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Draft

COMPARATIVE COST OF THE UNIVERSITY OF PITTSBURGH ELECTRONIC AND PRINT LIBRARY COLLECTIONS

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<i>Background</i>	5
<i>A Conceptual Framework of Metrics</i>	6
<i>Analysis Framework</i>	11
Analysis of Services and Service Components	11
Fixed, Variable and Marginal Costs.....	14
Direct and Indirect Costs	15
Analysis of Annual and Life-Cycle Costs.....	15
<i>Steps in Developing Collection Service Costs</i>	16
<i>Analysis of Staff Input, Output and Performance</i>	18
Collection-Related Staff Input, Output and Performance	18
Collection-Related Economies of Scale	22
Backfile-Related Staff Input, Output and Performance.....	24
<i>One-Time Processing</i>	25
User-Related Staff Input, Output, Performance and Impact	26
Use-Related Staff Input, Output and Performance.....	27
Support-Related Staff Input Metrics.....	31
Support-Related Staff Input Costs Allocated.....	33
Allocate Print Staff Input Costs to Services	34
Amount of Use of the Electronic and Print Collections	35
Staff Cost-Effectiveness of Electronic and Print Collections	36
Allocation of Other Resource Input Costs.....	36
<i>Life Cycle Analysis</i>	39
<i>Appendix A</i>	40
Serials Activity List.....	40
<i>Appendix B</i>	43
Instructions for filling out the University of Pittsburgh ULS Serials Activity Log.....	43
University of Pittsburgh ULS: Activity Log.....	45
<i>Appendix C</i>	47
Detailed Methods and Assumptions	47
Estimates of Total staff Compensation and Productive Hourly Rates	47
Allocation of Support-Related Costs to Other Components	48
Allocate Non-Staff Resources to the Five Collection Services.....	49
Assumptions.....	50

Life-Cycle Analysis	51
Print Life-Cycle Analysis	51
Electronic Life-Cycle Analysis	52
<i>References</i>.....	55

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Background

In 2002 the University of Pittsburgh University Library System (ULS) was on the verge of adding and/or converting to a large number of electronic journals in their collection. Because of this, it was decided to be an appropriate time to perform an in-depth cost analysis and perform a user survey to establish a longitudinal base-line before the long-term effects of the change might take place. In 2003 the size of the electronic collection increased from 14,284 to 35,512 titles with the size of the print collection remaining relatively static at 16,924 subscriptions. The ULS serves the main Pittsburgh campus and four other campus sites (Bradford, Greensburg, Johnstown, and Titusville). It has main libraries at these sites as well as 19 school, department or special purpose libraries and, altogether, serves 30,085 students, 1,725 faculty members and about 750 other professional staff. It does not serve the medical nor law communities at the University.

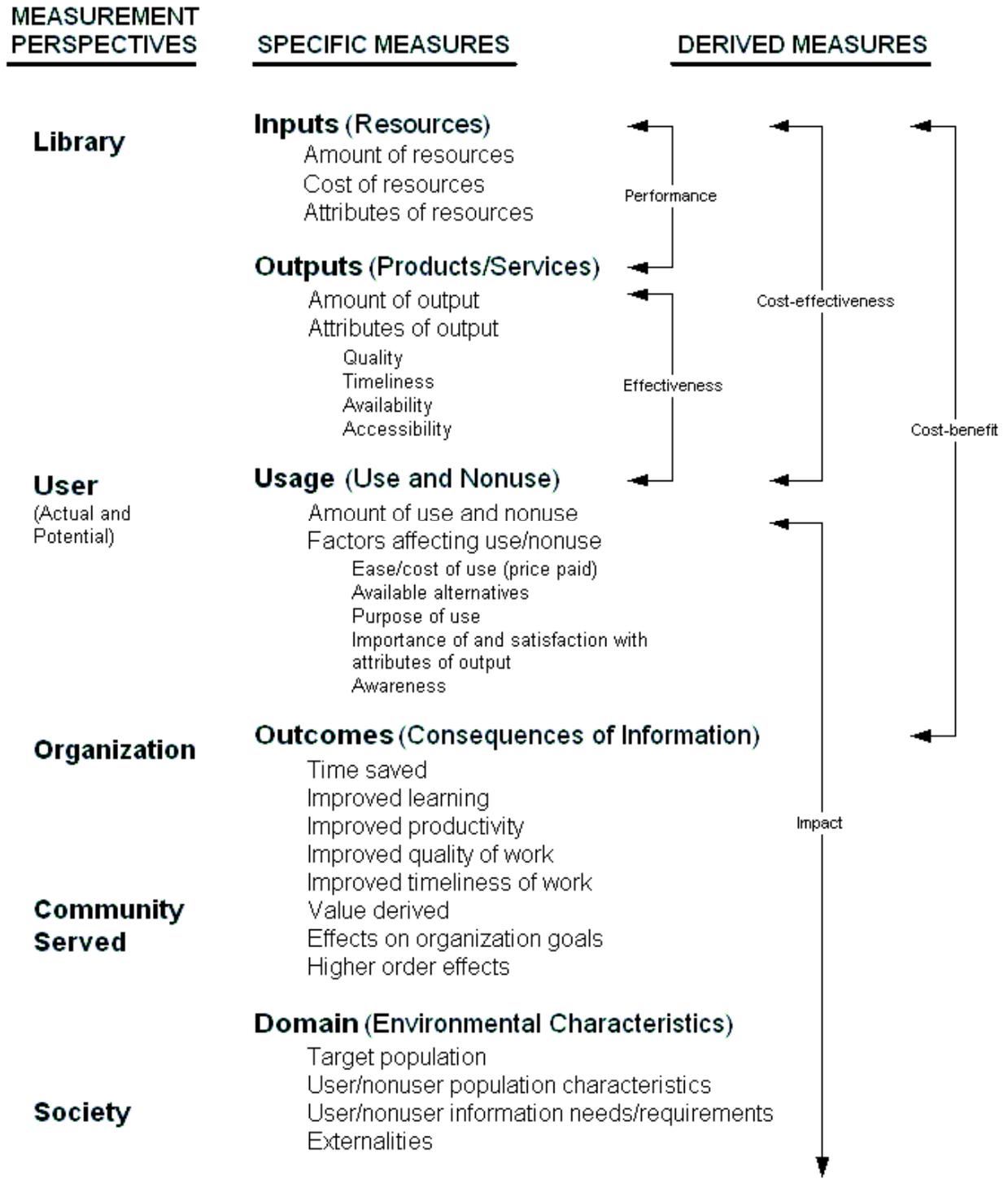
This report presents a description of a framework of metrics used to compare the cost and use of the electronic and print collections. It also presents the methods and comparative ULS costs of acquiring, processing and serving users' access to the electronic, current periodicals, backfile and external collections. A companion report (King et al., 2004) describes the comparative readership of these collections, as well as, use of the electronic collection measured by "hits" and download data provided by publishers, vendors and consortia and use of the print collections measured by number of issues and bound volumes reshelfed following use.

A Conceptual Framework of Metrics

A conceptual framework has been developed over the years for assessing library services (Griffiths and King, 1993 and King et al. 2003). The framework was partially developed to provide information and data that can be used for decision-making by library staff and management and University administration. It also enhances an understanding of the library and its operation and how it affects the user community of faculty, staff, and students; the overall higher education community; and to all of society served by academic institutions. A second aspect of the framework is that it could apply to an entire library, specific services, or resources used to perform services. In this study we focused on specific services involving Pittsburgh's University Library System (ULS) electronic and print journal collections. The framework is also applied to two basic resources required to provide these services: that is the collections themselves and library staff.

A schema depicting the framework of metrics is given in Figure 1. The framework includes five sets of specific metrics (inputs, outputs, usage, outcomes, and domain) and five sets of derived metrics that relate combinations of the specific measures (performance, effectiveness, cost-effectiveness, impact, and cost-benefit). These metrics are briefly described below with examples for services, involving library journals collections.

Figure 1. Conceptual Framework for Library Economic Measures



Two sets of specific metrics include:

- **Inputs** (of resources) including the *amount of resources* used to provide services such as number of journal titles, hours of staff time, square feet of space; *cost* of these resources; and *attributes* of them such as, for staff, degree, years of experience, competence, and so on.
- **Outputs** (of services) are *amount of output* such as number of titles processed and *attributes* of the output such as quality, timelines, availability, accessibility, and so on.

One set of derived metrics is **performance** which relates input and outputs such as input costs divided by output quantities (i.e., unit costs) or output quantities divided by number of staff hours (i.e., staff productivity). These relationships are indicators of how well the library performs in providing a service, or how well staff performs an activity, and so on. Examples include the cost per journal title acquired, instructional cost per class conducted, cost per interlibrary loan, or number of interlibrary loans provided per hour (or minutes) of staff time.

A third set of specific metrics is **usage** which is the *amount of use of information obtained from journal collection services*, perhaps best measured by amount of reading. Other usage metrics are *factors that affect amount of use* (or non-use) such as ease or cost of using the services, importance of and satisfaction with attributes of service outputs. For example, if the library (collections) hours of opening is very important to readers and readers are very satisfied with the hours, there is likely to be more reading than if the

hours are not important and readers satisfied and less if hours are not important and readers very dissatisfied. Awareness of services or their attributes is another factor of use. Finally, readers always have the option of choosing from alternative sources of articles or their information. Alternatives to journal collection services to readers include personally subscribing to journals, asking the author(s) or colleagues for copies of articles, obtaining a copy from a preprint archive or author web site, and so on. Thus, availability and attributes of alternative sources are a factor in amount of use of library collections. Otherwise all reading would come from library collections.

The second set of derived metrics, **effectiveness**, indicates how effective the journal collections services are in achieving use (i.e., readership). These metrics relate output and use metrics. Examples of effectiveness are amount of reading per journal title (or distribution of reading among titles) or the user cost of access and reading at various levels of availability or accessibility (e.g., user's time required to access electronic journals from one's office, home, etc.). **Cost-effectiveness** is derived from input metrics (primarily cost) and usage metrics such as a collection cost per reading.

In this framework the fourth set of specific metrics include **outcomes** which are the consequences of using the information provided through services. Outcomes are generally favorable, but can be unfavorable as well such as wasting a reader's time or misapplication of information due to misleading or false information content provided from a library collection. Examples of favorable outcomes include effects on the purposes of reading such as improving research, teaching, and the reader's lifelong

learning. Other examples are saving time or money, increasing readers' productivity, and so on. Others have defined "outcomes" in broader terms which we include in **cost-benefit** metrics and qualitative terms.

The fifth set of specific metrics are **domain** descriptions of the community or environment served by the services such as number of branch libraries, faculty, students or characteristics of users such as their degree, field or discipline, age and so on. Domain measures are useful to place a context on the other metrics such as the cost of the collection per faculty member (or student) or amount of reading per faculty member (or student) or by science faculty.

Impact derived metrics are several useful relationships among the five specific metrics. They are designed to demonstrate the impact of decisions at any level on other levels. Sometimes the derived metrics can be connected. For example, reductions in service input costs would ultimately affect output and, in turn, usage, outcomes and, perhaps, number of users. Similarly, decisions concerning output attributes would have an impact on usage, outcomes and number of users. Changes in number of users (e.g., increase in enrollment) will affect input costs. More favorable outcomes will, in turn, result in increased use and input cost.

We define **cost-benefit** as unfavorable and favorable comparisons between services or between resources; for example, electronic vs. print collections, having library collections vs. not having them, in-house cataloging vs. outsourcing (e.g., Serials Solutions), and so

on. A “benefit” is when the comparison is favorable and a “cost” is when the comparison is unfavorable; perhaps, better named “detriment.” The cost-benefit comparisons can be made for all the specific and derived sets of metrics and can be in qualitative terms as well. For example, if a university library replaces a print collection with an electronic database, benefits might be reduced input costs, saving of users’ time, increasing available number of journal titles, and subsequent use and favorable outcomes. Sometimes benefits must be implied, if unable to measure. The “costs” might be detrimental effects on some users who do not wish to use electronic collections in which case they would seek other sources at a cost to them and long term access to the electronic collection may well be jeopardized because of archival issues.

This report primarily addresses the input, output, and performance of the Pittsburgh ULS collection services. A second report focuses on usage and outcomes of these services (King, et al., 2004).

Analysis Framework

Analysis of Services and Service Components

The analysis of library electronic and print collections is based on a hierarchy of five services, five service components, component functions, and activities required to perform the functions. The **five basic collection services** are:

- access to the electronic collection,
- access to the current periodicals collection,
- access to the backfile or bound volume collection,

- interlibrary lending (ILL) from the collections, and
- access to external collections through interlibrary borrowing (ILB) and document delivery services.

We subdivide the print collection into current periodicals and backfile collections to provide information that would facilitate possible future decisions concerning whether to rely on electronic only; electronic and current print only; electronic, current and backfile print; or collection sub-sets of these options. Interlibrary lending is one use of the collections that can have a bearing on staff time and costs. Interlibrary borrowing (or use of document delivery services) only indirectly involves the library collections in that the service is used primarily as an alternative to purchase of a journal or to supplement the collection (or to replace missing or damaged collection copies).

There are many activities (or tasks) performed by library staff in order to provide these services. Each activity is analyzed regarding staff input time and cost. In order to analyze staff performance (i.e., productivity and unit cost) we group the activities into service functions and the functions into *five service components* as follows:

- The **collection-related component** is necessary to make the collections available for access. It involves *functions* such as collection development, licensing and negotiations, acquisitions, receipt processing, and cataloging and catalog maintenance. Collectively, the function costs tend to vary with number of subscriptions processed.

- The **backfile-related component** is required to make the backfile collections available for access. *Functions* include binding, physical processing, and so on. Collectively, these function costs vary with the number of volumes bound.
- The **user-related component** is performed to prepare or enhance users' access to the electronic, current, and backfile collections. User-related *functions* include user instruction, faculty liaison, tours and briefings, related resources and guides, and other user-related services. These functions tend to vary to some degree with number of training sessions, the size of the user community, or more specifically with number of persons given user instruction, thus being user-related costs.
- The **use-related component** involves *functions* and *activities* that vary with the amount of use of the collection services, such as reference and research, online bibliographic searching, circulation, photocopying for users, and reshelving. For each of the five collection services, these costs tend to vary with amount of reading or other use metrics.
- The **support-related component** includes such *functions* as systems development and operations, maintaining statistics, preparing staff procedural manuals, and other support.

These five components are designed to facilitate analysis described later. However, the sum of the costs of these five components are allocated to each of the five journal-related services above. The activities and functions are grouped into these five service components because analysis of each provides insights as to why there are cost differences among the five services and how future decisions might affect these costs.

Fixed, Variable and Marginal Costs

There are two kinds of costs that are useful to distinguish for examination of the collection services. **Fixed costs** are independent of the amount or use of a service. For example, *collection-related costs* are incurred whether or not the collections are used. Similarly, *backfile-related costs* are incurred whether or not the backfile is ever used. **Variable costs** on the other hand increase with amount of use. For example, the annual cost of reshelving issues or bound volumes (following use) increases with an increasing amount of use. **Marginal cost** is the incremental cost of each item reshelved. Each use may incur a different marginal cost and sometimes a particular use-related activity is sporadic. For example, photocopying articles read by faculty is only done on occasion. Yet increased in-library reading of issues or bound volumes will likely have a corresponding increase in photocopying. Generally, collection, backfile, user and support-related costs are considered fixed costs and the use-related costs are variable costs. The total cost of a service is the sum of its fixed and variable costs.

The reason a distinction is made for these kinds of costs is that subsequent analysis depends on them. For example, consider a comparison of services of (1) the current collection only versus (2) the current and backfile collection (both with an electronic collection available to users). The current collection only would have the fixed current, user and support-related costs plus current use-related cost plus additional use of the electronic collection to replace the use of the backfile collection and interlibrary borrowing when the electronic collection does not hold an article.

Direct and Indirect Costs

The collection, backfile, user and use-related costs are **direct costs** in that they are directly identified with the collection services. Some functions and activities are necessary to provide the services but are indirectly related to these services and the cost of them are called **indirect costs**. The support-costs above are indirect costs that are allocated (or proportionately added) to the direct costs to establish total costs.

Analysis of Annual and Life-Cycle Costs

Analysis involves two separate phases involving (1) the current (2002) **annual cost** of the five collection services and (2) the **life-cycle cost** of a single electronic or print title. The annual cost is equivalent to allocating an annual budget of resources (i.e., staff, space, etc.) into the cost components and ultimately the five collection services. A comparison is made among services of their cost per reading or use (in the case of ILL and ILB).

Unit costs are given for each of the five service components to provide evidence from which one can establish how much potential change in output might affect costs over a short duration. For example, it could be anticipated that the print collection for next year might increase (or decrease) by 1,000 titles. With a cost per title known, one can estimate how much more it will likely cost. Furthermore, one can estimate how the change will affect staff requirements based on productivity estimates (i.e., titles processed per hour or hours per title processed).

Life-cycle analysis provides an entirely different perspective. This analysis, based on a model developed by Roger Schonfeld and colleagues (Schonfeld et al., 2004a, b), establishes the cost of a single electronic or print title over a 25-year period. This approach provides a means of examining various combinations of collection services such as an electronic collection only or electronic collection in combination with a print title through current and backfile collections, a print title only through a current periodicals collection and sub-sets of these collections. This expansive analysis is possible because the Pittsburgh ULS collections were heavily overlapped at the time of analysis.

Steps in Developing Collection Service Costs

Once the five basic Pittsburgh ULS journal collection services are established, we developed twelve steps of data collection and analysis. These steps are briefly described below, with details given in Appendix C. The **first step** in estimating costs is to establish a list of activities performed by staff that is directly or indirectly related to provision of these services. A list of 67 activities is given in Appendix A. These activities are grouped into the five service components mentioned above.

The **second step** is to identify the resources used to provide the collection services, such as staff, space, systems, workstations, binding, and photocopiers. The largest costs associated with the services are for staff time and the purchase expenditure for the collections. The purchase expenditure is relatively easily identified with the electronic

and print collections, although print expenditure is ultimately allocated to the current and backfile collections and interlibrary lending. Staff time, however, is involved in every activity and a staff member is likely to work on multiple activities. Thus, the **third step** is to allocate staff time to the 67 activities mentioned above. This is done by having each staff member fill out a time log identifying the annual proportion of time spent on each activity (see Detailed Methods in Appendix C). The instructions for staff allocation are given in Appendix B.

The **fourth step** is to assign a cost to a staff member's time, thus providing a means of estimating the total staff cost for each activity. This is done by using one's total compensation including salary or wage plus all fringe benefits such as social security, Medicare, health and life insurance, pension, and so on (see Detailed Methods in Appendix B). The total staff cost for each activity is summed across activities and functions in each of the five components above (**Step 5**). **Step 6** is to analyze the input, output and performance of parts of the five components. Since the support cost component (i.e., support costs) is not directly associated with any services, **Step 7** is to allocate these costs to the other four components. This is done by allocating the staff support cost to the other categories in proportion to the staff cost in those components.

Step 8 is to partition the print staff input time and cost to current and backfile collections. The next step (**Step 9**) is to estimate amount of use (i.e., reading) for each of the services. **Step 10** is to allocate the staff print collections-related costs and user-related costs to each of the five collection services. This allocation is based on the proportion of use made of

these services. To that is added the staff use-related costs. Therefore, all staff costs will be allocated to the relevant five services. **Step 11** is to allocate all other resource costs to these services to estimate the total cost, cost per title and cost per use of the five collection services.

Step 12 is detailed cost analyses including:

- Estimated annual service total and unit costs, and
- Life cycle unit costs.

These results are presented in the following sections.

Analysis of Staff Input, Output and Performance

Collection-Related Staff Input, Output and Performance

This section addresses the staff time and cost of initially processing the electronic and print collections. There are several functions and activities necessary to process the collections including¹:

- **Collection development** including review and select approval materials (27), review and decide on materials from Gift & Exchange (28), collection weeding (29), and collection analysis (30).
- **Licensing and vendor interaction** (63).
- **Acquisitions** including order new subscriptions and journal back-orders (32, 33), communicate with vendors and publishers (34, 35), verify vendor quotes for

¹ Activity codes are given in parentheses with detailed descriptions of the activities given in Appendix A.

renewals (36), Voyager activities (37, 38, 39), investigate invoice payments (40), and clear suspense file of invoices (41).

- **Receipt processing** involving mail processing and serials delivery (42, 43), serials check-in (16), periodical stamping, marking, and tattletaping (52), and initial shelving of incoming issues (11 allocated).
- **Cataloging and catalog maintenance** involving OPAC searching (5, 6 allocated), copy and enhanced cataloging (44), original cataloging (45), authority control (46), and catalog maintenance (47, 48, 49, 50).

The functions and activities above would be performed whether or not a library chooses to add print volumes to the backfile. Thus, they can establish a one-time staff time and cost for the current periodicals collection. An additional current periodicals activity is **identify and make changes to the current issues display** (17).

Details of collection-related inputs of staff time and costs are given in Table 1 below.

Table 1

**Collection-Related Staff Time and Cost of Electronic and Print Collections:
University of Pittsburgh 2002**

Function	Electronic		Print	
	Time (Hrs)	Cost (\$)	Time (Hrs)	Cost (\$)
Collection Development	1,523	\$93,725	4,579	\$242,224
Licensing/Interaction	586	\$32,197	146	\$6,309
Acquisitions	1,162	\$57,636	4,030	\$132,169
Receipt Processing	50	\$1,638	15,421	\$336,576
Cataloging	3,449	\$110,336	5,870	\$200,380
Total	6,770	\$295,532	30,046	\$917,658
Current Display	125	\$2,985	1,938	\$45,346
Total	6,895	\$298,517	31,984	\$963,004

Source: Pittsburgh University Library System Staff Time Logs

It is clear that collection development of the print collection requires substantially more staff time (31,984 vs. 6,895 hours) and staff costs (\$963,004 vs. \$298,517) than the electronic collection. However, as discussed below, this is partially due to the size of the two collections. Another cost differential is that the hourly rate for initial processing of electronic journals is substantially higher than for print journals (i.e., \$43.30 vs. \$30.10 per hour).

There are several ways that one can characterize collection-related outputs. For example, the electronic journal collection could be characterized by the total number of electronic journal titles acquired (14,284 at the end of 2002). However, with arrangements involving 23 licenses, there is substantial overlap of titles. Thus, perhaps a better output metric is the number of unique electronic titles made available to ULS users, which was 8,560 titles at the end of 2002.² Similarly, the ULS acquired 16,924 print subscriptions for the five campus and 19 departmental or special collections. The number of unique print titles is estimated to be 9,400 titles. However, we have chosen in this instance to use the number of subscriptions (16,924) as the print output metric for two reasons. First, the total electronic cost is relatively insensitive to the duplicated titles, whereas the cost to process print subscriptions does vary by number of subscriptions and issues involved. Second, the use of the electronic collection is relatively independent of duplicated titles, whereas nearly all duplicated print titles are independently used in their respective libraries.

² Shortly thereafter, an additional 10,957 unique and 20,228 aggregated electronic titles were added to the available collection. That is, the size of the electronic collection more than doubled.

As mentioned earlier, performance is the relationship between input and output metrics. Two examples are staff productivity (i.e., output quantity divided by input time) and unit cost (i.e., input cost divided by output quantity). Using the output metrics from above the staff productivity for electronic titles is 2.1 aggregated or 1.2 unique titles processed per hour and for print journals the productivity is 0.4 subscriptions processed per hour. Thus, staff productivity is much higher for the electronic collection-related processing. The staff unit cost of processing the electronic titles is about \$20.90 per aggregated or \$34.90 per unique title and for the print collection it is \$56.90 per subscription. Thus, the unit cost of processing electronic titles is less than for print, but not as pronounced as for the staff productivity because, as mentioned earlier, the staff hourly rate (\$) is much higher for electronic processing.

There are other collection-related performance metrics as well. For example, licensing involves a combination of electronic and print journals which requires 732 staff hours at a total cost of \$38,506, thus with an output of 23 licenses, the staff produces 0.03 licenses per hour or better said about 32 hours (or about 4 days) per license. The unit cost is \$1,670 per license which is similar to that observed with other libraries (Schonfeld et al., 2004b). One can use subscription titles for the electronic collection and subscriptions for the print collection as rough performance indicators for collection development, acquisitions, and cataloging output metrics. As such, the productivity and unit costs for these functions are as follows:

	Productivity (Units per Hour)		Unit Cost (\$ per Unit)	
	Electronic*	Print	Electronic	Print
Collection development	5.6	3.7	\$10.90	\$14.30
Acquisition	7.4	4.2	\$6.70	\$7.80
Cataloging	2.5	2.9	\$12.90	\$11.80

*Unique electronic titles are used as the output metric.

Productivity appears to be greater and unit costs less for acquisition and collections development processing electronic journals than print journals, but the reverse for cataloging. Receipt processing primarily involves print journals and the best indicator of output is the number of issues received which is estimated to be 113,400 issues processed by ULS staff. Thus the staff productivity for this function is 7.4 issues processed per hour (or 8.1 minutes per issue) at a unit cost of \$3.00 per issue.

Collection-Related Economies of Scale

Another performance relationship is economies of scale, which implies that the unit cost of a function or activity decreases as the number of units processed increases. There are many examples of economies of scale for library processes (e.g., Griffiths and King 1993, Cooper 1983). There are several reasons for economies of scale. For example, when a library service involves a large fixed cost, the cost per use decreases as the amount of use increases. Examples of this are given later. Often libraries are able to negotiate a lower purchase cost (i.e., price) when larger amounts are involved due to

“volume discounts.” In a sense, negotiated electronic journal licenses or “big deals” involve such volume discounts.

Another aspect of economies of scale is that staff productivity is often improved as amount of output increases. This happens when amount of output is sufficient to assign staff with appropriate knowledge and skills to perform a function such as cataloging or reference. Also, when staff works exclusively on a function they tend to be more productive and a library can make such assignments with larger outputs. Pittsburgh ULS is somewhat unusual in that it has centralized processing for some functions, thus achieving economies of scale, but also performs some functions within the smaller ULS libraries, thus not having the benefits of economies of scale. For example, print collection development is partially decentralized and the staff productivity is much lower than centralized academic libraries having a similar number of subscriptions. A multi-institutional study report (Schonfeld et al., 2004) shows that one university has 17,956 subscriptions (compared with 16,924 at Pittsburgh), but its productivity rate for collection development is 9.8 subscriptions per hour versus 3.7 at Pittsburgh. Other larger libraries in the multi-institutional study also had better productivity for this function (17.0 subscriptions per hour with 27,241 subscriptions; 17.8 subscriptions per hour with 12,828 subscriptions). On the other hand, most of the ULS libraries have fewer than 500 subscriptions. Drexel, with only 370 print subscriptions, has a collection development productivity of 1.6 subscriptions per hour which is more in line with 3.7 subscriptions per hour at Pittsburgh, keeping in mind that Pittsburgh also has one large library with 7,336 subscriptions. Yet productivity of receipt processing, a very high volume function done

centrally at Pittsburgh, is very similar at Pittsburgh and the university with 17,956 subscriptions (7.4 vs. 8.1 issues per hour at the two universities respectively).

While there are some disadvantages to having a large number of small branch libraries, there are advantages as well. Later we will show that having small libraries could have significant advantage to users which may result in more overall use of the ULS, (see, for example, King, et al. 2003).

Backfile-Related Staff Input, Output and Performance

After a period of about one year, the ULS libraries decide whether or not to remove issues, bind them, and maintain volumes on shelves for subsequent use. Therefore, just as with the collection-related component, there are initial one-time or fixed backfile staff time and costs. There are also ongoing costs that are fixed as well in the sense that the costs do not vary with use. The reason that a distinction is made between one-time and ongoing costs is that the two categories of cost are relevant to life-cycle costs discussed later.

The input metrics remain the same as for the collection-related component (i.e., staff time and cost). The input values are given in Table 2 below, with codes for the activities performed for backfile processing given in parentheses. The time spent on one-time processing is estimated to be 7,310 hours at a cost of \$200,754 or an average of \$27.50 per hour which is slightly less than collection-related processing (\$30.10 per hour).

Ongoing processing requires about 4,459 hours at cost of \$140,186 or \$31.40 per hour, not too different than print collection-related processing.

Table 2

Backfile-Related Staff One-Time and Ongoing Processing Time and Cost the Backfile Collections: University of Pittsburgh 2002

Functions	Time (Hrs)	Cost (\$)
One-Time Processing		
Periodical Binding (53)	2,861	\$72,220
Spine Label, Stamping, etc. (51)	1,307	\$34,915
Shelving Volumes (12)	184	\$3,539
Voyager Volume Holdings (47)	2,958	\$90,080
Total	7,310	\$200,754
Ongoing Processing		
Shelf Maintenance (13)	1,497	\$38,581
Order Missing/Lost Issues (31)	846	\$38,581
Process Back-Orders (33)	596	\$16,814
Weeding, Transfer to Remote (29)	530	\$26,155
Update Voyager Holdings (49)	298	\$8,473
Disaster Recovery (54)	692	\$18,956
Total	4,459	\$140,186
TOTAL	11,769	\$340,940

Source: Pittsburgh University Library System Staff Time Logs

The principal output metric is 9,415 volumes bound in 2002. Performance of the one-time processes is about 1.3 volumes processed per hour or \$21.30 per volume.

Particularly relevant performance metrics are for periodical binding (3.3 volumes bound per hour, \$7.70 per volume bound), spine labeling, barcode labeling/linking and tattletaping (7.2 volumes processed per hour, \$3.70 per volume processed), and initial shelving (51 volumes shelved per hour, \$3.30 per volume shelved). An output metric for ongoing backfile processing is 126,900 volumes held in library shelves or remote storage. Thus, productivity is roughly 28 volumes processed per hour or \$1.10 per volume.

User-Related Staff Input, Output, Performance and Impact

User-related processes are distinguished because they depend somewhat on the size of the user population and those given specific user instruction. These processes are also considered fixed costs since they are independent of amount of use. The user-related input staff time and costs are given in Table 3, with activity codes in parentheses. The staff time and costs of processes involving electronic and print collections are similar for these activities, but staff hourly rates for the electronic user-related functions tend to be higher than print rates (\$44.60 per hour vs. \$40.20 per hour respectively).

Table 3

User-Related Staff Time and Cost of Electronic and Print Collections: University of Pittsburgh 2002

Function	Electronic		Print	
	Time (Hrs)	Cost (\$)	Time (Hrs)	Cost (\$)
Training Sessions (24)	1,229	\$49,019	836	\$30,566
Tour, Briefings (23)	796	\$39,238	796	\$39,170
Other User Instruction (25)	427	\$18,672	297	\$12,031
Resources, Guides (26)	370	\$16,122	725	\$26,640
Faculty Liaison (57)	107	\$7,437	171	\$9,605
Journal Routing (14, 15)	--	--	305	\$7,834
Total	2,929	\$130,488	3,130	\$125,86

Source: Pittsburgh University Library System Staff Time Logs

A domain metric of all the user-related functions could be the total number served in the user community (32,560 persons). With this metric, input with total electronic and print time would be 5.4 persons served per hour and unit cost \$7.90 per person. Other impact or productivity metrics are estimated below:

- Training (24), briefings (23), and other user instruction (25) served 17,299 participants, with productivity of 3.9 participants served per hour and unit cost of \$10.90 per participant.
- Faculty liaison involved 1,725 full-time faculty, with productivity of 6.2 faculty members served per hour and unit cost of \$9.90 per faculty member served.
- There were 182 print titles routed, with productivity of 0.6 titles routed per hour and unit cost of \$43.00 per title routed.

Tours and briefings has a fixed cost of \$38,891 to prepare for tours and briefings and a variable cost of \$29,516 to actually conduct tours and present briefings.

Use-Related Staff Input, Output and Performance

There are a number of use-related activities that are performed to facilitate and support access to electronic and print collections. These activities include:

- **Reference and research** such as replying to directional and access questions (1), access questions that require going off the desk (2), brief reference that are five minutes or less (3), and in-depth reference that are over five minutes (4).
- **Online bibliographic searching** quick look up on OPAC that requires one minute or less (5 allocated), in-depth OPAC searches (6 allocated), quick look-up using other databases (7), and in-depth searches of other databases (8).
- **Circulation of journal materials** (9).
- **Photocopying for users** (10 allocated).
- **Reshelving used issues** (11 allocated) **and volumes** (12 allocated).

Other use of the collections includes interlibrary lending (ILL) to external libraries (20) and among Pittsburgh ULS libraries (21). ILL involves processing requests (20, 21), photocopying (56 allocated), and reshelving (11, 12 allocated). Also, the ULS libraries borrow articles from other external libraries and, obviously, from internal libraries (19). The ULS also routes journal issues and Tables-of-Contents to faculty, but we include this service in user-related activities since the costs of the identified activities are more a function of number of users than uses.

The use-related input staff time and costs are given in Table 4 below. We emphasize that these input metrics are variable costs and do not include other time and costs that are allocated later. Reference and research and online bibliographic searching dominate the use-related staff time and cost. These two functions are roughly the same for electronic use, but with print use, the reference and research amounts are over double that of online bibliographic searching, even though together they are in the same magnitude as electronic collections use. As with other functions, the hourly rate of staff supporting electronic collection use is higher than for print collection use (\$35.80 per hour vs. \$30.50 per hour).

Table 4**Use-Related Staff Time and Cost of Electronic and Print Collections: University of Pittsburgh 2002**

Functions	Electronic		Print	
	Time (Hrs)	Cost (\$)	Time (Hrs)	Cost (\$)
Reference & Research	8,862	\$325,136	11,780	\$384,586
Online Searching	7,617	\$252,015	5,097	\$168,404
Circulation	309	\$8,809	904	\$20,701
Photocopying	160	\$4,397	931	\$22,167
Reshelving	--	--	2,353	\$47,064
Total	16,948	\$590,357	21,065	\$642,922
Interlibrary Lending				
Internal	23	\$617	2,180	\$53,420
External	21	\$496	1,272	\$35,337
Total	44	\$1,113	3,452	\$88,757
Interlibrary Borrowing				
Internal	92	\$2,315	1,252	\$34,653
External	93	\$2,238	1,170	\$36,398
Total	185	\$4,553	2,422	\$71,051
TOTAL	17,177	\$596,023	26,939	\$802,730

Source: Pittsburgh University Library System Staff Time Logs

We did not collect output data for any of these functions other than current issues and bound volumes reshelved as a result of use. The number of items reshelved was counted as 95,000 items (not including interlibrary loans). Therefore, productivity of reshelving is 40 items per hour and unit cost of \$0.50 per item reshelved. None of the functions are performed for every reading, so that an estimate of the unit cost per reading is only a proxy metric for marginal costs. They are revealing nevertheless in comparing electronic and print collections. The marginal cost per reading of the electronic collection (933,200 readings) is about \$0.60 per reading compared with \$1.90 per reading for the print collection (341,200 readings) or about a third the cost per reading from the print collection. This means that another reading costs \$0.60 or \$1.90 on average from the

electronic and print collections. A readership survey is discussed in detail in the technical report on use and outcomes (King et al., 2004).

There appears to be little interlibrary lending and borrowing from electronic collections. The input staff time for ILL, including both electronic and print collections, is 3,496 hours and the staff cost \$89,870. With output of 38,400 items loaned, the staff productivity is 11.1 items loaned per hour and unit cost of staff is \$2.30 per item loaned. Interlibrary borrowing staff input time is 2,607 hours and cost is \$75,604. With 10,600 items borrowed, staff productivity is 4.0 items borrowed per hour and unit cost is \$7.10 per item borrowed.

In Table 5, we partition the print collection staff time into current and backfile collections.

Table 5**Use-Related Staff Time and Cost of Current and Backfile Collections: University of Pittsburgh 2002**

Functions	Current		Backfile	
	Time (Hrs)	Cost (\$)	Time (Hrs)	Cost (\$)
Reference & Research	4,167	\$143,487	7,613	\$241,099
Online Searching	1,810	\$62,831	3,287	\$105,573
Circulation	321	\$7,351	583	\$13,350
Photocopying	347	\$8,270	584	\$13,897
Reshelving	622	\$13,686	1,731	\$33,378
Total	7,267	\$228,274	13,798	\$414,648
Interlibrary Lending				
Internal	352	\$4,512	1,828	\$48,908
External	210	\$2,980	1,062	\$32,357
Total	562	\$7,492	2,890	\$81,265
Interlibrary Borrowing				
Internal	242	\$3,465	2,180	\$31,188
External	--	--	--	--
Total	242	\$3,465	2,180	\$31,188
TOTAL	8,071	\$239,231	18,868	\$527,101

Source: Pittsburgh University Library System Staff Time Logs

The estimated amount of reading of the two collections is 127,300 readings for the current collection and 213,900 for the backfile collection. The proxy productivity is 17.5 and 16.7 uses per hour respectively. The unit or marginal proxy costs are \$1.80 and \$1.90 per use for the current and backfile collections respectively. Thus, the total time and cost are largely due to the respective amount of use. The staff hourly rate is approximately the same.

Support-Related Staff Input Metrics

Some functions and their activities are relevant to electronic and print collections, but do not directly vary with size of the collections, number of users or amount of use. Rather,

they are performed to support the latter kinds of activities. These staff functions include support systems activities such as PC support (58), software and web site programming (59), server support (60), system administration (61), and digitization work (62). Other such functions include maintaining statistics (55), work on a job description procedural manual (64), and other support (5, 6 allocated). The staff input time and cost to perform these functions are summarized in Table 6 below.

Table 6

Support-Related Staff Time and Cost of Electronic and Print Collections: University of Pittsburgh 2002

Functions	Electronic		Print	
	Time (Hrs)	Cost (\$)	Time (Hrs)	Cost (\$)
Systems-Related	3,747	\$155,955	99	\$2,969
Maintain Statistics	1,299	\$41,077	2,299	\$65,437
Procedural Manual	102	\$5,657	169	\$6,965
Other support	2,722	\$91,517	2,647	\$82,257
Total	7,800	\$294,206	5,214	\$157,628

Source: Pittsburgh University Library System Staff Time Logs

Support is greater for the electronic collection than the print collection because nearly all the systems-related function is used in this way. Again, the hourly rate of staff working on electronic collections support is higher than for print (\$37.70 per hour vs. \$30.20 per hour). Below we allocate the support-related costs to the collection, backfile, user and use-related functions.

Support-Related Staff Input Costs Allocated

The support-related input costs are allocated in proportion to costs involving the electronic and the print collections. This is done by calculating an allocation factor to apply to each relevant cost with result shown in Table 7 below. See Detailed Methods (Appendix C) for how the allocation factors are derived.

Table 7

**Staff Cost of Electronic and Print Collections with Support-Related Costs Allocated:
University of Pittsburgh 2002**

Category	Electronic	Print
Collection-related	\$384,198	\$1,030,997
Backfile-related	--	\$365,012
User-related	\$167,941	\$134,732
Use-related	\$759,802	\$688,315
Interlibrary Lending		
Internal	\$794	\$57,192
External	\$639	\$37,832
Interlibrary Borrowing		
Internal	\$2,980	\$37,100
External	\$2,880	\$38,968
Total	\$1,318,234	\$2,390,148

Source: Pittsburgh University Library System Staff Time Logs

The use-related functions are subdivided into (1) direct collection uses that facilitate or are related to reading such as reference and research, photocopying and reshelving and (2) interlibrary lending and borrowing.

Allocate Print Staff Input Costs to Services

In order to assess the cost-effectiveness of access to the current and backfile collections it is necessary to allocate the collection-related, user-related and interlibrary lending (ILL) costs to the services. When added to the use-related costs, we have the total staff costs for all services. In the absence of a better allocation method, as before (Table 5) we merely allocate on the basis of relative use (i.e., amount of reading). Thus, fixed costs are added to the variable costs to arrive at the total staff cost of electronic, current, backfile and external collections as shown in Table 8 below. Note that internal and external ILL and ILB are displayed differently in Tables 7 and 8.

Table 8

**Total Staff Cost of Electronic, Current, and Backfile Collections by Service
Component: University of Pittsburgh 2002**

Service Component	Electronic	Collection		ILB	ILL
	(\$)	Current (\$)	Backfile (\$)	External (\$)	External (\$)
Collection-Related	\$384,198	\$363,942	\$667,055	--	--
Backfile-Related	--	--	\$365,012	--	--
User-Related	\$167,941	\$55,526	\$79,206	--	--
Use-Related	\$763,576	\$252,932	\$529,675	--	--
Subtotal	\$1,315,715	\$672,400	\$1,640,948	--	--
Interlibrary Lending	--	--	--	--	\$38,471
Interlibrary Borrowing	--	--	--	\$41,848	--
Total	\$1,315,715	\$672,400	\$1,640,948	\$41,848	\$38,471

Source: Pittsburgh University Library System Staff Time Logs

The average or unit costs of the six services are found by dividing the total costs by amount of use (i.e., reading from the collections or items processed for interlibrary lending and borrowing).

Amount of Use of the Electronic and Print Collections

In the spring of 2003, readership surveys were conducted with Pittsburgh faculty (and staff) and students (King, et al., 2003, King, et al., 2004). The survey results yielded the following estimates of amount of reading of articles from the ULS collections:

- 933,200 readings from the electronic collections (21.4% faculty, 78.6% students)
- 368,000 readings from the print collections (18.1% faculty, 81.9% students)
 - 129,980 from the current collection
 - 238,020 from the backfile collection

Other use metrics are an estimated 1,320,000 “hits” produced by vendors or publishers. This amount is expected to be more than actual reading because of the nature of the way in which hits are recorded. On the other hand, not all vendors or publishers report these data. Reports from other studies suggest that the overcount of hits to reading may be about one-third (King and Montgomery, 2003), compared with 41 percent at Pittsburgh.

Also estimates of print use are often made by counting the number of issues and volumes reshelfed following their use. At Pittsburgh the number of issues reshelfed is 44,600 and the number of volumes reshelfed is 88,800 compared with an estimated 127,300 readings from the current collection and 213,900 readings from the backfile collection (both excluding interlibrary lending). Reshelfing counts are known to be less than amount of reading for several reasons, not the least being that readers often read more than one article from an issue or volume. In other studies, the ratio of readings to items reshelfed is 1.8 and 3.2 readings per item (King and Montgomery, 2002; Griffiths and King, 1993).

At Pittsburgh this ratio is 2.6 readings per item. Thus, the estimates of reading appear to be in line with what one might expect. The principal advantages of the survey reading metric is that it is common to both electronic and print collections, and the metric is a better proxy for usage which we define as the use of information content.

Staff Cost-Effectiveness of Electronic and Print Collections

Not only is the total staff cost of the print collections substantially higher than the electronic collection (\$2.35 vs. \$1.32 million), the cost per reading is much higher for both current and backfile collections than the electronic collections as shown in Table 9 below. The reason for this is the extensive use of the electronic collection.

Table 9

Total and Average Staff Cost of Collection Access Services: University of Pittsburgh 2002

Collection Access Service	Amount of Use	Total Cost (\$)	Cost Per Use (\$)
Electronic	933,200 readings	\$1,315,715	\$1.40
Current	129,980 readings	\$659,050	\$5.10
Backfile	238,020 readings	\$1,615,899	\$6.80
External ILB	5,124 items	\$41,848	\$8.20
Interlibrary Loan	14,236 items	\$76,870	\$5.40

Source: Pittsburgh University Library System Staff Time Logs

The same relationships hold when other resources costs are added to the staff costs.

Allocation of Other Resource Input Costs

In Table 10 below the costs of other resources are given including the “purchase” cost of subscriptions and licenses, space, binding, photocopies, workstations and central systems.

The print purchase cost is allocated to current, backfile and interlibrary loan on the basis of amount of reading and items loaned. The approach used to allocate non-staff resources is discussed in the Detailed Methods section of Appendix C. The purchase and staff costs dominate the overall cost.

Table 10**Total Cost and Cost Per Use of Collection Access Services: University of Pittsburgh
2002**

Resource	Total (\$)	Electronic (\$)	Collection Access Services			
			Current (\$)	Backfile (\$)	ILB (\$)	ILL (\$)
Purchase	\$4,350,832	\$1,394,832	\$1,005,252	\$1,840,728	--	\$110,020
Staff	\$3,709,382	\$1,315,715	\$672,400	1,640,948	\$41,848	\$38,471
Space						
Staff	\$39,150	\$12,067	\$7,424	\$18,354	\$478	\$827
Shelving	\$157,700	--	\$65,800	\$91,900	--	--
Photocopy	\$10,830	\$1,061	\$2,771	\$4,657	--	\$2,341
Binding	\$924	--	--	\$924	--	--
Support	\$8,750	\$2,697	\$1,659	\$4,102	\$107	\$185
Binding	\$85,710	--	--	\$85,710	--	--
Photocopying	\$12,567	\$1,231	\$3,216	\$5,404	--	\$2,716
Workstations						
Staff	\$35,309	\$10,883	\$6,695	\$16,554	\$432	\$745
User	\$6,357	\$6357	--	--	--	--
System	\$30,000	\$29,440	\$205	\$355	--	--
Total (\$)	\$8,443,919	\$2,774,283	\$1,765,422	\$3,709,636	\$42,865	\$154,666
Use	--	933,200	129,980	238,020	5,124	14,236
\$/use	--	\$3.00/reading	\$13.60/reading	\$15.60/reading	\$8.40/item	\$12.60/item

Source: Pittsburgh University Library System Staff Time Logs

One complexity with the results displayed in Table 10 deals with the fact that some licenses cover common electronic and print titles. Thus, the “price” of the duplicated titles should be substantially less than double the subscription price of electronic or print alone.

Life Cycle Analysis

The analysis above merely reflects “current” annual costs. In order to make decisions concerning combinations of electronic, current and backfile collections in their entirety or sub-sets of them, it is useful to know what the average cost is of an electronic or print title over its life, say 25 years, in the library. A life cycle cost model that was implemented in a recent related study (Schonfeld et al., 2004a, b) is applied here. In our analysis, we added some additional costs such as the purchase price, overhead, support costs, and so on. The model is described in detail in Detailed Methods in Appendix C.

The 25-year life cycle cost of an electronic title at the University of Pittsburgh ULS is about \$180 per title and print is about \$580 per title. Thus, across a 25 year period, electronic titles continue to be less expensive. Expected reading over this period of time is problematic to estimate, partially because the survey estimates take age of an article into account but it is difficult to parse the time and amount of reading of a particular title. A rough estimate is about \$7.30 per electronic journal reading and \$23.50 for print titles.

Appendix A

Serials Activity List

University of Pittsburgh ULS Study

Reference and Research (For all formats including microforms)

1. Directional/ Access Questions
2. Access questions that require going off the desk (compact shelving/assistance in stacks) including responses to search requests from patrons
3. Reference (brief- five minutes or less)
4. Reference (in-depth- more than five minutes)

Online Bibliographic Searching

5. Quick look up on OPAC (one minute or less)
6. In-depth on OPAC (more than one minute)
7. Quick look-up using other databases
8. In-depth with other databases

Circulation and Use

9. Circulation work including recalling of overdue materials.
10. Physical withdrawal activities, such as collection shifting
11. Shelving, re-shelving and shelfreading of current periodicals
12. Shelving, re-shelving and shelfreading of bound volumes
13. Shelf maintenance, i.e.- labeling shelves/ranges

Serial Processing

14. Create and route journal lists
15. Maintaining route lists
16. Serials check-in using Voyager (for the currently received issues)
17. Identify and make changes to current issue display (includes addition of notes and setting up or changing check-in patterns)

Interlibrary Borrowing, Lending and Storage

18. Interlibrary borrowing (external resources, i.e.- from outside of ULS system)
19. Interlibrary borrowing (internal resources, i.e.- from within ULS)
20. Interlibrary lending (external), i.e.- delivery of items from document delivery services
21. Interlibrary lending (internal), i.e.- photocopying, printing resources for outside requests.

User Instruction

22. Conduct tours and/or present briefings
23. Prepare for tours/ briefings
24. Conduct training sessions/demonstrations

25. Other user instruction
26. Creation of resources/ guides

Collection Development and Management

27. Review and select approval materials as well as materials form slips, catalogs and other ordering tools.
28. Review and decide on materials from Gift & Exchange; or received directly in departmental libraries
29. Collection weeding, including transfer of journals to remote storage
30. Collection analysis and work with collection reports (including vendors, in-house)
31. Identify and place orders for missing/lost issues

Acquisitions

32. Order new subscriptions, including selection and download of bibliographic record, verifying title information on vendor's website and creating the purchase order.
33. Order and receive journal back-orders
34. Direct communication with Vendors and publishers other than Voyager claiming (i.e., asking for invoice information, canceling orders, etc)
35. Communicate with vendors and publishers regarding electronic access problems.
36. Receive, verify and return vendor quotes for subscription renewal.
37. Set up vendor information in Voyager
38. Post invoices from vendors and publishers in Voyager via Elect, Data Interchange or manually.
39. Verify and approve payments in Voyager and complete invoice data transfer to Accounts Payable.
40. Investigate invoice payments for vendors, publishers and ULS staff.
41. Clear suspense file of invoices upon receipt of monthly PRISM levels.

Materials Receiving and Mail Processing

42. Mail and materials processing (for example, opening the mail and delivering first class mail, opening, sorting and delivering library materials).
43. Serials delivery to campus (preparing bins, boxes, etc.)

Cataloging

44. Copy and enhanced cataloging for new serials and for title changes, cessations, etc.
45. Original cataloging for new serials and for title changes, cessations, etc.
46. Perform authority control functions on records (name and subject heading corrections)

Catalog Maintenance

47. Create and update volume holdings in Voyager
48. Report holdings and check in errors (public services staff)
49. Voyager withdrawal activities (location information and last copy withdrawal)
50. Union listing activities with OCLC

Physical Processing & Preservation

51. Spine labeling, barcode labeling/linking, tattletaping for classed items
52. Periodical stamping, marking and tattletaping + any other activities of this type
53. Periodical binding and repair
54. Disaster recovery planning and activities

Other Support Functions

55. Maintaining statistics
56. Making photocopies for users
57. Faculty Liason Service
58. PC support and troubleshooting
59. Software/ Website programming
60. Server support
61. System Administration
62. Digitization work
63. Vendor interaction, including licensing
64. Creation and update of procedural manual for job descriptions

Other work activities

65. Break/ Slack time (coffee breaks, etc)
66. Email correspondence
67. Vacation, sick leave, and holidays
68. Professional development and training, including conferences and meetings

Appendix B

Instructions for filling out the University of Pittsburgh ULS Serials Activity Log

The purpose of the Serials Activity log is to determine what activities related to serials you have performed in the last year and to indicate how much time you spent on these activities. To help you identify all of the activities that you did which were related to serials, we have included a list of activities and a code for each activity.

Please look through the list and select the activities that best describe what you do, especially as it relates to your work with serials. Make a note by any activity which you do **over the period of a year in any capacity of your ULS job**.

If you have worked at more than one ULS site during the past year, please prepare a log (photocopy the log) for each site.

Record the activity code number, located to the left of the activity, and a brief description of the activity, and whether it relates to print (P) or electronic (E) journals on the Activity log. If this distinction is not relevant, place a (0) on the form in this area. For any activities which you perform that are not included on the numbered list (but which are related to serials), record them at the bottom of the log and number them. If you run out of room and need an additional sheet, please photocopy the log.

Note that vacation, sick leave and holidays should be indicated as a separate activity.

Record the proportion of time you spend annually performing each activity. As a guide, if you work full-time, one week is about 2% of your time. Therefore, if you took one week of sick leave and two weeks of vacation, it would account for about 6% of your time. Two 15 minute coffee breaks each day account for about 6% of your time over the course of a year. On the next page is a guide for converting actual time spent to a percentage of total time.

In past studies, it has been useful for the participants to first record the percentages of time for the activities they did not perform regularly, such as something you do once or twice a year; then calculate the numbers for coffee breaks, vacation, sick leave, holidays and so on, and then record the percentages for your regular activities.

Don't worry about listing the activities in any particular order on your form.

If you don't find any activities on the list that generally describe the tasks that you do, please note this on the form and send it back to us anyway. This will help in accounting for everyone in the ULS system.

If you only work with serials for part of the day (say, half the day in serials cataloging, the other half in general reference), please state this percentage on the last line of the log and calculate all other percentages accordingly.

Be sure the percentage column totals 100%.

Please complete the bottom of the log as follows:

- (a) your name,
- (b) If you work full time, please fill out the next section only if you regularly work more hours than the normal work week. Please indicate the total additional hours that you worked over the course of a year.
- (c) If you work part time, or were not a staff member for the entire year, (ie, because you are a new employee, were sick or had a maternity or military leave) please total the number of hours that you worked over the last year.

Send the completed Activity log (via campus mail) directly to:

Donald King
School of Information Sciences
135 N. Bellefield Ave, Office 600
Pittsburgh, PA 15260
Phone: 412-624-9315

If you have questions, please call Donald King at the number above or email Sarah Aerni at sea22@pitt.edu.

These surveys will be kept confidential, and only aggregated numbers will be used for analysis.

Guide for converting “Actual Time” to “Percentage of Time”

Actual Time	Percentage
Two or three days	1%
One week, or 40 hours	2%
Two weeks, or 80 hours	4%
Three weeks	6%
Two coffee breaks at 15 minutes each day	6%
One month	8%

Appendix C

Detailed Methods and Assumptions

Once it is clearly understood what journal-related services are involved the Pittsburgh ULS staff developed a list of relevant activities, based initially on a set of activities used at Drexel University for their cost analysis (Montgomery and King 2003), but revised several times (see Appendix A). The staff allocation of time was determined from activity time logs on which staff were asked to report the annual proportion of time spent on any of the 67 journal-related activities.³ Instructions for filling out the activity time log and a copy of the log are also given in Appendix A. Following agreement on the method, we visited every library or relevant library group to discuss the project, staff responsibilities, confidentiality measures taken by us, and how the results are used. A total of 205 library staff completed the logs, a few with encouragement.

Estimates of Total staff Compensation and Productive Hourly Rates

Total compensation was calculated for each relevant library staff member based on the salary or wage range they fell into plus fringe benefits (i.e., 26.9% for exempt staff and 28.0% for non-exempt staff). To this amount was added 48 percent for overhead. Thus, a salary of \$50,000 ended as \$93,906 with fringe benefits and overhead included ($\$50,000 \times 1.269 \times 1.48$). In order to accurately measure staff productivity and unit cost we asked

³ In the late 1980s King Research performed an experiment to determine the strengths and weaknesses of various methods for estimating staff time; for example, daily, weekly, or annual activity time logs; random alarm devices; random walks; direct observation, etc. It was found that all methods were reasonable accurate but annual log easier to report and administer (Griffiths and King, 1991)

staff to indicate any additional hours spent above a normal work week (i.e., 37 1/2 hours per week) to establish the annual hours compensated. For example, an additional 200 hours would yield 2,150 total hours (i.e., $37\frac{1}{2} \times 52 + 200$ hours). Next we subtracted "non-productive" time from the total hours. Such non-productive time includes vacation, sick leave, holidays, breaks (e.g., coffee breaks), professional development, and so on. The total non-productive time (say, 340 hours) is subtracted from the total time (2,150 hours) to estimate the amount of productive time spent by staff on journal-related and other productive activities (i.e., 1,810 hours). This provides an estimate of hourly rates (e.g., \$51.88 per hour for the example). This amount is used to estimate the cost of the staff members' time spent on productive activities. For example, if the staff member spends 108 annual hours on an activity, the cost would be \$5,603 (i.e., \$51.88 per hour x 108 hours). The cost of each activity is found by summing across all 205 staff members.

Allocation of Support-Related Costs to Other Components

Staff support costs were allocated to other staff costs as follows. Referring to the list of activities under staff support costs for the electronic access services: systems-related activities (58 through 62), maintaining statistics (55), preparing staff procedural manual (64); and OPAC online searching (5, 6) allocated at (50%) to support. The total cost reported for electronic journals is \$294,206. The total electronic journal-related staff cost is \$1,316,234, therefore the support costs (\$294,206) is allocated to the other activities by a factor of 1.287022⁴; that is, $\$1,316,234 / (\$1,316,234 - \$294,206)$. Thus, for example, the electronic staff cost for vendor interaction, including licensing is \$32,197, which

⁴ The factor is taken out to six places to avoid rounding errors.

comes to \$41,438 after support costs are allocated. The allocation factor for the print collection is 1.070605, which is lower due to the fact that costs of systems-related activities are relatively less for the print collection activities.

Allocate Non-Staff Resources to the Five Collection Services

The purchase cost for the electronic collection is given as budgeted by ULS for the size and cost at the time the reader survey was done. The print purchase cost is allocated to the current collection, backfile collection and external interlibrary lending in proportion to estimated amount of reading/use: 129,980 for the current collection, 238,020 for the backfile collection, and 14,236 items loaned to external libraries. Space costs are problematic because we had difficulty in determining them. Therefore, we used costs given by a cohort university library at Cornell University (CLIR report). These costs are \$7.22 per square foot for housing the current periodical collection and reading room, \$3.25 per linear foot for backfile shelving space, and \$5.00 per square foot for remote shelving space. Staff space is estimated to be about 100 square feet per person at \$7.22 per square foot. This cost is allocated in proportion to the time spent on various activities, including non-journal related activities. Photocopying (i.e., article reproduction costs) and photocopying space costs are allocated to the collection services by the proportion of photocopying staff time devoted to the services. The administrative support space is allocated in proportion to staff costs. A total of 205 staff workstations are reported to be expensed at \$650 per workstation or \$133,250 total cost. This cost is allocated in the same way as staff space. There are approximately 163 user workstations at \$650 each for a total annual cost of \$105,950. Journal use accounts for only a portion

of the time user workstations are used and this amount is unknown at Pittsburgh. The cost study at Drexel University (Montgomery and King 2003) kept page counts of user workstations and observed that about six percent of web site page views were from journal article pages. Thus, we assume the same proportion at Pittsburgh yielding a total cost of \$6,357 allocated to access to the library electronic collection. We emphasize that workstations in the office, etc., are not included in these costs. The system costs (\$30,000) are allocated in the same proportion as staff time.

Assumptions

Important Assumptions

1. The staff time and cost of quick and in-depth OPAC searching are subjectively allocated to electronic and print user support services (20%), cataloging (30%), and allocated activities (50%). Time and cost of quick and in-depth other searching are allocated to electronic and print user support services (90%) and allocated activities (10%).
2. Shelving and reshelving of current periodicals are allocated to number of issues received, amount of use and number of items loaned (ILL).
3. Shelving and reshelving of backfile volumes are allocated to number of volumes bound, shelf maintenance, amount of use, and number of items loaned (ILL).

Life-Cycle Analysis

The Life-cycle model subdivides costs into one-time and ongoing costs. These costs are averaged by the appropriate number of items involved to yield a total cost of a title over a 25-year duration.

Print Life-Cycle Analysis

<u>One-time Costs</u>	<u>Total (\$)</u>	<u>Unit (\$)</u>
Collection-related (16,924 subscriptions)		
Purchase	\$2,888,300	\$170.66
Staff (Table 7 less ongoing display)	982,449	58.05
Space (staff support allocated)	13,940	0.82
Workstations allocated	10,524	0.62
Current (16,924 subscriptions)		
Shelf Space (Table 10)	\$65,800	\$3.89
Backfile-related (9,415 volumes bound)		
Staff (Table 2 x 1.070605 support allocated)	\$214,928	\$22.83
Space (staff, support allocated)	3,389	0.36
Workstations, system (allocated)	2,548	0.27
Binding (Table 10 including space)	86,634	9.20
<u>Ongoing Costs</u>		
Current (16,924 x 25)		
Display staff (Table 1 x 1.070605 support allocated)	\$48,548	\$71.71

Space (staff, support allocated)	915	1.35
Workstations, system (allocated)	690	1.02
Backfile-related (5,074)		
Staff (Table 2 x 1.070605 support allocated)	\$150,084	\$29.58
Space (staff, support allocated)	2,082	0.41
Workstations, system (allocated)		
Shelf Space (Table 10)	91,900	18.11
User-related (5,074)		
Staff (Table 7)	\$134,732	\$26.55
Space (staff, support allocated)	2,520	0.50
Workstations, system (allocated)	1,095	0.22
Use-related (5,074)		
Staff (Table 7 with internal ILL, ILB)	\$782,607	\$154.24
Space (staff, support allocated)	9,777	1.93
Workstations, system (allocated)	7,381	1.45
Photocopy (Table 10 including space)	16,048	3.16
TOTAL	\$5,628,591	\$576.93

Electronic Life-Cycle Analysis

The one-time costs for the electronic collection include collection-related costs which are sub-divided into two components (1) collections, development, receipt processing and cataloging and (2) license negotiation and acquisitions. The former functions are divided by the 14,284 titles processed in 2002 to provide an estimate of the cost to process an

electronic title. However, the ULS negotiated and acquired an additional 21,228 titles that were physically added at the beginning of 2003 for 35,512 titles in all. A portion of these costs (75%) are considered one-time and the rest added to ongoing costs that are likely to be replicated above every five years.

<u>One-time Costs</u>	<u>Total (\$)</u>	<u>Unit (\$)</u>
Collection-related (14,284 titles)		
Staff (Table 1 x 1.287022)	\$264,739	\$18.53
Space (staff support allocated)	2,776	0.19
Workstations, system (allocated)	2,046	0.14
License, Acquisitions (34,512 titles)		
Purchase (x 0.75)	\$750,000	\$21.73
Staff (Table 1 x 1.287022 x 0.75)	86,712	2.51
Space (staff, support allocated x 0.75)	723	0.02
Workstations, system (allocated x 0.75)	533	0.02
<u>Ongoing Costs</u>		
License, Acquisitions, etc. (6,902)		
Purchase (x 0.25)	\$250,000	\$36.22
Staff (Table 1 x 1.287022 x 0.25)	32,746	4.74
Space (staff, support allocated x 0.25)	236	0.03
Workstations (allocated x 0.25)	174	0.03
System	29,440	4.27
User-related (14,284 x 1.29)		

Staff (Table 7)	\$167,941	\$15.17
Space (staff, support allocated)	1,609	0.15
Workstations (allocated)	1,186	0.11
Use-related (14,284 x 1.29)		
Staff (Table 7)	\$763,576	\$68.96
Space (staff, support allocated)	9,419	0.85
Workstations (allocated)	6,943	0.63
Photocopy (including space)	2,292	0.21
User workstation	6,357	0.57
TOTAL	\$2,380,531	\$175.13

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