

Print to Electronic: Measuring the Operational and Economic Implications of an Electronic Journal Collection

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Abstract: As digital libraries move from demonstration projects to the real world of working libraries, it is critical to assess and to document the impact of the shift. This paper reports the methodology and initial results of an Institute for Library and Information Studies (IMLS) funded research study of the operational and economic impact of an academic library's migration to an all-electronic journal collection.

Drexel Library's entire print and electronic journal collections and associated staff are the test bed to study three key research questions:

- (1) What is the impact on library staffing needs?
- (2) How have library costs been reduced, increased and/or re-allocated?
- (3) What other library resources have been affected?

We are using quantitative and qualitative methods to answer the research questions operationalized in the following tasks:

- (1) Measure the staff time, subscriptions costs and other costs related to each activity required to acquire and maintain print and electronic journals.
- (2) Compute the per-volume, per-title, and per-use costs of acquiring and maintaining print and electronic subscriptions.
- (3) Study all impacted library services, including changes in reference service, document delivery, and instructional programs.

Initial results of measuring staff time indicate Information Services and Systems Operation departments constitute the majority of personnel costs for electronic journals. Technical Services and Circulation account for the majority of staff costs for print journals. Per title subscription costs appear to be substantially lower for electronic titles obtained through aggregator collections.

0. INTRODUCTION

The transition from the traditional mission of *building and archiving* a physical collection to *providing access* to remote, globally dispersed electronic resources represents a fundamental paradigm shift for libraries. But does the traditional mission make sense in the global web-based information environment now used regularly by the overwhelming majority of the academic community? Our users want (*and expect*) easy, anytime, anywhere, access to information, and in 2001 this means delivery via the web to networked computers. In this model storing information in thousands of local library files

does not make economic sense. Indeed, it is not even economically feasible. We must rather depend upon the formation and maintenance of central depositories by large organizations and publishers.

The tension between the paradigms is particularly salient in collection development of scholarly journals in academic libraries. Libraries made the transition, gradually and with minimum anguish, from collecting print abstracting and indexing resources to providing electronic access to them; however, the idea of replacing print with electronic journals is a source of much concern (Edwards, 1997; Hurd, 1999; Stewart, 2000; Keyani, 1999; Okerson, 2000). Several factors contribute to this concern. First, the pace of change is very rapid. For abstracting and indexing the transition took place gradually over nearly 30 years, but publication of electronic journal equivalents of important print journals accelerated dramatically three years ago and could be nearly complete in two more years. Second, new, reputable electronic-only journals are becoming commonplace. Finally, archiving is critical because journal literature is the primary scholarly record. Abstracting and indexing services are surrogates for the scholarly record, and thus presumably perceived as less necessary to archive.

In 1998 the staff of the W. W. Hagerty Library, Drexel University decided to make the transition to an all-electronic journal collection as quickly as possible. Print counterparts of electronic journals, with few exceptions, are not maintained, even when we must pay for them. This decision was based on several assumptions:

1. The electronic format serves our users better than print.
2. A critical mass and eventually the majority of scholarly journals of interest to our users would become available electronically within the next few years.
3. Maintaining a print collection takes significant resources that can be better used elsewhere.
4. Appropriate organizations would step forward and assume responsibility for archiving these journals.

Thus far, the first two assumptions have proven correct, and there is considerable evidence that our prediction about the last one was also right.¹ We are investigating the third assumption with the assistance of a grant from the Institute of Museum and Library Services. This paper describes the methodology used for determining personnel costs and preliminary results of that study.

This transition is happening faster at Drexel than at most, if not all, academic libraries in the United States. For 2001 renewals, the library subscribes to about 300 print journals and provides access to approximately 6,000 electronic journals through subscriptions and access to full-text databases. We expect to eventually have only a small browsing collection of about 100 titles in print. See Montgomery (2000) and Montgomery and Sparks (2000) for a description of the factors leading to this decision, and the collection policies and acquisition procedures.

Drexel is a technologically oriented urban university rated Research Intensive in the Carnegie classification, with strengths in engineering, computer science, information science and technology, design arts, and business. Current enrollment is 10,600 undergraduates and 2,500 graduate students. Full-time faculty members number just under 500. The largest colleges are Engineering and Business.

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. The staff is comprised of 13 professional librarians, four systems staff, 23 support personnel, and seven graduate students from the college of Information Science and Technology 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 local area wireless network. Thirty laptops, which are circulated, and Public Access Workstations consisting of 100 desktop

computers are available for patron use. The Library manages its own web site and related servers.

1. LITERATURE REVIEW

Assigning costs to library services has always been a complicated process, and the advent of electronic resources has only compounded the process. Library managers and researchers have struggled for some time to develop appropriate and accurate models for measuring the economic consequences of the shift to electronic resources. The National Information Standards Organization (NISO), which recently sponsored a forum to discuss performance measures and statistics for libraries, concluded there is a critical need for systematic data collection as well as the development of new tools and approaches for practical application by the library community. Participants at the NISO forum acknowledged the difficulties of measuring and collecting data, particularly of electronic resources in the absence of standards (National Information Standards Organization 2001).

Several researchers have looked at methods for analyzing library costs (Abels 1997; Abels, Kantor, & Saracevic 1996; Saracevic & Kantor 1997; Kantor 1986). These authors, in a series of studies, investigated library services from the standpoint of unit costs, or functional cost analysis. Kantor and Saracevic identified two difficult problems in cost allocation for library services: allocation of salaries and the allocation of shared resources.

Abels (1997) advocated the use of sophisticated measures, such as Activity Based Costing, to determine costs. This method provides an analysis of what an organization or unit does over a period of time and the associated costs. Activity Based Costing concentrates on detailing all activities related to the focus of interest and assigning the time to particular cost centers. Through periodic samplings of time and related costs, information is gathered for use in determining staffing and resource allocation. These methods are adaptable to service organizations (Abels 1997; Danilenko 1994; Berts & Kock 1995).

ARL, in its New Measures initiative, is also supporting the development of statistics and performance measures to evaluate electronic information services (Association of Research Libraries 2000a,b). ARL is leading an effort to identify high impact library functions that call for economic study. These functions, known as cost drivers, offer library managers a focus for reducing source costs. At a brainstorming session at the American Library Association Midwinter meeting in February 2000, participants from various academic institutions identified potential cost drivers and recommended criteria for assessing them. The identified cost drivers are located in all departments of the library (Association of Research Libraries 2000c).

ARL is also sponsoring a Technical Services Cost Study (also known as a Time and Cost Study), in which five institutions, Cornell University, Iowa State University, Vanderbilt University, University of California at Santa Barbara and University of Missouri at Kansas City, are currently gathering data within their Technical Services Departments. The methodology uses a longitudinal approach and time sampling. All staff time is tracked for a seven-day sample week. Four to six weeks are sampled annually, providing ongoing data (Association of Research Libraries, 2000d).

One model study for research on costs is the landmark Interlibrary Loan Cost Study sponsored by the ARL and the Research Libraries Group (Roche 1993). Survey results from seventy-six academic libraries were used to establish benchmark data on the costs of borrowing and lending materials. Information on direct costs included both staff and equipment costs but did not include indirect costs of major library functions or general overhead.

2. RESEARCH QUESTIONS

Drexel Library's entire print and electronic journal collections and associated staff are the test bed to study three key research questions related to the migration from a print to an electronic journal collection:

- (1) What is the impact on library staffing needs?
- (2) How have library costs been reduced, increased and/or re-allocated?
- (3) What other library resources have been affected?

We will use both quantitative and qualitative methods to:

- (1) Measure the staff time, subscriptions costs and other costs related to acquiring and maintaining print and electronic journal collections.
- (2) Similarly determine the per-journal cost of acquiring and maintaining print and electronic subscriptions.
- (3) Study all impacted library services, including changes in reference service, document delivery, and instructional programs.

This paper reports preliminary results from the initial phase of this research which includes an analysis of staff and subscription costs.

3. METHODOLOGY

The cost analysis we are conducting at Drexel follow the approach of the ARL/RLG Interlibrary Loan Cost Study (Roche 1993) and the ARL Technical Services Study. We are identifying the operational cost elements associated with journals in both print and electronic formats, including capital and operational components, and are looking at their contribution to the cost of maintaining the two journal collections.

We are developing two perspectives on Hagerty Library's transition to electronic journals: (1) a comprehensive comparison of the current costs of print and electronic journals; and (2) an assessment of overall changes in library costs since 1998, just prior to introduction of electronic journals. We use a number of different strategies to capture cost-related data. Personnel related costs amount to almost fifty percent of the library's operating budget. Therefore, in order to calculate the comparative costs of print and electronic journals, it is crucial to assess the amount of staff time spent on journal related activities. Staff time is tracked according to the tasks performed during sample weeks. The hourly salary of each employee is then multiplied by task time to arrive at task costs for each activity. Task times and costs are aggregated by library department.

Developing the instrument, Staff Activity Logs, and the data collection process took approximately six weeks. The project researcher (second author) met with staff members to formulate detailed lists of their journal related activities. We developed the activity checklists from the "ground up" for several reasons. First, we were unable to find any previously constructed lists of activities except for the Vanderbilt University Technical Services Cost Study, which unfortunately, investigated only Technical Services. Second, we believe that staff members are the individuals most knowledgeable about their jobs and the details of how their time is spent. Third, staff cooperation is critical in obtaining reliable, accurate and meaningful data. Our belief is that staff members will more readily support the goals and methods of the study if they have some ownership of the content and process in which they are participating. Fourth, we hope to

provide a resource for future research. Lists compiled by Hagerty Library staff obviously differ in particular details from staff activities in other libraries; however, we expect that most of our staff's activities are generalizable across academic libraries. The conceptual model we presented to the staff was that of an organization in which professionals are asked to assign their billable time to various accounts. In this case, time spent on billable activities was assigned to pre-established categories for either print or to electronic journals.

The scope of the study is comparing print and electronic *journals*, not electronic and print *resources*. This distinction is crucial because we did not collect data on databases, only on journals. The scope made defining terms such as *databases* and *electronic journals* difficult because aggregators often include both abstracts and full text for some articles. We chose to define electronic journals as including both titles to which we acquire explicit and deliberate access through individual or group subscription and also those that are available through licensing full text databases (aggregators). We defined databases as resources with *only* abstracts or citations.

The process of assigning time to print and electronic journals called for staff members to view their jobs in a new way. Some staff found it difficult to separate the details of their activities because of their holistic view of their jobs. For example, an information services librarian focuses on finding the appropriate resource to respond to a patron's information need. That librarian sitting at the reference desk might spend some time working with print or online indexes as well as with online journals available through an aggregator. Technical Services workers similarly reported that their time with print and e-journal activities is commingled.

It is essential that the project be clearly endorsed by the Dean of Libraries, who is also the project's principal investigator. Although staff found the process of formulating the activity logs and recording the data time consuming and tedious, they also expressed interest in learning whether their perceptions about job changes wrought by the advent of electronic journals were, in fact, accurate.² The researcher translated results from interviews and meetings into checklists of activities. The checklists or Activity Logs were reviewed by staff and revised through an iterative process that occurred several times until the lists were defined adequately. We constructed a Data Dictionary containing definitions for the categories on the Activity Logs. The dictionary serves as a staff resource to prevent conceptual drift over time and will hopefully also become a model for future research.

Data collection officially began in mid-February 2001 and continued for eight weeks. Staff completed a daily Activity Log in which they recorded the number of minutes spent on a particular activity. Sampling will continue throughout the year by collecting data the first week of every month. Journal related activities in Hagerty Library follow a cyclical pattern, depending on renewal times and the academic calendar. Thus, we expect that this initial data collection period will show the smallest amount of journal related activity occurring during the year and will serve as a baseline or "steady state".

4. ANALYSIS OF RESULTS

4.1 STAFF TIME AND COSTS

The project research assistant collected completed Activity Logs daily and entered the data into Excel spreadsheets. See Table 1 for the major activities in each department³. The Table includes most staff and departments that work directly with journals. Administrative personnel, the Interlibrary Loan/Document Delivery Department and most of the Library

Systems Department are included in overhead expenditures, which will be reported at a later date.

Table 1: Major Journal Related Staff Activities By Department

Department	Journal Related Activities
Circulation	Reshelving current and bound volumes
Information Services	Information literacy workshops Liaison & communication with faculty & students Reference services Collection development
Technical Services	Vendor related activities, including ordering, renewing, canceling, claiming Current periodical activities, including check-in, processing, binding
Systems Operations	Maintaining E-resources web page Support for staff web pages Assist faculty/students with access problems Resource development Maintaining existing resources Problem troubleshoot Liaison with other staff

See Table 2 for staff time and annualized costs, derived from multiplying staff time by the total salary *and benefits* for each worker. Individual totals were aggregated by department. The relationships among departmental costs are presented in Graph 1 and Graph 2. Several observations are immediately apparent. Total staff costs associated with print are considerably higher than staff costs related to electronic journals in this low activity period. This ratio will change when we measure activity during the journal renewal period which takes a great deal of the time (categorized as Collection development) of the Information Services Department.

Not surprisingly, there is a large departmental difference in the amount of time and costs associated with each journal format. The Information Services staff and part of the Systems Operations staff constitute the major categories of staff costs for electronic journals. Information Services staff are on the “front lines” in the library, working with students and faculty, demonstrating how to access electronic journals as well as answering reference questions. The Systems staff is responsible for making the electronic journals available and accessible via the library’s web site.

Table 2: Annualized Print and E-journal Costs by Staff Category*

	Print		Electronic	
	Hours	Costs	Hours	Costs
Circulation	1,139	\$15,800	0	\$0
Information Services	379	\$8,241	830	\$19,082
Technical Services	2952	\$51,326	73	\$1,709
Systems Operations	-	\$0	779	\$23,401
Total	4,470	\$75,367	1,682	\$44,192

* Annualized from eight weeks of data. Note that these numbers represent a period of low staff activity for journals.

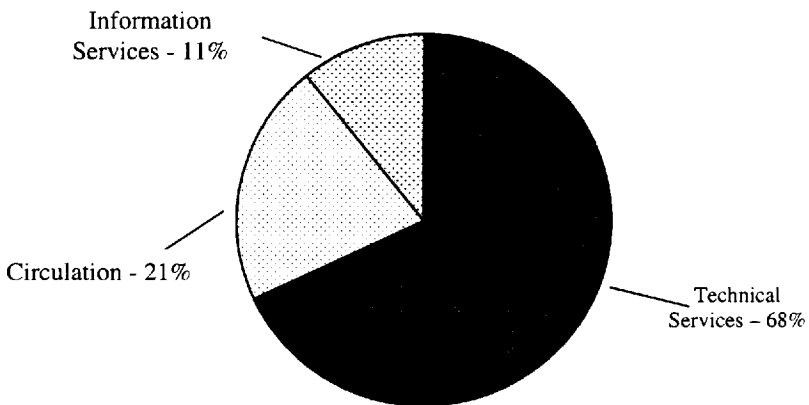


Fig. 1: Print Journal Costs by Staff Category

Print journals, on the other hand, present a very different constellation of staff costs. Technical Services and Circulation staff, who do shelving, represent almost ninety per cent of the staff costs for print journals. It is important to note that the Interlibrary Loan/Document Delivery, which works exclusively with print journals, is not included in this preliminary analysis.

These ratios do not include either non-personnel costs, such as equipment maintenance and bindery or capital costs, such as for computer hardware and software or the capital building costs. They will be included in the final analysis at the end of this study.

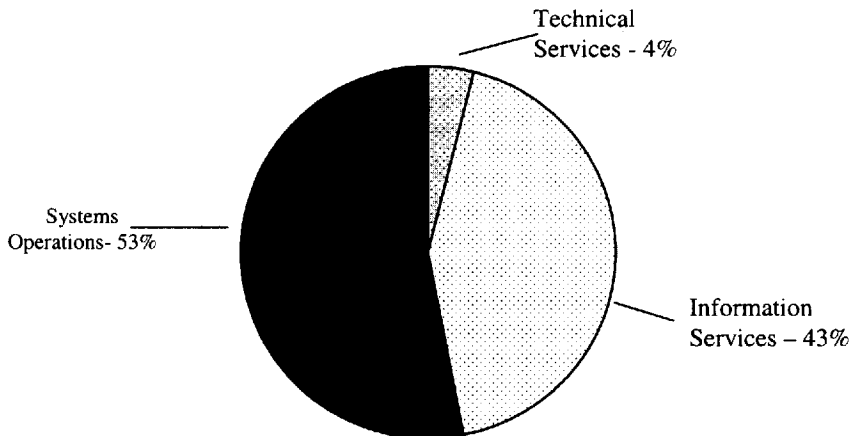


Fig. 2: Electronic Journal Costs by Staff Category

4.2 SUBSCRIPTION COSTS AND USE

Table 3 shows the range of costs associated with journal formats subscribed to by Hagerty Library. Print “only” are those titles which have no electronic counterpart. Titles for which we must subscribe to the print in order to receive the electronic versions are counted in Electronic Subscriptions. We define Electronic Subscriptions to be titles for which we have a subscription to the individual title with a persistent URL. We may purchase these titles individually or in groups from a single publisher or individually through a vendor such as OCLC. Aggregator Databases are services such as ProQuest or Lexis/Nexis that contain a mix of abstracts and the full text or partial full text of journals.

Table 3: Per Title Cost Information Spring 2001

Format	Number of Titles	Ave. Cost per Title
Print “only”	300	\$120/title
Electronic Subscriptions	2,800	\$196/title
Aggregator Databases	3,500	\$ 12/title

These numbers are a snapshot in time (Spring 2001); Electronic Subscriptions and Aggregator Databases are a constantly moving target. The number of titles changes continuously in aggregator databases as titles are added or dropped without consultation with users and, often, without any notification. Our current small print collection includes about one-third general interest browsing journals, with most of the other print journals in the humanities, art and social sciences. On average, these titles are much less expensive than science and engineering journals. The latter have been leaders in converting to digital format and, along with business publications, form the majority of the Electronic Subscriptions collection. On the other hand, both types of electronic journals frequently come with several back years for the same price, a factor which makes these journals less expensive on a per volume basis. A comparison by volume would lower the cost of electronic publications compared to print.

Overall, these numbers cannot be generalized to other libraries’ situations as they reflect Drexel’s particular “deals” with vendors. Nevertheless, it is safe to say that on a simple title-by-title basis the journals in the aggregator databases cost far less than those from the other two sources. But all journals are not the same, and the title-by-title comparison does not reflect relative value. Both the print and E-Subscription titles are selected carefully to match the needs of our students and faculty. We have access to them for the subscription (i.e. calendar) year. Libraries subscribe to the Aggregator databases and the electronic journals in them as a whole (“what you see is what you get”) and this can change from day to day. Also, coverage of titles may be partial in aggregator collections and often tables, illustrations and figures are not included.

Table 4 shows use data for the Drexel library’s print journal collection in 1998/99 and 2000/01 (extrapolated). Several factors confound this data. The number of discontinued print titles is 3427, far greater than the number of current subscriptions in either time periods. The library had about 130,000 bound journals volumes in 1998/99 and, after extensive weeding, about 95,000 in 2000/01. For about five years preceding 1998/99 Drexel’s print journal subscriptions were stable, but then decreased dramatically from 1999 to 2001. Cost per use cannot be calculated without accounting for these factors.

Table 4: Print Journals Use and Cost

Year	No. of Titles	Uses	Total Cost	Cost/Title
98/99	1,710	45,305	\$375,203	\$219
00/01*	300**	26,435	\$36,000	\$120

*Cost figures are given for the calendar Year 2001, while use covers 07/00-06/01 (extrapolated), and includes counts for titles that were cancelled in 2001.

**2001 subscription year titles only

Table 5 shows electronic journal use and cost data for several types of suppliers in 2000/01. The use data comes from publishers and is defined here as a view of a full-text file or download of a PDF file. Unfortunately, we cannot compute use data for all our electronic journals because it is not available from all publishers.

Table 5: Sample Electronic Journal Use and Cost (00/01) (Extrapolated)

Type of Publisher	No. of Titles	Uses	Total Cost	Cost/Title	Cost/Use
Society Publisher	32	4,352	\$ 21,980	\$687	\$5.05
University Press	134	9,742	\$ 6,000	\$ 45	\$0.62
Commercial Publisher	1,174	54,199	\$123,960	\$106	\$2.29
Commercial Aggregator	1,791	106,000	\$ 20,263	\$ 11	\$0.19

One very clear conclusion can be drawn from these numbers: *Electronic journals are used more heavily than print journals*. Even taking into account that the University has grown in the last three years, and that the print counts are *per-volume* while the electronic counts are *per article* which would make them somewhat higher, the differences are startling. Two of the sample electronic collections shown in Table 5 were used more than all the 1710 current print titles and 130,000 [est] bound volumes held by the library in 1998/99. There is significant variation in the cost per title and cost per use for these sample publishers. The Aggregators is the least expensive, but all are far less expensive than, for example, obtaining an article via Interlibrary Loan.

5. NEXT STEPS

To determine the average unit cost of print journals compared to the unit cost of electronic journals we will continue to record staff time throughout the year. Because of the increase in time taken by the renewal process in early Fall, this is the only way to obtain an accurate picture. We will also complete measurement of the non-staff, non-subscription capital and operations costs to provide a picture of the true cost of each journal format. To do this, adjustments must be made for major complexities not accounted for above, such as length of journal runs and age of journal volumes. Ultimately we will compare costs on three units of measure: per-volume, per-title, and per-use.

6. FOOTNOTES

1. A number of major archiving initiatives have begun. They include:
Library of Congress - <http://memory.loc.gov/ammem/amhome.html>,
Association of Research Libraries (ARL) - <http://www.arl.org/preserv/index.html>,
Council on Library and Information Resources - <http://www.clir.org/diglib/preserve/criteria.htm>.

The JSTOR Project - <http://www.jstor.org/>,

Online Computer Center Library (OCLC) - <http://www.oclc.org/oclc/presres/>,

Open Archives Initiative (OAI) – <http://www.openarchives.org>,

UK Digital Preservation Coalition - Joint Information Systems Committee (JISC) – <http://www.jisc.ac.uk/dner/preservation/dpcintro.htm>,

The British Library Digital Library - <http://www.bl.uk/>.

2. Staff members will also be interviewed about their perceptions of the job changes occurring with electronic journals. The results of these interviews will be reported separately.

3. Detailed lists of activities is available in the Data Dictionary, which can be found at <http://www.library.drexel.edu/facts/imls/default.html>.

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