Towards Demonstrating Value: Measuring the Contributions of Library Collections to University Research and Teaching Goals

Denise Pan, Gabrielle Wiersma, and Yem Fong

Introduction

Research on the value and impact of academic libraries is of growing interest to librarians and university administrators. Libraries can no longer assume to be recognized as the 'heart of the academic enterprise.' Faculty members have become more effective at identifying the materials they need online and libraries are no longer the gatekeeper to peer reviewed scholarly resources. In the current economic climate, when university administrators are looking for ways to balance the budget, it is imperative that libraries provide evidence of value and demonstrate their contribution to university priorities. In response to these challenges, Librarians from University of Colorado Denver (UCD) and University of Colorado Boulder (UCB) worked together to create a cost benefit model to demonstrate the institutional value of funding library materials for both teaching and research in a multi-campus university system.

Librarians from University of Colorado Denver (UCD) and University of Colorado Boulder (UCB) share similar concerns. They question their ability to communicate the value of libraries more effectively with campus and system administrators. Because of their roles in acquisitions and collection development, they are intimately aware of rising journal subscriptions costs and declining materials budgets. They work diligently to negotiate competitive prices though consortia purchasing. However, as funding becomes increasingly limited, established collection development strategies are being questioned by library and university administrators. This study aims to provide evidence of value and demonstrate that their collection development efforts support university priorities. This paper presents the results of a pilot study that analyzed the extent to which use of online library resources contributed to faculty teaching and research outcomes. The paper is organized into three parts: overview of the pilot study, summary of the implementation and results at each campus, and assessment of the successes and obstacles encountered during design and implementation.

Pilot Study Overview

The University of Colorado (CU) system includes three universities, four campuses, and five libraries. In response to faculty requests, the CU libraries make every effort to purchase the same sets of electronic resources across the university system. This is possible when the shared collection supports the participating campus' needs, budgets are available, and publishers are willing to offer system-wide licenses. Pan and Fong explain that, "While both the libraries and faculty assume there is value to shared journals and

Denise Pan is Associate Director of Technical Services at the University of Colorado Denver, Auraria Library, e-mail: denise.pan@ucdenver.edu; Gabrielle Wiersma is Electronic Collections & Assessment Librarian at the University of Colorado at Boulder Libraries, e-mail: gabrielle.wiersma@colorado.edu; Yem Fong is Faculty Director for Collection Development at the University of Colorado at Boulder Libraries, e-mail: yem.fong@colorado.edu

databases, explaining and championing the value of consortial purchasing in both qualitative and quantitative terms is becoming more and more important in economic downtimes."[1] All five CU libraries were invited; however, three libraries opted to participate in the pilot study. Only librarians from the Boulder Campus' Norlin Library and Denver Campus' Auraria Library are presenting results at this time.

One of the first major research initiatives to calculate a return on investment for an academic library was conducted by Elsevier at the University of Illinois at Urbana-Champaign (UIUC). The study provided a framework to demonstrate economic value in terms of total dollars spent and returned to the university via sponsored research awards.[2] Other research conducted by Cornell and members of the Association of Research Libraries describes the costs of funding services and collections as represented in terms of business costs or a fair market assessment and argues in favor of the hidden value that the library provides to the academy.[3]

Although grant funding and other cost measurements are important to universities, there are many other factors to consider. Since previous studies have not addressed the relationship between library resources and instructional and scholarly outcomes, this study intends to fill that gap by developing two new cost benefit models for research and teaching and applying the models to selected academic departments. The study will include both quantitative and qualitative methodologies, including citation analysis and faculty interviews.

To make the citation analysis portion of the study more manageable, the presenters limited the scope to articles and book chapters published in 2009 forward. They focused on journal articles cited in the reference lists, since a majority of library materials budgets are allocated for electronic resources. With the journal titles, they determined the source of full-text access and calculated the percentage of reference from journals and citations from online library resources.

Most faculty interviews were conducted in-person. However, in a few cases at Denver, conversations occurred via phone or email. During the interviews, the researchers described the goals of the project; requested a copy of the curriculum vita and syllabi for the citation analysis; and asked 4 questions about their use of library resources. There were two questions regarding faculty research practices, and two more inquiries regarding the role of library collections in teaching, which included the following:

1. In your most recently published article, for every article you cited how many additional articles did you read but **did not cite**?
2. Approximately what percent of the articles cited or read were obtained from the following: Electronically from the library? In print format from the library? Via Interlibrary loan from the library? From non-library sources?
3. Approximately how many articles did you read to prepare for each course you taught during the 2009–2010 academic year?
4. Approximately what percent of the articles read in preparation each course for were obtained from the following: Electronically from the Library? In print format from the Library? Via Interlibrary loan from the Library? From non-library sources?

Implementation and Results

Although both pilot projects shared the same basic parameters, each library implemented the study with different participants. The Denver case study focused on a single academic department, while Boulder sampled from multiple disciplines. The paper will provide alternating reports from each library.

Chemistry was selected for the Auraria Library study based on the recommendation by the Dean, and the support of the Department Chair. To recruit participants, the researcher emailed all 16 faculty members listed on the department website. Three Chemistry faculty members with minimal research or teaching obligations, such as university administrators, were excluded from the study. With endorsement from the Dean and Chair, nearly 70% (9 out of 13) of the faculty members participated. The interviews revealed that Chemistry faculty relied on library collections for their research more so than teaching. The Denver study participants published 16 articles in the last two years (9 in 2009 and 7 in 2010). In the classroom, they relied almost exclusively on the course textbooks, and only a few required additional reading. Therefore the Denver pilot focused exclusively on research outcomes.

Librarians at Boulder recruited faculty from several academic departments including engineering, business, history, philosophy, sociology, and economics. Similar to the Auraria Library study, faculty members with minimal research or teaching obligations were excluded from the study. The Boulder faculty

who participated in the study published 18 articles in the last two years (9 in 2009 and 9 in 2010). On average, Boulder faculty indicated that they obtain the majority (66%) of resources needed for their research electronically from the library.

Boulder study participants taught 21 courses during the 2009–2010 academic year (7 graduate and 14 undergraduate level courses). Several Boulder faculty also indicated that they only assign a textbook for their courses. However, faculty reported that on average they read on average 13 additional articles to prepare to each undergraduate level course they taught and on average 62 additional articles for each graduate level course. The majority (52%) of the resources that they used to prepare for their courses were obtained electronically from the library.

Based on interviews, Denver's Chemistry faculty read on average 3 additional articles for every reference citation. The citation analysis revealed that 88% (742 out of 845) of all references were from journals. Research found that at least 84% of articles were obtained from library electronic resources in both qualitative answers received from faculty (84% average and 95% median) and the quantitative citation analysis (83.6% in 2009, 90.5% in 2010, and 86.5% total). When they published 16 articles over two years, pilot participants cited 642 journals (357 in 2009 and 285 in 2010) and read an additional 2,660 full-text articles (1457 in 2009 and 1206 in 2010) from library e-resources. The non-cited resources were estimated by multiplying the number of references by the faculty member's response to the first interview question. The result was multiplied by the percentage from journals and citations from online library resources (table 1).

TABLE 1
Denver Citation Analysis

	2009	2010	Total
# of published articles	9	7	16
# of references	497	348	845
# of additional articles read	2,028.5	1,472.5	3,501.0
% from journals	85.9%	90.5%	87.8%
% from library database	83.6%	90.5%	86.5%
# journal citations from library e-resources	357.0	285.0	642.0
# articles read from library e-resources	1,457.1	1,205.9	2,659.9

The sample of Boulder faculty pilot participants published 18 articles in 2009–2010. Within those 18 articles, Boulder faculty cited 726 resources including 386 articles. Boulder's lower percentage of cited references from articles (53% compared to 88% at Auraria) can partly be attributed to the varied research disciplines of the pilot participants. 50% of the Boulder participants are faculty in the humanities who indicated in their interviews that they relied more heavily on primary resources than secondary sources for their research. Overall, Boulder faculty were able to obtain at least 87% of the references cited in their articles from electronic library resources. Interviews indicated that Boulder faculty read on average 11 additional articles for every article that was cited in a published article. This means that pilot participants read approximately 4,561 additional articles from library e-resources in preparation for researching, writing, and publishing their articles (table 1a).

TABLE 1A
Boulder Citation Analysis

	2009	2010	Total
# of published articles	9	9	18
# of references	279	447	726
# of additional articles read	2,790	6,981	9,771
% from journals	79.9%	36.4%	53%
% from library database	90%	83%	88%
# journal citations from library e-resources	200	135	339
# articles read from library e-resources	2,003	2,113	4,561

If the Denver study participants did not have access to Auraria Library's collections, they would have spent nearly $100,000 over two years. This amount was calculated by multiplying the total number of journal citations and articles read by an estimated cost of $30 to purchase an article. The $30 price was determined by a sample of the 14 most cited journals from 6 different publishers. To serve the participating Chemistry faculty's research outcomes, Auraria Library subscribed to a total of 200 journal titles (113 in 2009 and 87 in 2010) with the overall cost of about $68,000 ($28,561 in 2009 and $39,482 in 2010). This approximate purchase price was established by dividing the annual e-resource cost by the number journals available. Then the value was multiplied by the

number of journals accessed by study participants to publish their article (table 2).

TABLE 2
Denver Cost Estimates

	2009	2010	Total
Faculty citations & articles read	1,814.1	1,490.9	3,301.9
Estimated average cost per article	$30.00	$30.00	$30.00
Estimated cost to purchase articles	$54,422.75	$44,727.80	$99,057.94
Library journal subscriptions	113	87	200
Estimated cost of library journal subscriptions	$28,560.85	$39,481.98	$68,042.83

Boulder also calculated an average price that users would be asked to pay for an article if the library did not provide access. A sample of 15 journals from 13 different publishers resulted in the same $30 estimated calculated at Auraria. Using the $30 estimated cost of purchasing an article, Boulder faculty participants would have spent approximately $147,000 to acquire the articles they needed for their research during 2009–2010. On average, the libraries on the Boulder campus subscribed to 95% of the 150+ journals cited in faculty research at a cost of approximately $67,700 (table 2a).

TABLE 2A
Boulder Cost Estimates

	2009	2010	Total
Faculty citations & articles read	2203	2248	4900
Estimated average cost per article	$30.00	$30.00	$30.00
Estimated cost to purchase articles	$66,083.82	$67,445.24	$147,004.85
Library journal subscriptions	81	71	152
Estimated cost of library journal subscriptions	$39,232.07	$28,468.93	$67,701.00

As a result of faculty interviews, citation analysis, and cost estimates, the researchers could finally calculate a cost benefit analysis (CBA). CBA is the ratio showing dollar value of benefits gained for dollar value of costs. The basic formula is benefits divided by costs. For this library collections pilot study, the formula is the estimated faculty article purchase price divided by the library journal subscription costs.

At Denver, the CBA was quite strong at almost $2.00 in 2009, and then dropped dramatically in 2010. The total CBA over the study period was nearly $1.50. The declining CBA is possibly a result of astonishing renewal increases from a couple publisher packages, since the average journal price increased from $250 to $450 in this two year period. Another possible factor was the decrease in publications, which also lowered the number of articles cited and read (table 3).

TABLE 3
Denver Cost Benefit Analysis

Year	Faculty Publications	Faculty Articles	Library Journals	CBA
2009	9	$54,422.75	$28,560.85	$1.91
2010	7	$44,727.80	$39,481.98	$1.13
Total	16	$99,057.94	$68,042.83	$1.46

The overall CBA for the Boulder study was $2.17 and ranged from $1.68 in 2009 to $2.37 in 2010 (table 3a).

TABLE 3A
Boulder Cost Benefit Analysis

Year	Faculty Publications	Faculty Articles	Library Journals	CBA
2009	9	$66,083.82	$39,232.07	$1.68
2010	9	$67,445.24	$28,468.93	$2.37
Total	18	$147,004.85	$67,701.00	$2.17

ROI uses the same values as CBA, however ROI is calculated as a percentage. It shows the return or increase in value on dollars spent to achieve a benefit. The generic formula is benefits minus costs divided by costs and multiplied by 100. Denver's ROI was over 90% in 2009, dips to 13% in 2010, for an overall ROI of nearly 50%. (Insert table 4)

Boulder's overall ROI was impressive at 117%; but like Auraria, varied widely from 68% in 2009 to

TABLE 4 Denver Return on Investment				
Year	Faculty Publications	Faculty Articles	Library Journals	ROI
2009	9	$54,422.75	$28,560.85	91%
2010	7	$44,727.80	$39,481.98	13%
Total	16	$99,057.94	$68,042.83	46%

137% in 2010. There are many possible reasons for this fluctuation including changes in subscription costs and faculty research output. A larger, more representative sample of faculty would probably more accurately reflect overall CBA and ROI (table 4a).

TABLE 4A Boulder Return on Investment				
Year	Faculty Publications	Faculty Articles	Library Journals	ROI
2009	9	$66,083.82	$39,232.07	68%
2010	9	$67,445.24	$28,468.93	137%
Total	18	$147,004.85	$67,701.00	117%

Using CBA and ROI in the Denver pilot study further validates Auraria Library's contribution toward university outcomes by supporting faculty research with library collections. Both faculty interviews and citation analysis reiterate that Chemistry faculty utilized online resources 84% of the time. This results echo the library literature which describes the importance of the acquisition or buyer role for libraries. According to Schonfeld and Housewright, "While the buyer role has always been important to the most faculty members, it is now by far the most important of the three: while 90% of faculty members view this buyer role as very important…"[4]

The Denver results also questions the assumption that low usage implies low value. In 2009, the *Journal of Chemical Theory & Computation* (JCTC) was an example of a journal title with low usage because full-text articles were accessed only 18 times. In comparison to other American Chemical Society (ACS) journals, JCTC ranks in the bottom third or 35 out of 46. Yet, the percentage of citations per full-text articles accessed was 33%. This is a significantly higher percentage than the 2% for the *Journal of the American Chemical Society* which was accessed nearly 1,700 times for full-text articles, the most accessed, and the highest ranking title for ACS usage. Similarly, Chemical Reviews was accessed 205 times, ranked in the top ten titles used, was cited 6 times, and the percentage of citations per full-text articles accessed was only 3% (table 5).

TABLE 5 Sample of Three American Chemical Society Journals				
2009	Ranking	Full-text Articles	# Cited	% Cited
J of the American Chemical Society	1	1690	29	2%
Chemical Reviews	9	205	6	3%
J of Chemical Theory & Computation	35	18	6	33%

Interview data and the CBA and ROI calculations provide evidence that the UCB Libraries' online resources directly contributed to faculty teaching and research outcomes. Boulder faculty indicated that a majority (66%) of resources needed for their research and 52% of the resources that they used to prepare for their courses were obtained electronically from the library. In addition, approximately 10% of the articles they needed for their research were obtained in print from the library. Interlibrary loan (ILL) services were used 12% on average to acquire articles not owned by the UCB Libraries. Interviews also provided data that faculty are getting on 20–25% of the articles they need for their research from non-library sources (e.g. freely available Web resources or their own personal collections).

Interviews gave faculty the opportunity to share their comments about library resources and services. Many Boulder participants indicated a preference for electronic books and journals for use in both their research and teaching activities. Boulder faculty also expressed high praise and appreciation of our ILL services which allow them to acquire the resources they need if not owned by the UCB Libraries.

Pilot Study Assessment

During implementation, the presenters encountered some issues that could impact future iterations of the pilot. For example, faculty input was essential to begin

the study. Finding a window of opportunity to contact and interview faculty was challenging and could potentially stall the project. Since they were concerned about obtaining faculty participation, the qualitative research did not distinguish between junior and senior faculty. Faculty rank, however, could make a significant impact on research activities.

Following the Elsevier-UIUC model, the researchers asked faculty to estimate the number of articles read and these values were included in the quantitative model. However, the qualitative data is subjective and cannot be validated. Furthermore, focusing on journal titles made the pilot more manageable. This is somewhat problematic because some disciplines, such as the humanities, rely more on primary sources than secondary sources, both in print and online. As a result, some expensive and important resources were excluded from the study.

Finally, the publication year was used to estimate the subscription cost. However, the faculty member could have accessed the cited article prior to the publication date. It was also difficult to calculate the cost for journals that are bundled into packages. As a result, an average cost per title was used for select titles which may not reflect individual subscription prices for those titles.

From this experience, the UCD and UCB librarians have learned a couple of lessons. The mixed methodology approach was very time consuming. However, valuable insights have been gained from the study. Speaking directly with faculty was a great collection development outreach opportunity. The Denver pilot benefited from a Dean's support and received a strong response from the recommended academic department. Despite that most Chemistry faculty did not use library collections in their classroom teaching, one instructor recognized the significance and offered to co-develop a separate student ROI project.

This pilot study focused on calculating CBA and ROI for electronic journal access because a majority of library materials budgets are allocated for electronic resources. However, 80% of the resources cited in articles written by faculty in the humanities were references to books or primary sources. Even if the library provided access those materials they were not included in the CBA or ROI calculations. This meant that the model was unable to account for differences in research needs according to discipline. While the model more accurately measured library support for disciplines that primarily rely on journal literature, it could not measure the extent to which the library supported disciplines that rely on print or primary sources.

Despite the pitfalls and drawbacks of the pilot, the presenters still see significant value in the project. Going forward, additional pilot academic departments will be identified and the student ROI project will be incorporated at Denver. Furthermore, due to the low CBA and ROI numbers for 2010, pay-per-search options will also be investigated for Chemistry.

Librarians at UCB would also like to identify additional participants from each discipline in order to get a more representative sample of Boulder's faculty. We would also like to adapt the model so that we can measure the impact of print library resources and ILL services as they are used in faculty research and teaching activities. Citation analysis helped us identify gaps in our collection and collection development is looking into subscription or purchase-on-demand options for those resources.

Conclusion

This pilot study created and tested a model that can be used to calculate ROI and CBA in any academic library. These calculations provide evidence of the value of our collections and demonstrate that library collection development efforts directly support the research and teaching outcomes of academic faculty. Like any statistical measurements, ROI and CBA calculations are only meaningful when put into context. This pilot study produced valuable comparative data for a multi-campus university system. If the CU System libraries continue to calculate these figures over time, this model has the potential to produce time series data that librarians can use to share with administrators and track trends over time. Librarians at all CU System libraries will continue to coordinate collection development activities in an effort to improve overall ROI and CBA for our users and our libraries.

Notes

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