocopying are functions of the Access Services Department. Bound journal re-shelving has been reduced by 29 percent; re-shelving of current (loose) journals is down 30 percent in the past year and a half. This is a dramatic change. We have eliminated one of four permanent shelving positions while using about the same amount of student help. Very poor photocopy machines, managed by an under-performing vendor, were replaced in the summer of 1998 (just about the same time the electronic journals were introduced) by new machines managed by an excellent vendor who has staff on-site. This improvement more than compensated for any reduction in photocopying of print journals at that time. We now have photocopy use statistics based on the new machines for a year and a half. They show that for the period from October 1999 through February 2000 photocopying on machines used by students dropped 20 percent below use in the same period in the previous year.

Statistics collection, an activity that consumes a lot of staff time, is *in theory* (18) easier in the electronic environment where it can be done automatically. At Drexel, collection of journal statistics is only partly automated. Fewer journals to shelve translates to less time collecting statistics.

Unexpectedly, book re-shelving and book circulation have fallen by 20 percent this past year. This is particularly remarkable since it happened at a time when the Library's gate count is up 36 percent (from 1998 to 2000), and there has been a major investment in the book collection. Does this mean that students are substituting Web-based information for a large portion of the information that they obtained previously in printed texts? Drexel has begun experimenting with e-books via netLibrary and by cataloging important free monographs on the Internet. However, the number of electronic books we have made available so far is much too small to have contributed to the significant change in use of the print collections.

Reserve: Circulation of reserve materials, which was steady at about 30,000 items per year, dropped by 50 percent during the current academic year (1999/2000). Since we will not be implementing an electronic reserve system until this coming summer, this change is likely due to the availability of electronic resources. What portion of the e-resources used are electronic journals, and what are other e-resources, is an open question. Less staff time will be needed to maintain and circulate the print reserve collection; however, maintenance of the electronic reserves collection will become a new staff function.

Technical Services: Less staff time is required for all Technical Services activities associated with print journals: check-in, claiming, repairing, replacing missing pages, and binding. To date we are re-deploying staff to work on clean-up projects associated with a recent physical re-organization of the journal collection and a migration to a new automation system. However, there is an increased workload in Technical Services in the area of providing access to electronic journals. Maintenance of the database described above that now creates our journal lists is still a major task since the collection is much more volatile than a print collection. Links break, coverage changes, and sometimes the electronic journals themselves are available through a new distributor. And in the current environment, journals are added and sometimes discontinued intermittently by aggregators during the year. The job of maintaining this database, and eventually e-journals in the Library catalog, requires a higher level of skill than the activities associated with maintaining a print journal collection. Thus, we are facing the need to either retrain, re-deploy, or reduce existing staff.

Subscription Costs: To state the obvious, in the scenario we are describing, print subscription expenditures have decreased and electronic journal expenditures have escalated. Drexel's current print-only journal subscription costs (19) are \$112,564, down from approximately \$355,000 two years ago. Electronic subscription costs are more difficult to calculate as we subscribe to some services and databases such as Academic Universe, RDS Business & Industry, and ABI Inform that are part database, part electronic journals. With a "best guess" allocation of the cost of these services, we are spending or expect to spend \$335,000, after renewals, for electronic journals in the 1999/2000 academic year. Only the e-journal figure includes the cost of journals received in both formats. We are receiving far more journals for our e-journal dollars since they almost all include several back years. The cost of paying for these backfiles in print would have been prohibitive.

On a per title basis the e-journal dollar has more purchasing power. Print journals now cost an average of \$118 per title, while e-journals are \$68 per title. This difference is all the more remarkable considering the fact that nearly all the electronic journals come, even when a subscription is first entered, with several years of backfiles.

Information Services: Questions at the reference desk have been decreasing. The statistics confirm staff observation that students using the computers in the "hub" near the reference desk are much more self-sufficient than patrons dependent on a combination of text-based online resources and print. For the current year we calculate that the number of reference questions will decrease by about 15 percent. The offset here is that the Information Services staff spend time on outreach and instruction activities to make faculty and students aware of, and competent with the Library's resources and services. And the e-journal selection process, a responsibility of the Information Services Librarians, is more time-consuming now that electronic journals must be evaluated. These librarians also publicize new electronic resources and prepare documentation to help users understand how to use them. The assignment of these responsibilities to the Information Services Librarians follows the practice of the majority of ARL libraries. (20)

Document Delivery/InterLibrary Loan: There is no evidence so far that the expected decrease in "borrowing" photocopies of journal articles is occurring. Total requests for journal articles from Drexel users filled either via InterLibrary Loan or from the Library's collections is actually growing modestly. Drexel's campus document delivery service,

which provides copies of articles from the Drexel Library collections free of charge to faculty, will deliver about 1,000 articles from the electronic journal collection this year. These, presumably, are for faculty who are not aware of the ready accessibility of e-journals, or who either cannot or choose not to, retrieve the articles themselves. Likely the primary reason is lack of awareness, something the Library staff is addressing campus-wide.

So far, due to the publishers' license restrictions or, in one case, onerous record-keeping requirements, Drexel has not "lent" articles from electronic journals. We will give this issue some attention in the coming year.

Systems: The Library has added four staff in the systems area in the past two years. Two are responsible for infrastructure and PC setup and maintenance; a percentage of their time should be allocated to e-journals since use of these journals is a large component of infrastructure use. The other two systems staff are the Webmaster and the Electronic Resources Librarian. The Webmaster has easily spent 30 percent of his time on electronic journal access while we have maintained the numerous large HTML pages listing e-journals and developing the journal database. As we move to a cataloging model, the involvement of the Webmaster in this area will probably decrease. The Electronic Resources Librarian, a new position created to provide a focal point for integrated development of all electronic resources, spends the majority of her time keeping up-to-date on the availability of new electronic resources, negotiating with vendors, interacting with consortia that function as "buying clubs" for purchase of electronic resources, communicating IP information to vendors, maintaining the content on the electronic resources pages, and gathering and organizing statistics for electronic resources. Because of their large number and the rapid change in this area, a high percentage of the Electronic Resources Librarian's time is dedicated to electronic journal issues.

None of the Library hardware is used exclusively for electronic journals. The servers, network and PCs are shared among the Library's electronic and computer services. Printing from the public access PCs is done to a laser printer located behind the circulation desk. This is an interim solution. We are waiting for the development of a campus-wide solution that will allow charging directly to a student's account, thereby eliminating the need for the Library to handle money for printing. Revenue from printing should compensate in part for loss of photocopy revenue from journals.

Space Utilization: The transition to electronic journals essentially eliminates space concerns; no more trimming the collection, converting to microfilm, or moving it to a remote location to make space for new volumes. Eventually, because of retrospective conversion efforts like JSTOR, we will be able to reclaim journal storage space for other purposes. The cost savings both on a capital and annual basis are considerable. At \$100 per square foot (21), the typical cost for library buildings in large urban centers, the 20,000 square foot space currently occupied by the Drexel journal stacks would cost \$2,000,000 to construct. Estimating annual maintenance costs at \$12/square foot, the cost of the space occupied by the Library's journal collection is approximately \$240,000 per year.

Administration: Journal issues have always required serious attention from academic library directors. In science and technology libraries they often consume the majority of the materials budget. Faculty often have strong feelings about particular titles which

they do not hesitate to make known. A decision to subscribe to a journal has long-term implications which must be considered. And for the last two decades as prices escalated so dramatically, directors became involved in seeking ways to pay for the price increases and in instituting cost cutting measures. Electronic journals raise new issues which require the director's involvement to an even greater extent. Determining a strategy for e-resource acquisition, communicating and obtaining institutional support for the strategy, contract negotiation and review, joining consortial "buying clubs," building a staff with the appropriate skills, and managing the change are some of the activities that are new or escalated for a director who makes a major commitment to electronic journals.

In regard to flexibility in staffing at the clerical and technician levels, Drexel has an advantage not available to most other academic libraries. We have instituted a policy of hiring only masters students from Drexel's College of Information Studies into these positions whenever possible. These students benefit from free tuition and from the "real world" experience. The Library benefits from the skills and maturity the students bring to their jobs **and** from the fact that they graduate and leave for professional positions after two years. This allows for staff reductions and frequent work re-assignments without the necessity of layoffs.

Impact on Drexel University Students and Faculty

Staff have developed a multi-faceted promotional effort to make students and faculty aware of the electronic journals. There have been announcements on the Library Web site, announcements via electronic mail to both the general community and specific colleges, vendor demonstrations, and articles in campus publications. We have received much of unsolicited positive feedback from our users. The dean of one of our engineering schools has stated categorically that her faculty only want online journals, "They are not interested in print."

In order to systematically assess the user impact of the journal transition and other changes in the Library's collections and services, a survey was distributed via electronic mail and the Web to all Drexel faculty and students in June of 1998. (22) This survey was intended to establish a baseline against which to measure the success of planned changes in many library services. A total of 473 responses were received. A nearly identical survey was distributed exclusively via the Web in June of 1999, about nine months after the first electronic journals were made available. Total responses were 135. In addition, we gave a brief survey to all persons who entered the Library during nine one-hour periods in October 1999. (23) The number of respondents was 500. Results of the responses to the parts of the surveys relating to print and electronic journals are given below.

Tables 2 and 3 show that in the brief period of a year, reported use of electronic journals is roughly equal to reported use of print subscriptions among graduate and undergraduate students. Satisfaction with electronic journals is also roughly equivalent for both groups, and satisfaction among students with both formats is relatively high. (See **Tables 4 and 5**) Sample size for faculty is too small to draw conclusions. It is tempting to speculate that by October 1999 most faculty were using electronic journals from their offices, thus accounting for the low number of faculty entering the Library. On the other hand, faculty may be sending students to the Library to look for articles, or have little time for research during the beginning of the school year. The relatively high level of satisfaction recorded by the surveys for the print journal collection is surprising

and contrary to nearly all informal comments received from faculty and students. It will be interesting to see if this result continues in the third online survey that is scheduled for May of 2000.

Table 2
Use of Print Periodicals

User Class	June 1998 Online Survey YES (%)	June 1999 Online Survey YES (%)	October 1999 Door Survey YES (%)
Faculty/Staff	86 N=83	75 N=12	60 N=5
Graduate Student	80 N=158	80 N=41	78 N=140
Undergrad Student	72 N=230	60 N=82	66 N=290

Table 3
Use of Electronic Journals

User Class	June 1998 Online Survey YES (%)	June 1999 Online Survey YES (%)	October 1999 Door Survey YES (%)
Faculty/Staff	NA	75 N=12	80 N=5
Graduate Student	NA	83 N=41	74 N=140
Undergrad Student	NA	66 N=82	57 N=291

Table 4
Satisfaction with Print Periodicals

User Class	June 1998 Online Survey*	June 1999 Online Survey*	October 1999 Door Survey YES (%)
Faculty/Staff	64 N=78	67 N=6	25 N=4
Graduate Student	64 N=152	84 N=19	79 N=104
Undergrad Student	73 N=222	72 N=29	69 N=297

*Percent rated 6 or better on a scale of 1-10.

Table 5
Satisfaction with Electronic Journals

User Class	June 1998 Online Survey*	June 1999 Online Survey*	October 1999 Door Survey YES (%)
Faculty/Staff	NA	40 N=10	25 N=4
Graduate Student	NA	82 N=28	74 N=88
Undergrad Student	NA	82 N=56	63 N=164

*Percent rated 6 or better on a scale of 1-10

Statistics comparing the print journals to the electronic collection on a cost-per-use basis are one of the best measures of collection value. Unfortunately, at this stage of e-journal development, comparable title-by-title use data is not available from many of our vendors. Some statistics come in print, some via computer files, and some are posted on vendor Web sites. The statistics do not always come regularly; long delays are common; the terminology used is not defined; time frames are different (monthly, quarterly) and one vendor lost several months of use statistics due to a systems crash. We are in the process of identifying what is available, determining comparability (is it site accesses, title accesses, article hits, page hits?), and bringing the data together for analysis.

Discussion

In a 1995 *Harvard Business Review* article, Kotter describes what he believes to be the eight stage process necessary for an organization to create major change. (24) His insights come from watching more than 100 companies try to make fundamental changes in the way they conduct business. Many of these steps have been incorporated into the journal transition project at Drexel. A sense of urgency (Step 1) was created by the University administration which expected tangible results from their major investment in the Library and also by vocal dissatisfaction with the collections expressed in comments from faculty and students.

Steps 2 (Creating the guiding coalition), 3 (Developing a vision and strategy), and 5 (Empowering broad based action) were all carried out by the Library's top management, the Dean and Associate Dean. In early 1998 most of the Library's key administrative positions were open and a systems department did not exist. Persons who were hired shared the vision and formed the core implementation team. The Dean and Associate Dean communicated the vision for change (Step 4) broadly and continuously to the staff and to the user community. Most staff embraced the vision and the Library Advisory Committee, made up of students and faculty representatives from all the Colleges, voted their support.

The primary obstacle in implementation was resistance of some of the Information Services Librarians, who are responsible for collection development for specific colleges. They saw advocacy for print journals in their areas as one of their roles. Establishing objective evaluation criteria, providing data pertaining to these criteria (such as use data, availability of electronic versions) and compromise (we'll wait one more year before making the change) were all part of working through these issues. The total and often expressed commitment of the library leaders - and surely their positions - facilitated overcoming this and other minor obstacles.

The Drexel Library staff generated short-term wins (Step 6) in the fall of 1998 by bringing up a completely revamped Web site with many databases important to the Drexel community and a critical mass of electronic journals, and by installing the technology to use these resources in the Library. These improvements were very visible. We are still in Step 7 (Consolidating gains and producing more change). The credibility achieved through the popularity of the electronic journals, and the regular addition of important electronic collections and titles, along with the continually increasing number of journals available for purchase, should make another substantial increase in electronic subscriptions possible with the 2001 renewals. It should also help as we introduce electronic books.

Step 8 (Anchoring the new approaches in the culture) involves improving customer relations, productivity, leadership, and management. This tells us that we should now put increased effort into communications with our users to make them aware of the array of electronic resources they can use and to improve the Library's instructional programs. And we will continue to look at workflow, procedures, and staffing issues related to productivity. This rapidly changing organization also requires skills in leadership and management in order to succeed, and the Library administrators (also authors of this paper) readily concede that they are still learning.

While substantial progress has been made, the Drexel Library is only partway through the process of changing the format of its journal collection. We are now, to use a term popular in Great Britain, a "hybrid" library. (25) For journals, we believe that the endpoint will be when the only print journals are about 100 browsing titles composed of newspapers, publications such as *Sports Illustrated* and *Newsweek* -- more properly called magazines rather than journals -- and a few serious but popular journals like *Scientific American* and *Forbes*.

Although we are far from unique at this point in time, we are probably farther along in the transition to all electronic journal collection than most academic libraries in the United States. A late 1997/98 survey of ARL and non-ARL academic libraries found that 29 and 33.5 percent, respectively, had cancelled print journals in favor of electronic access in the previous twelve months. (26) This description of the Drexel experience should be useful to others because our transition is likely typical of what most academic libraries will experience. There are accredited academic institutions that are functioning with completely digital libraries, i.e., they never had a print library. Examples are Jones International University (27) and the University of Phoenix. (28) Other libraries have created large electronic journal collections - e.g., the University of California system (29) and most, if not all, large research libraries - but they are **maintaining large print collections** concurrently. We believe that Drexel's approach to implementation - **substituting** electronic for print - will be the path eventually taken by most academic libraries because it will be necessary to make electronic collections affordable.

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- (16) See note 10 above.
- (17) See note 6 above.
- (18) In reality, currently, it is not easy to track comprehensive title-by-title usage of electronic journals. Compiling and organizing the data in a way that is useful for making management decisions is more complex and labor intensive than might be expected. See discussion in the section below on the impact of electronic journals.
- (19) This number excludes continuations but does include newspapers.
- (20) See note 14 above.

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APPENDIX

Content Sources for Hagerty Library's Electronic Journal Collection

Last revised 3/01/00

The following 47 sources provide the bulk of content for Hagerty Library's Electronic Journal Collection:

ACM (Association for Computing Machinery)
ACS (American Chemical Society)
AMA (American Medical Association)
ASCE (American Society for Civil Engineers)
ASM (American Society for Microbiology)
American Institute of Physics
American Mathematical Society
American Meteorological Society
American Physical Society
American Physiological Society
American Society for Biochemistry and Molecular Biology
American Society for Clinical Nutrition
Biomedical Engineering Society/American Institute of Physics
Business and Industry (RDS)
Cambridge University Press
CMP Media Inc.
Community of Science
Congressional Quarterly Library
Dept. of Information Studies, University of Sheffield
Deutsche Physikalische Gesellschaft and Institute of Physics
ECO (OCLC Electronic Collections Online)

Fairchild Publications
Genetics Society of America
Highwire Press
IAC (Gale Group)
IEE (Institute of Electrical Engineers)
IEEE (Institute of Electrical and Electronic Engineers)
Ideal (Academic Press)
Institute of Chemical Engineers
JSTOR
MCB University Press
Macmillan Publishers Ltd.
Massachusetts Medical Society
McGraw-Hill
NIST (National Institute of Science and Technology)
National Academy of Sciences
Oxford University Press
ProQuest (UMI Company)
Project Muse (Johns Hopkins University Press)
SIAM (Society for Industrial and Applied Mathematics)
School of Architecture and Environmental Design, Kent State University
ScienceDirect (Elsevier Science)
Society of Plastics Engineers
The Biophysical Society
Thomas Telford Ltd.
Wiley Interscience
WilsonSelect