Library Storage Facilities and the Future of Print Collections in North America

Lizanne Payne

Executive Director
Washington Research Library Consortium

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Lizanne Payne, for OCLC Programs and Research

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Please direct correspondence to:
Constance Malpas
Program Officer
constance_malpas@oclc.org

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Contents

Tables

Figures

Abstract

This report, commissioned by OCLC's RLG Programs unit as part of its Shared Print Collections program, examines the current context and status of library storage facilities.

It reviews storage facility designs and the extent of their use; the context supporting the development and use of off-site storage facilities; the key trends of shared journal archives, last- and single-copy facilities, "virtual storage," mass digitization, and local scanning and print-on-demand technology; and considers the future of library print collections, including the potential development of a distributed print repository network.

The author concludes that high-density library storage facilities have moved into the mainstream for collection management in academic libraries, and that this is the optimum time for the academic and library communities to leverage this collective capacity to develop a broader, system-wide approach to maintaining print collections across institutional boundaries.

Recommended actions for libraries currently making use of storage facilities include to move aggressively to archive print copies of selected journal titles where backfiles are available in electronic form; implement "last copy" policies for ongoing storage transfers at shared facilities; identify and disclose the facility's stored journal and book holdings, and relevant access and preservation policies, to partner institutions and service providers; and explore local prototypes such as the Five Colleges model for subscription to stored holdings in a region.

Recommended actions for the academic library community are to support development of a common mechanism to disclose library storage holdings and the services associated with them; convene workshops among a variety of potential participants to explore issues related to establishing and operating a formal print repository network; and develop appropriate financial models.

The report includes two data tables, three charts, twenty-two endnotes with full citations, a suggested reading list, and an appendix suggesting areas for further research.

Introduction

College and university libraries in North America hold a billion books, and add approximately 25 million more each year.[1] Libraries face great pressure to find efficient and cost-effective ways to house their existing holdings and to make room for new materials. While digital data storage and on-demand delivery hold great promise for ameliorating the space pressure, it may be many years before electronic versions supplant most print collections in most academic libraries.

In the past two decades, academic libraries of all sizes and types have sought to relieve local space pressures by building high-density storage facilities to accommodate overflow from campus collections.[2]

As of July 2007, at least 68 such facilities exist in the United States and Canada, holding more than 70 million volumes in total. Most library storage facilities in North America (79% or more) are operated by individual institutions, providing a local solution to a local space problem. In some instances where a consortial relationship already existed or could readily be developed, multiple libraries share a common storage facility. However, cooperative storage solutions remain relatively rare, representing just 14 (21%) of the 68 facilities described here. Even in consortial arrangements, the shared facility most often operates as secondary shelving for the individual member libraries, not as a jointly-owned collection.

As space and budget pressures increase, some academic libraries are implementing creative new approaches to inter-institutional collaboration. Some groups consolidate and store a single backfile of bound journal volumes, enabling partners to selectively de-accession local print runs. Others groups have negotiated with publishers to receive and store a single archival print copy of electronic journals to which they all subscribe.

The library community could provide lasting benefits to scholarship and economies to their institutions by proactively developing a collaborative print repository network on a regional, national or global scale.

The ever-expanding scope of online journals, e-books and mass digitization projects will have a dramatic impact on library print collections, simultaneously shaping patron use of scholarly resources and institutional measures of library service and value. With uncertainty about future demand for print collections, university administrators are understandably reluctant to expand campus libraries and almost as disinclined to build library storage facilities to accommodate growth in physical holdings.

Over the next decade, as the transition from print to electronic information access continues to unfold, academic institutions should collectively reassess system-wide supply and demand for library print holdings: the library community could provide lasting benefits to scholarship and economies to their institutions by proactively developing a collaborative print repository network on a regional, national or global scale.

Viewed collectively, academic and research libraries constitute a distributed network of repositories capable of sustaining a rich variety of research methods and materials, including a continuing (even if reduced) reliance on traditional print collections. Library storage facilities occupy an important niche in this system:

- They provide environmental conditions designed for long-term preservation of physical materials;
- They contain materials which will rarely, or never, be removed, and
- They offer delivery services which support efficient access to the stored materials.

These library storage facilities could provide the core infrastructure for a network of planned archival repositories serving the long-term needs of scholars throughout the world.

It is the purpose of this paper to review the current state of library storage practices in North America, identify key trends, and suggest areas where further research and collaborative action might improve system-wide preservation and access.

Library storage facilities: state of the art

As of summer 2007, 68 high-density library storage facilities in North America hold over 70 million library volumes, or approximately 7% of the one billion volumes owned by academic libraries in the region.

When traditional library shelves run out of space, when compact shelving no longer provides enough relief, and when library expansion is not possible, academic and research libraries of all types and sizes have invested in high-density library storage facilities. (While some public libraries store some materials, they do not generally share the long-term preservation goal that is central to the mission of most research-intensive university libraries.) As of summer 2007, 68 high-density library storage facilities in North America hold over 70 million library volumes, or approximately 7% of the one billion volumes owned by academic libraries in the region.

High-density library storage facilities share these characteristics:

- They are designed for efficient storage of very large quantities of library materials with no direct patron access. For purposes of this paper, high-density facilities are those which were designed to hold at least several hundred thousand volumes. Many such facilities hold several million volumes.
- They are usually separate from the traditional library stacks and often are located off-campus.
- In most cases, holdings are organized by size rather than by call number order, to maximize storage density.
- Most offer preservation-quality environmental conditions with reduced and stable temperature (around 50°Fahrenheit) and relative humidity (35%).

High density storage facilities offer 15 to 20 times the capacity of traditional library shelving. For example, 10,000 square feet in a traditional library has a capacity of about 100,000 volumes, while a high-density facility of the same size can hold 1.5 million to 2 million volumes.[3]

Storage facility designs

Some of the earliest high-density storage facilities in North America were built to various custom designs, such as the Northern and Southern Regional Library Facilities (NRLF and SRLF) that have served the University of California Libraries since the early 1980s. The NRLF and SRLF store volumes by size, double-deep on shelves, with manual access by staff on mezzanines. Other libraries, like Pennsylvania State University and the University of Alberta, have adapted existing commercial space for off-campus book storage. There are a total of 15 facilities in North America, holding almost 14 million volumes, which use some customized high-density storage solution of this kind.

Libraries around the world have also developed custom-designed high-density storage facilities, including the National Library of Australia; the CARM Centre (shared by ten university libraries in Victoria, Australia); the National Repository Library of Finland; and the Bayerische Staatsbibliothek (Germany).

However, most purpose-built high-density facilities constructed in North America over the past 20 years follow one of two designs:

- High fixed shelving (30+ feet in height) with volumes stored by size in cardboard trays for manual retrieval by an operator using a mechanical order-picker. This design is often called the "Harvard model" after the first such facility constructed at Harvard University in 1986.
- Automated Storage and Retrieval Systems (ASRS) with volumes stored in metal bins for retrieval by a robotic mechanism.

Harvard-model facilities

The majority of high-density facilities in North America today generally follow the Harvard design (38 of 68 facilities, or 56%). A wide variety of libraries have built Harvard-model facilities, including the Library of Congress, Yale University, Stanford University, Brown

University, Arizona State University, Rice University, the University at Buffalo, and West Virginia University.

Eleven of the Harvard-model facilities were designed to be shared among multiple libraries, including the Research Collections Access and Preservation (ReCAP) facility operated by Princeton, Columbia, and the New York Public Library; the Washington Research Library Consortium (WRLC) facility used by George Washington University, Georgetown University, American University, Catholic University, and others; and the Minnesota Library Access Center (MLAC) shared by the University of Minnesota and other academic, public and government libraries in the state. Including the three shared "custom-design" facilities, there are a total of 14 shared library storage facilities in North America, of which eight were funded by four state governments for their state university systems (California, Minnesota, Missouri, and Ohio); three are operated by consortia which already provided other consortial services such as shared library systems (WRLC, Five Colleges (Massachusetts), and the Tri-Universities Group (TUG) in Ontario); and three were jointly-developed specifically for the purpose of library storage (University of Alberta, ReCAP and the Preservation and Access Service Center for Colorado Academic Libraries (PASCAL) serving five libraries in Colorado).

Harvard-model facilities are designed to achieve maximum space efficiency at the lowest cost of construction. They are not designed for rapid retrieval, and most often are used for materials specifically identified as "low use." They are usually built off campus to take advantage of lower land costs, and provide a courier or van service to deliver items to campus users, typically within 24 hours of the request. Almost all provide same- or next-day electronic document delivery services for journal articles. Many of these facilities also provide an onsite reading room where researchers can review large quantities of materials, such as a long run of journals or a large archival collection.

Because these facilities typically hold low-use items, circulation rates are usually quite low. Harvard-model facilities consistently report annual circulation in the range of 1% to 2% of stored volumes. For example, the ReCAP facility, which holds about 6 million volumes,

reports about 100,000 retrievals per year (1.6%) while the WRLC facility with 1.1 million volumes supports about 10,000 retrievals per year (.9%).

Harvard-model facilities constructed in recent years have cost from $4.5 million to $7.8 million USD, depending on size and location, with a total construction cost ranging from $3 to $4 per volume. These facilities are usually constructed incrementally, in modules holding approximately 1.5 million volumes each. Construction costs for subsequent modules may be lower, because common areas (loading dock, processing areas) are already in place.

For ongoing operations, Harvard-model facilities commonly employ 2 to 4 staff for every million items stored. ReCAP reports a staff of 10 processing assistants who handle about 600,000 accessions annually and 100,000 retrievals on a collection of 6 million items. (By contrast, on-campus academic libraries average more than 75 staff per million volumes, although this includes departments not directly supporting collections.[4])

Staffing for storage accessions is variable and depends on institutional policies and resources affecting selection and transfers. Transfer of items to storage often involves very large shipments in the early days of a facility's operations, as pent-up demand for shelving space on campus is released. Subsequently, staffing needs for accessions may vary significantly over time or may be relatively steady. For instance, a library with a zero-growth policy that was staffed accordingly could transfer items at a fairly predictable rate, whereas a library dependent on occasionally-available staff time or special funding would more likely transfer items sporadically as resources allow. By contrast, the number of staff needed for retrieval tends to rise incrementally in a relatively predictable fashion, as the storage collection grows.

Table 1. Harvard-model library storage facilities in North America

Harvard-model facilities (or modified Harvard-model)	Ownership	Year opened	Current capacity*	Current volumes
Harvard University	Individual	1986	16,000,000	6,300,000
University of Michigan	Individual	1992	2,100,000	2,100,000
University of Texas, Austin	Individual	1992	1,600,000	1,200,000
Northeastern Ohio Cooperative Regional Library Depository	Shared	1994	1,175,000	1,175,000
Southwest Ohio Regional Depository	Shared	1994	2,000,000	1,999,000
Washington Research Library Consortium	Shared	1994	1,500,000	1,100,000
Ohio State University	Individual	1995	2,400,000	2,400,000
Northwest Ohio Regional Book Depository	Shared	1996	1,800,000	1,200,000
University of Missouri	Shared	1997	1,300,000	1,250,000
University of Virginia	Individual	1997	750,000	735,000
Cornell University	Individual	1998	4,100,000	3,200,000
University of Pennsylvania	Individual	1998	2,000,000	1,200,000
University of South Carolina	Individual	1998	1,500,000	900,000
Yale University	Individual	1998	3,000,000	2,000,000
Minnesota Library Access Center	Shared	2000	1,400,000	1,100,000
Research Collections and Preservation Consortium (ReCAP)	Shared	2000	7,000,000	5,950,000
West Virginia University	Individual	2000	1,000,000	1,000,000
Duke University	Individual	2001	3,000,000	2,000,000
Five Colleges (Massachusetts)	Shared	2001	500,000	320,000
Johns Hopkins University	Individual	2001	2,400,000	1,000,000
PASCAL (Colorado Academic Libraries)	Shared	2001	1,600,000	1,000,000
Library of Congress	Individual	2002	3,800,000	2,200,000
University of Pittsburgh	Individual	2002	2,500,000	1,300,000
Arizona State	Individual	2003	1,700,000	1,100,000
Indiana University, Bloomington	Individual	2003	2,800,000	1,400,000
Rice University	Individual	2003	1,750,000	625,000
Stanford University	Individual	2003	3,000,000	1,200,000
University of Illinois, Urbana-Champaign	Individual	2004	2,000,000	2,000,000
University of Western Ontario	Individual	2004	1,600,000	300,000
University of Nebraska, Lincoln	Individual	2005	800,000	400,000
University of Texas, Arlington	Individual	2006	500,000	300,000
University of Toronto	Individual	2006	2,000,000	200,000
Total			**80,575,000**	**50,054,000**

* Capacity measured in "volume equivalents"; i.e., space required for an average monographic volume. Archival boxes (equivalent in size to 20 volumes), which occupy a notable share of available capacity in most facilities, are not reflected in these figures. Available storage space may therefore be significantly less than the difference between Current Capacity and Current Volumes.

ASRS facilities

Automated Storage and Retrieval System (ASRS) facilities typically are built as an addition to a campus library building during an overall library remodeling project. The ASRS approach represents the fastest-growing segment in high-density storage, with a total of 15 ASRS facilities in North American libraries of which 9 (60%) were built in the three year period from 2004 to 2007. Libraries using ASRS include California State University at Northridge (the first in 1992), the University of Utah, the University of Nevada at Las Vegas, Chicago State University, and Colgate University.

There are also a number of ASRS facilities in operation abroad, including the National Library of Norway, the National Library of Slovenia, and the National Library of Spain in Barcelona. ASRS facilities are in planning for Macquarie University (Australia), the National Diet Library (Japan), and the British Library.

Table 2. Automated Storage and Retrieval System library storage facilities in North America

ASRS Facilities	Ownership	Year Opened	Current Capacity	Current Volumes
California State University, Northridge	Individual	1992	950,000	900,000
Eastern Michigan University	Individual	1998	800,000	350,000
Grand Valley State University (Michigan)	Individual	2000	250,000	100,000
Sonoma State University (California)	Individual	2001	750,000	350,000
University of Nevada, Las Vegas	Individual	2001	600,000	175,000
Valparaiso University, Valparaiso, Indiana	Individual	2004	300,000	300,000
University of British Columbia, Canada	Individual	2005	1,450,000	800,000
Utah State University	Individual	2005	1,500,000	1,100,000
Chicago State University, Chicago, Illinois	Individual	2006	800,000	375,000
Georgia Southern University	Individual	2006	200,000	120,000
Santa Clara University (California)	Individual	2006	800,000	750,000
University of Louisville (Kentucky)	Individual	2006	600,000	150,000
University of Utah	Individual	2007	2,000,000	1,000,000
California State University, Long Beach (under construction)	Individual	2008	850,000	n/a
Total			**11,550,000**	**6,470,000**

ASRS facilities are designed both for efficient use of space and for rapid retrieval. These facilities can be built to hold the same large quantities as Harvard facilities, but can retrieve and deliver a requested item within minutes. ASRS facilities are attempting to match the user's experience in a traditional open-stacks library environment by providing requested items in about the same time as patrons would normally spend retrieving volumes from traditional library shelves. Interestingly, some libraries also store special collections in the ASRS; these materials do not typically require the same ready-access as book and journal holdings, but do benefit from the security and environmental control of a closed storage environment.

By their nature and location on campus, ASRS facilities are intended to provide storage space for individual libraries and are not generally designed as shared facilities.

ASRS facilities are more expensive to build than Harvard model facilities, but are significantly less expensive than the equivalent space in a traditional library building. It is often difficult to separate the cost of an ASRS facility from the library space in which it is situated, since it is usually integrated within the cost of a larger library remodeling project. According to ASRS vendor HK Systems, an ASRS mechanism costs more than $1 million per row, not including the building structure itself.[5] The University of Utah describes its ASRS as costing $4 per volume[6] not including the building. Most ASRS facilities are built with significant extra capacity to cover many years' growth, since it is generally difficult to expand the total footprint of the campus library.

It is also difficult to make a direct comparison between the operating costs of ASRS and Harvard-model facilities because the general facility costs of ASRS are usually not separated. Under the Harvard model, explicit reporting of operations costs is easier because, as noted above, the facility stands alone. Direct costs of ASRS tend to be higher due to the expenses related to the robotic system, and, though it may seem counter-intuitive, staffing needs are similar to those of Harvard-model facilities with comparable capacity. Although the ASRS automates the process of retrieving and refiling storage bins, operators are still required to locate and remove the

requested item from the bin, and to refile returned items. Some of the larger ASRS libraries, with about 1 million volumes, report average daily "picks" (retrievals) of 75 to 100 items per day, which is similar to those reported for many off-campus facilities. In contrast to Harvard-model facilities, where requests typically are batched and processed at fixed times, the ASRS must be staffed to respond to requests in real time, whenever the library building is open to patrons. Because the ASRS is usually integrated into the circulation operations of the campus library, existing staff including student assistants may be deployed to handle the ASRS requests as they arise, which may reduce the need for dedicated staff.

Growth of ASRS as a storage solution indicates that more universities may be willing to pay more for rapid delivery, even if they can't match the convenience of direct patron access to holdings. Some ASRS facilities, like Utah State University, attempt to maintain some limited browsability by storing items in the ASRS bins in call number order to allow patrons to browse all items in a given bin, similar to browsing on a library shelf. A library administrator at the University of Chicago, which is planning an ASRS facility, noted that the university viewed it as "an investment in the library to support the humanities and social sciences in the same way that investment in laboratory space supports the sciences."[7]

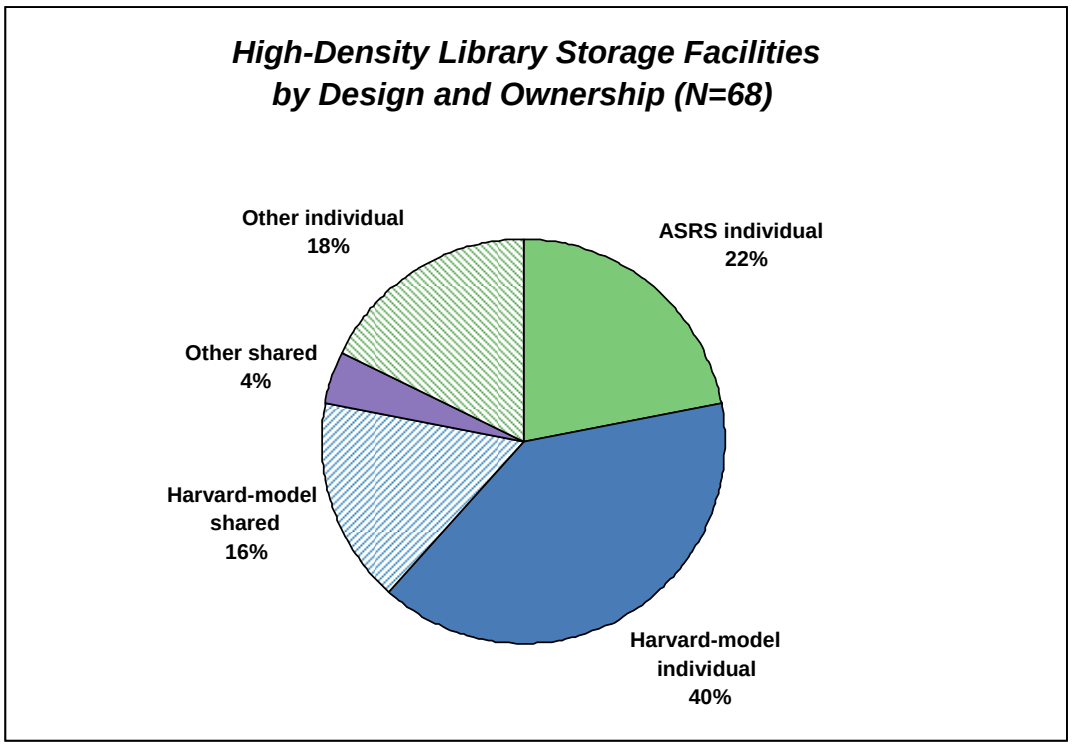

Figure 1. High-density library storage facilities by design and ownership

Environmental scan: the current context

While libraries have suffered chronic space shortages since ink was first applied to parchment, a number of factors have led to the rapid proliferation of high-density library storage facilities in recent decades.

1. Redefinition of main-campus libraries. Many university campuses are fully built out. Especially in urban and suburban settings, campuses are mature and have exhausted prime building locations. Libraries or library expansions are vying for space with dormitories, student centers, and other spaces which offer a more direct return in terms of attracting students. At the same time, the "library as place" movement has redefined what space within the library should be used for. As a result, libraries are coming to be seen primarily as centers for independent and collaborative study and learning rather than as housing for physical collections.

Many universities -- including Yale, Cornell, Brown, Johns Hopkins, and Ohio State University -- have adopted zero growth policies for the main campus collection, requiring that new print acquisitions be offset by an equivalent number of de-accessions or transfers to storage.

Libraries are vying for space with dormitories, student centers, and other spaces which offer a more direct return in terms of attracting students.

2. Rise of electronic journals. Electronic journals and databases which are available around the clock from anywhere on or off campus have dramatically reduced use of bound journal volumes in the campus library. This is particularly true for titles in scientific and engineering disciplines, where currency of information is of paramount importance. The JSTOR project, which has digitized backfiles of over 700 journal titles primarily in the social sciences and humanities,[8] explicitly proposed that libraries could afford the cost of the online JSTOR collection through the cost-avoidance achieved by removing bound journals from the library.

Key trends

Shared journal archives

Several major library systems or consortia have developed formal print journal archiving agreements based at their storage facilities.

For many libraries, the JSTOR titles are natural candidates for storage and an easy starting point for shared journal holdings. JSTOR itself has contracted with the University of California system and the Harvard Depository to host dark archives containing print volumes of JSTOR titles. At least a dozen other university libraries reported to JSTOR that they have entered into agreements to consolidate their holdings of JSTOR bound volumes in a shared storage facility.[9]

Other libraries engage in "prospective archiving" projects in which a publisher sends print versions of electronic journals directly to the storage facility. The program at the University of California system archives thousands of journal titles from publishers Elsevier, ACM, Kluwer/Wiley, and others at the Southern Regional Library Facility (SRLF). Similarly, the libraries of the Committee on Institutional Cooperation (CIC) consortium maintain a program for 1,500 journal

titles published by Wiley and Springer Verlag, stored at the facility operated by the University of Illinois at Urbana-Champaign.

Last and single copy facilities

A small number of shared storage facilities have implemented formal "single (or last) copy" policies. In these arrangements, the participating libraries agree not to send duplicate copies to the storage facility, and to share ownership or at least provide guaranteed permanent access to the stored material. This policy enables the other participating libraries to discard their matching copies in campus libraries by relying on the stored copy.

Details of single- and last-copy policies vary from one consortium to another:

- At the PASCAL facility, shared by 5 libraries within 3 universities in Colorado, duplicates are prohibited and ownership remains with the original library. As a result, libraries sometimes strive to be the first to deposit certain materials in order to own the copy of record.

- The Five Colleges consortium in Massachusetts actively consolidates complete runs of bound journals from the four participating colleges in order to deposit a single complete set at the shared storage facility. Ownership of the shared volumes is transferred to the consortium.

- The Northeastern Ohio Cooperative Regional Library Depository is retroactively consolidating bound journal runs and assigning volumes to a "Library of Record," with all member libraries sharing access to the stored volumes.

- The Tri-Universities Group (TUG) consortium in Ontario has a policy to keep only items that are not available in any of the three member libraries, i.e. no duplication even among the campus libraries. The consortium has another project under way to reclaim space in the Annex by removing items which are also held on campus.

"Virtual storage"

Nine libraries in the Association of Southern Research Libraries (ASERL) including Vanderbilt, the University of South Carolina, Duke, and the University of Virginia have explored creating a "virtual storage" program, in which members rely on items already stored by other members in their own storage facilities. The non-storing members could discard rather than store their campus copies, relying instead on guaranteed access to the "virtual storage collection." Initial investigations revealed that there was a high degree of uniqueness among the already-stored items and across the collections, which has led to expansion of the concept to encourage proactive storage of unique materials for long-term preservation.[10]

Mass digitization

Mass digitization efforts like the Google Books Library Project, Microsoft Live Academic Search Books project, and the Open Content Alliance (supported by the Internet Archive, Microsoft, Yahoo, Adobe, and many others) are likely to have a dramatic influence on existing library book collections in the years to come.

Google has contracted with a wide array of libraries including Oxford, Harvard, Michigan, the University of Texas, the University of California Libraries, and the Committee on Institutional Cooperation (CIC) consortium to provide tens of millions of books for digitization. Libraries ship the books in large quantities to Google-operated scanning facilities, where they are digitized and made available (subject to copyright restrictions) for full-text searching and display on the Google Books search platform. Participating libraries receive digital copies of their scanned volumes which they can host locally, subject to certain individually-negotiated limitations. Of current Google Library partners, only the University of Michigan has yet developed a local delivery platform for the content. With other members of the CIC, Michigan plans to offer a public digital repository of that portion of its 10 million volumes which are out of copyright.

The Open Content Alliance project takes a different approach. Participating libraries, including the University of Toronto, Boston

Public Library, and campuses in the University of California system (among others) are using low-cost, high-throughput scanning workflows developed by the Internet Archive to produce thematic collections of works in the public domain. Titles scanned through the Open Content Alliance are made available for searching, display, download and printing through the Internet Archive's Open Library project and may also be integrated into other institutions' digital library collections. Several hundred thousand titles have been made available through the Internet Archive to date. A subset of titles scanned through this project have also been integrated into the Microsoft Live Academic Search service.

Local scanning and print-on-demand technology

Technology to support local book scanning within the library is becoming increasingly affordable. Kirtas Technologies, Bookeye, and others offer book scanners with automatic page-turning which would allow libraries or storage facilities to scan individual volumes as needed to create a local digital collection for further distribution and online access (through the Open Library, Amazon, or elsewhere). Emory University, the University of Maine, and the Cincinnati Public Library are using Kirtas scanners to digitize selected non-copyright collections and make them available for print-on-demand purchase through the Amazon bookseller site. Emory University explicitly proposes to move 200,000 volumes to offsite storage once they have been scanned through this project.

This small-scale book-scanning approach could also be a breakthrough technology and service for materials already in library storage facilities. Local scan and print-on-demand could serve as a cost-effective electronic delivery method for monographs (equivalent to services that have long been in place for journal articles) and a means to develop an e-book collection *ad hoc*, as individual items are requested from storage.

However, it will take years for these local scanning and mass digitization projects to develop a critical mass of volumes and the associated technologies, relationships, and legal structures which

will allow them to serve as true alternatives to locally-held print collections.

Several mechanisms must be developed which do not currently exist in a stable and consistent fashion:

- Libraries must be able to easily identify (in an automated match) which of their current holdings have been digitized by other institutions or agents and are available to their local constituents
- It must be possible to search and link seamlessly to these scanned books in the context of digital library systems and learning management systems offered by the university.
- These digitized book collections must support the specific use patterns associated with online teaching, research and learning, such as annotation, quotation, and collaborative use.

Only when the aggregate collection of digitized books, or some significant portion of it, approximates the utility and accessibility of local collections will academic libraries be able to give serious consideration to reducing their legacy print holdings…

Only when the aggregate collection of digitized books, or some significant portion of it, approximates the utility and accessibility of local collections will academic libraries be able to give serious consideration to reducing their legacy print holdings and increasing their reliance on a massively distributed body of digitized text.

The future of library print collections

In 2006, Ithaka, a non-profit research organization closely affiliated with JSTOR, conducted a survey of the attitudes of academic librarians and faculty members which found that "neither librarians nor faculty members anticipate e-books constituting a viable substitute for print books" and "neither faculty members nor librarians are enthusiastic to see existing hard-copy [journal] collections discarded, with the faculty much less enthusiastic than the librarians (20% and 42%, respectively)." However, the survey also found that "[t]here has been a decline in the share of faculty members who believe that their local library must maintain hard-copy collections of journals."[11]

While the promise of a universal digital library is far from being fulfilled, the sheer volume of digitized books being generated through Google Books and other conversion projects calls into question the future of print library collections. The increased discoverability of book content on the open web may paradoxically lead to increased demand on print collections, as readers may turn to libraries for the complete content. More often, however, academic institutions are questioning whether their already low-use print collections will be made obsolete by more flexible and accessible digital book collections.

In the near term, digitization projects are likely to drive additional volumes to storage, even from libraries not directly participating as contributors to the digitization efforts.

In the near term, digitization projects are likely to drive additional volumes to storage, even from libraries not directly participating as contributors to the digitization efforts. Over time, many libraries are likely to find a noticeable number of their holdings among the vast quantity of books that will become available in electronic form. Some libraries may be willing to discard the print versions in favor of an online or print-on-demand version, but many more are likely to save and store a print copy in a local or shared storage facility. Some libraries, like the ASERL and TUG consortia described earlier, may focus on the "long tail" by aggregating the supply of locally-unique items (a long narrow tail of individual works) for more efficient storage, preservation, and delivery to a broader pool of users.

In the meantime, many provosts, chief financial officers, and other administrators are reluctant to invest in additional book storage spaces of any kind, whether on-campus libraries or high-density storage facilities. The largest academic research libraries still add an average of 80,000 volumes per year (with the very large libraries adding far more), while mid-size university libraries typically add 20,000 to 30,000 volumes per year.[12] (See figures 2 and 3.) Since 1993 – well after online resources became widely available -- the number of books in print has more than doubled, from 1.1 million to over 2.5 million.[13] While many journals in science, technology, and medicine (STM) have completed the transition from print to electronic creation and distribution, print journals and books remain a core component of scholarly communications in the social sciences and humanities, and an essential feature of university library collections.

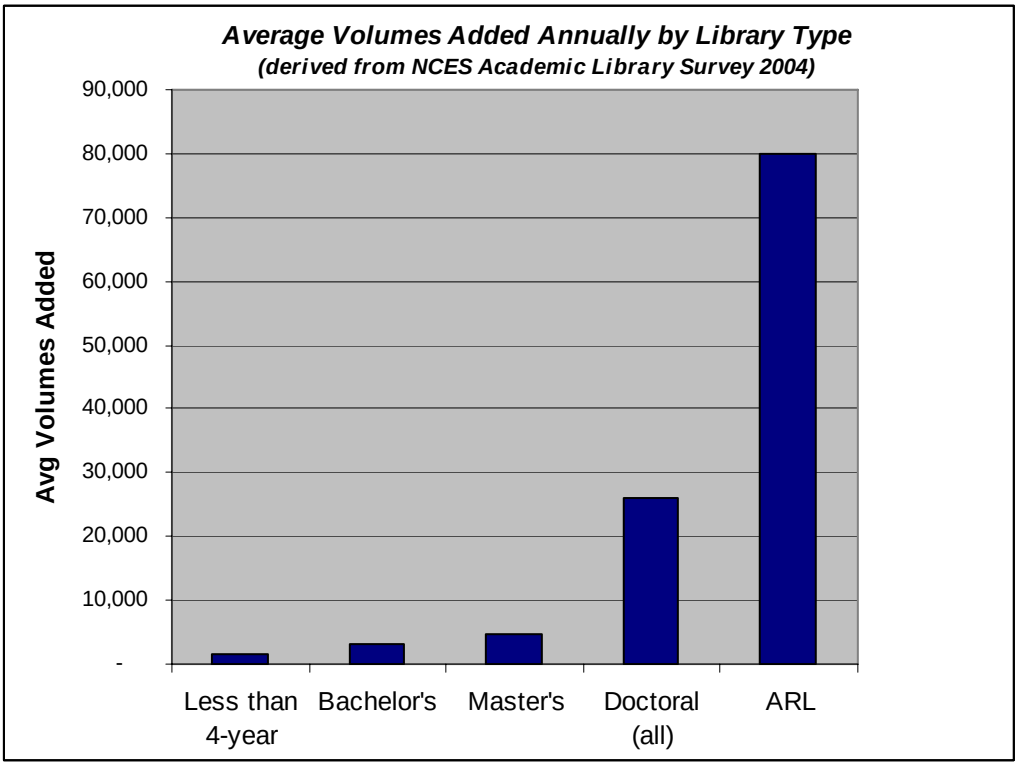

Figure 2. Average volumes added annually by library type (NCES Academic Library Survey 2004[14])

How academic libraries will handle their print collections over the next several decades is likely to vary by size and type of library:

- The uppermost tier of research libraries -- libraries with the strongest preservation mission and the deepest institutional reserves -- will continue to retain print copies of most if not all of their current holdings and their new acquisitions. Libraries in this category are the only institutions that are likely to continue building book shelving and storage spaces of significant size.

- Research libraries and university libraries with more limited resources may continue to build new individually-owned storage facilities or additional modules, including ASRS, but will likely investigate more cooperative approaches to both print collection building and management.

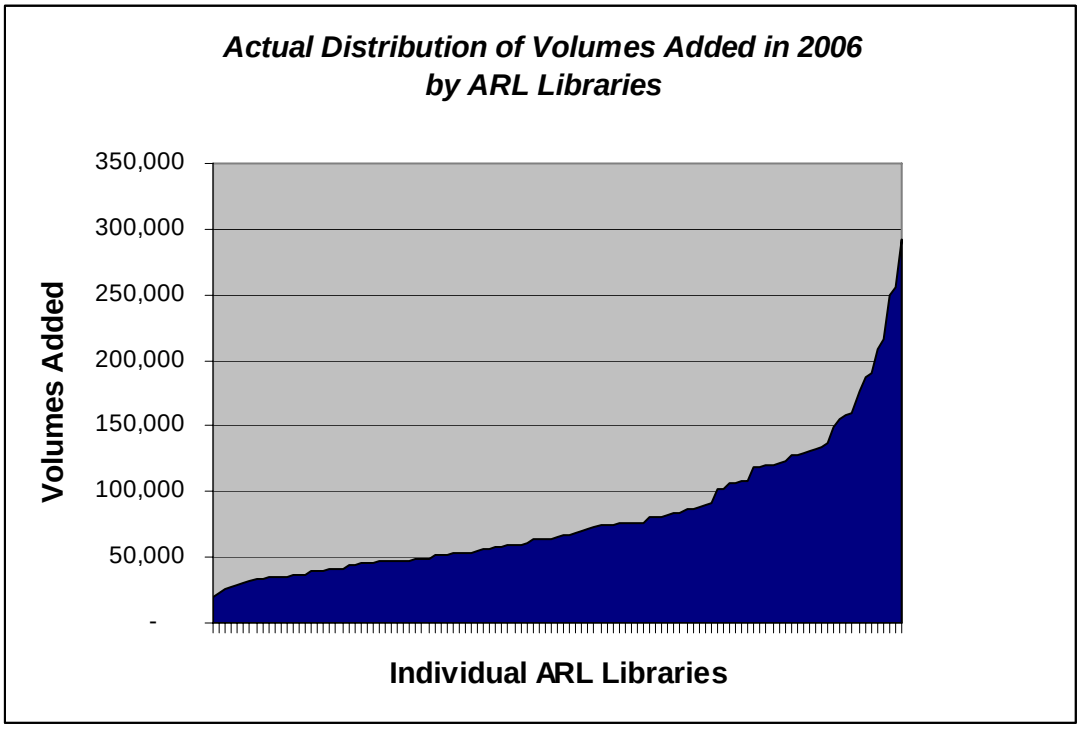

Figure 3. Volumes added to individual ARL library collections in 2006 (derived from ARL Statistics 2005-2006[15])

- College libraries with a research orientation may participate in shared storage solutions in partnership with larger institutions, but are likely also to integrate data-driven weeding programs into their operations, increasing their reliance on system-wide holdings and distributed preservation commitments.

Even as libraries are running out of shelf space, their off-site storage facilities are at or near capacity. Data gathered for this paper indicates that 75% of the 68 high-density facilities described here are more than half full;. Over 60% of the 5,000+ libraries responding to a Heritage Health Index survey in 2005 reported a need for new or additional offsite storage,[16] and more than half of the academic library respondents to an OCLC survey in 2006 reported that their storage facilities are more than two-thirds full.[17]

Some storage facilities, when pushed to the limits of capacity, are driven to remove duplicate materials from storage to reclaim space.

75% of the 68 high-density facilities described here are more than half full

The space reclaimed is generally modest compared to the effort required for retrospective deduplication, especially in high-density sites. For example, the Northeastern Ohio Cooperative Regional Library Depository initiated a deduplication project in late 2006. As of July 2007, the depository staff had reviewed 280 of the 7,000 journal titles represented in the facility and had removed about 6,000 volumes (less than 1% of the depository holdings).[18] Similarly, a report issued by the Tri-Universities Group in 2004 concluded that "only journal and periodical collections could be considered as cost effective targets for Annex weeding and space recovery" and then only because these volumes are stored contiguously in the TUG Annex.[19]

Capacity for storing print collections is increasingly limited throughout the academic library community, and the costs and benefits of maintaining "just in case" redundancies in the aggregate "inventory" deserve careful examination. Proactive efforts to optimize use of existing collection capacity in the context of regional or national holdings are likely to realize more value than local deduplication projects alone. A forthcoming report from Ithaka notes that "the human resource costs and library space needs required for print collections are significantly greater than those for electronic resources…In an environment of large-scale digitization, the cost to hold print versions locally may become greater than the benefit for many libraries."[20]

Distributed print repository network

In twenty years, it may be generally accepted that academic libraries, especially those at colleges and teaching universities, will house many fewer print books than they do now; even today, undergraduate book collections are a diminishing physical presence in the libraries of some major research institutions. As scholarly communication practices continue to evolve and new online research resources emerge, we will likely see reliance on print resources, even in the humanities and social sciences, trend downward in all but a few segments of the academic community. Until then, and as the landscape of electronic and print formats continues its seismic shift, institutions will be continually challenged to balance the costs and

benefits of managing legacy print collections at the local and system-wide level.

Academic institutions and the libraries that serve them could provide lasting benefits to scholarship and economies to their institutions by proactively developing a network of print repositories on a regional, national, or even a global scale. A full-scale print repository network would support informed choices about which additional materials to save, share, or weed, and what kinds of storage space to build or not build.

In a print repository network, participating libraries could compare holdings to determine what materials are already being preserved, and determine whether to retain, store, or discard local copies.

In a print repository network, participating libraries could compare holdings to determine what materials are already being preserved, and determine whether to retain, store, or discard local copies. Thus libraries could make difficult decisions about their holdings in the broader context of materials held regionally, nationally or even internationally under conditions and policies that meet local access and preservation standards.

For the past several years, a number of libraries, consortia, and other library organizations have been discussing the potential development of such a network, an initiative which is becoming known as the Cooperative Collections Management Trust (CCMT). There are several key components, both operational and organizational, that would facilitate broad participation in a network such as this:

1. A registry for libraries to indicate that certain volumes will be preserved, whether in storage facilities or in campus libraries, and a mechanism to compare holdings or storage candidates to a database of already-preserved items.

2. Formal agreements to ensure that participating libraries may rely on access to the preserved copies if they choose to weed their own. It would be important to provide a higher service level to network participants compared to standard interlibrary loan requests, which most libraries already support. At the same time, it would be important to allow for a very lightweight level of participation commitment so that

libraries could test the network relationship or choose not to participate at all.

3. Robust and timely delivery mechanisms to support requests for items. Local digitization- and print-on-demand could be a very important mechanism here.

4. Affordable operational support for local weeding of discarded items. To gain full value from the ability to rely on other libraries' materials, libraries must be able to weed significant quantities from their own shelves. However, most libraries do not maintain staff and operations to perform regular weeding on a large scale. A contractor or other external source to perform as-needed projects to withdraw, pack, remove, and dispose of a large number of items could be a more cost-effective method.

There are also factors which may hinder development of a print repository network.

1. Library and university evaluation criteria which assume a correlation between the size of local library print collections and institutional support for research and scholarship.

   Evaluation by collection size (volume count) encourages unnecessary redundancy, and creates a disincentive to coordinate local holdings in the context of aggregate and peer group holdings. To promote efficiency and cost-savings throughout the entire system, accrediting agencies and other evaluators could provide credit for once-owned materials which are still available through a formal agreement. The Association of Research Libraries has recently announced significant changes to its member statistics to de-emphasize collection size as a factor and to account for the increasing numbers of collaborative collections programs in which libraries share ownership or access to materials.[21]

Support for the Cooperative Collections Management Trust

OCLC is working with member libraries to develop and test some of the infrastructure that would be necessary to support the Cooperative Collections Management Trust (CCMT)

OCLC's Business Development and New Services Division is developing a pilot project for fall 2007 to provide a registry of providers, a database of stored items, and collection analysis reports to compare holdings.

RLG Programs, a division of OCLC Programs and Research, is working with partner institutions in the library community to define common agreements that will promote inter-institutional collection-building and sharing commitments.

2. Inequitable participation patterns.

   As in the interlibrary loan system, there will be libraries which mostly preserve (net lenders) and libraries which mostly discard (net borrowers). There may be objections from the patrons (especially the faculty) of both kinds of libraries. The top tier research libraries may not perceive any particular benefit to participation in a print repository network, and may not change their collection management behavior in ways that promote system-wide economies. However, they may commit to serving as libraries of last resort (at least for some partners) because they will be preserving this material for local use and can maximize its value by allowing it to circulate somewhat more widely. Digital delivery is likely to have an important impact here, especially for works in the public domain.

3. Inequitable financial support.

   The libraries and consortia which maintain storage facilities incur significant ongoing expenses, both capital and operating. They may be reluctant to support libraries which are able to avoid those expenses ("free riders").[22] It would be beneficial to develop a cost-sharing formula at the system level that compensates for different participation patterns.

   The Five Colleges consortium has implemented a local prototype version of a print repository network by allowing nonmembers to subscribe for access to the Five Colleges' stored materials. The consortium receives ongoing revenue to support the storage facility, and the subscribers receive guaranteed access to materials that they no longer need to retain in print form. The fact that Williams College and others have agreed to pay a fee for the potential right to access another library's stored collection is an important proof-of-concept that the print repository network could work on a wider scale.

Conclusion and recommended actions

High-density library storage facilities have moved into the mainstream for collection management in academic libraries. This is the optimum time for the academic and library communities to leverage this collective capacity to develop a broader, system-wide approach to maintaining print collections across institutional boundaries.

Recommended actions for libraries currently making use of storage facilities:

- Move aggressively to archive print copies of selected journal titles where backfiles are available in electronic form (e.g. JSTOR and others)

  Anticipated benefit: Reclaim significant space in campus libraries with the least effort related to storage selection and transfer

- Implement "last copy" policies for ongoing storage transfers at shared facilities

  Anticipated benefit: Extend the capacity of existing storage facility space while reducing unintended redundancies in system-wide holdings

- Identify and disclose the facility's stored journal and book holdings, and relevant access and preservation policies, to partner institutions and service providers

  Anticipated benefit: Facilitate sharing and cooperative ownership with other libraries

- Explore local prototypes such as the Five Colleges model for subscription to stored holdings in a region

  Anticipated benefit: 1) Provide more economical access to low-use titles by increasing reliance on regional storage holdings and selectively weeding local holdings (benefit to

subscriber) and 2) support financial sustainability of shared storage collection (benefit to storage provider)

Recommended actions for the academic library community:

- Support development of a common mechanism to disclose library storage holdings and the services (borrowing, digitization, document supply) associated with them

  Anticipated benefit: Extend the benefits of regional shared storage across a much broader area to achieve greater economies of scale and maximize efficient use of available storage space

- Convene workshops among a variety of potential participants to explore issues related to establishing and operating a formal print repository network

  Anticipated benefit: Identify goals and concerns of stakeholders in order to define optimal network, services, and participation options

- Develop appropriate financial models

  Anticipated benefit: Encourage libraries to participate as providers by providing compensation in some form and as borrowers by minimizing cost

Just as the LOCKSS (Lots of Copies Keeps Stuff Safe) initiative provides a voluntary distributed system among libraries to preserve electronic resources, a voluntary print repository network could provide a distributed solution to the challenges of print preservation. Viewed in the aggregate, library off-site storage facilities represent a shared infrastructure for print preservation efforts on a vast scale. By leveraging this collective capacity, and building on existing networks of trust within the library community, we can begin to manage our physical inventories in ways that reduce unnecessary redundancy while preserving the world's print heritage as a shared public good.

Suggested reading

Orphan, Stephanie. 2004. "ASERL to Create Virtual Storage System." News from the Field [column]. *College & Research Libraries News*, 65,8(September): 420.

Canadian Association of Research Libraries (CARL). 2006. *Print Repository Initiatives at Canadian University Libraries: An Overview*. Available online at: http://www.carl-abrc.ca/projects/preservation/pdf/print_repos_overview.pdf. [Accessed 19 September 2007.]

Gherman, Paul. 2007. "The North Atlantic Storage Trust: Maximizing Space, Preserving Collections." *portal: Libraries and the Academy,* 7,3: 273.

Nitecki, Danuta, and Curtis L. Kendrick. 2001. *Library Off-Site Shelving: Guide for High-Density Facilities*. Englewood, CO: Libraries Unlimited.

Some of the financial details may be dated at this point, but this is an excellent and thorough overview of the design and operation of Harvard-model storage facilities.

CHEMS Consulting. 2005. *Optimising Storage and Access in UK Research Libraries: A study for CURL and the British Library*. Available online at: http://www.curl.ac.uk/about/documents/CURL_BLStorageReportFinal-endSept2005.pdf. [Accessed 4 October 2007.]

Most of the issues raised apply equally well to North American libraries.

Reilly, Bernard F., Jr. 2003. *Developing Print Repositories: Models for Shared Preservation and Access.* With research and analysis by Barbara DesRosiers, Center for Research Libraries. CLIR Reports, pub117. Washington, D.C.: Council on Library and Information Resources (June). Available online at: http://www.clir.org/pubs/abstract/pub117abst.html. [Accessed 4 October 2007.]

See especially Chapter 7: Factors that Promote Cooperative Collection Management.

Notes

[1] Holton, Barbara, Kaleen Vaden, Patricia O'Shea, and Jeffrey Williams. 2004. *Academic Libraries: 2004.* (NCES 2007-301). U.S. Department of Education, Washington, DC: National Center for Education Statistics, p. 2. Available online at: http://nces.ed.gov/pubs2007/2007301.pdf. [Accessed 4 October 2007.]

[2] Institutional data referred to in this report were compiled by the author primarily from Web sites maintained by libraries or library storage facilities, as well as personal correspondence with facility managers in some cases.

[3] Boss, Richard W. 2002. "Automated Storage/Retrieval and Return/Sorting Systems." PLA Tech Note. Available online at: http://www.ala.org/ala/pla/plapubs/technotes/asrsystems.cfm. [Accessed 4 October 2007.]

[4] Derived from Association of Research Libraries (ARL) Statistics Tables 2005-06, available online at: http://www.arl.org/bm~doc/06tables.xls. Contextual information about these data is available at "ARL Statistics & Measurement," http://www.arl.org/stats/index.shtml, "ARL Statistics & Measurement: Annual Surveys," http://www.arl.org/stats/annualsurveys/index.shtml, and "ARL Statistics & Measurement: Annual Surveys: ARL Statistics," http://www.arl.org/stats/annualsurveys/arlstats/index.shtml. [All pages accessed 4 October 2007.]

[5] eSchool News. 2004. "New University Library Will Use Robotic Cranes To Fetch Old Books." *eSchool News Online.* Available online at: http://www.eschoolnews.com/news/showstory.cfm?ArticleID=4891. [Accessed 19 July 2007.]

[6] University of Utah. [n.d.] "Renovation-Innovation: ARC." [Automated Retrieval Center.] J. Willard Marriott Library Web site, available online at: http://www.lib.utah.edu/libraryinfo/construct/newprogramareas/arc.html. [Accessed 28 July 2007.]

[7] University of Chicago library administrator, personal communication with the author, 17 July 2007.

[8] JSTOR. 2007. "Currently Available Journals – Complete Title List." [Last updated May 24.] Available online at: http://www.jstor.org/about/all.list.html. [Accessed 4 October 2007.]

[9] JSTOR. 2006. "Bound Volume Survey Results." [Survey conducted October 2003.] Available online at: http://www.jstor.org/about/bvs2003.html. [Accessed 24 July 2007.]

[10] Burger, John, Paul M. Gherman, and Flo Wilson. 2005. "ASERL's Virtual Storage/Preservation Concept." Currents and Convergence: Navigating the Rivers of Change: Proceedings of the ACRL 12th National Conference, April 7-10, 2005, Minneapolis, Minnesota, ed. Hugh Thompson: 138-145. Available online at: http://www.ala.org/ala/acrl/acrlevents/burger-etal05.pdf. [Accessed 19 September 2007.]

[11] Ithaka. 2007[?] "2006 Librarian and Faculty Studies: Overview of Key Findings." Available online at: http://www.ithaka.org/research/Ithaka.Surveys.2006.Overview.pdf. [Accessed 4 October 2007.]

[12] Association of Research Libraries. "ARL statistics 2005-06". (See note 4.)

[13] R.R. Bowker, L.L.C. 2007. "Book Industry Statistics." [Web page.] Available online at: http://www.bowker.com/news/statistics.htm. [Accessed 11 October 2007.]

[14] Chart based on data from Holton, et al., 2004 (see note 1.), Table 6. "Number of volumes, units, and subscriptions added during the fiscal year in academic libraries, by control, level, size, and Carnegie classification of institution: Fiscal year 2004."

[15] Association of Research Libraries (ARL) Statistics Tables 2005-06, available online at: http://www.arl.org/bm~doc/06tables.xls. (See note 4 for references to explanatory material.) Data on gross volumes added per institution is found in sheet "coll1," column D, "Volumes Added (Gross)."

[16] Heritage Preservation. 2005. "Collections Storage." Chapter 6 of *A Public Trust at Risk: The Heritage Health Index Report on the State of America's Collections*, p. 59. Washington, DC: Heritage Preservation. Available online at: http://www.heritagepreservation.org/HHI/HHIchp6.pdf. [Accessed 11 October 2007.]

[17] Nilges, Chip. 2006. "Cooperative Collection Management Survey." Presentation at 149th Association of Research Libraries Membership Meeting, 19 October, Washington, DC (USA). Available online at: www.oclc.org/news/events/presentations/2006/coopcollmgtsurvey.ppt. [Accessed 4 October 2007.]

[18] Scalf, Judy (depository manager, Northeastern Ohio Cooperative Regional Library Depository), personal communication with the author, 6 September 2007.

[19] Gillies, Scott. 2004. "TUG Annex Space Assessment Report: Report to the Tri-University Group (TUG) of Libraries Executive Committee" Prepared on behalf of the TUG Information Resources Committee. (June 4 revised version.) Available online at: http://staff.tug-libraries.on.ca/annex/report.html [Accessed 19 September 2007.]

[20]Roger C. Schonfeld, 2007. "Getting from Here to There, Safely: Library Strategic Planning for the Transition Away from Print Journals." *Forthcoming* in *The Serials Librarian,* 52,1/2. Summary available online at: http://www.ithaka.org/research/completed-projects/resolveUid/26c873cbcddff419c3d2c99d808f9d72. [Accessed 11 October 2007.]

[21] ARL Statistics and Assessment Committee. 2007. "New Ways of Measuring Collections: An Implementation Plan." Washington, DC: Association of Research Libraries. Available online at: http://www.arl.org/bm~doc/implan.pdf. [Accessed 11 October 2007.]

[22] A useful summary of the "free-rider problem" as it applies to library cooperation is provided in Lavoie, Brian F. 2003. *The Incentives to Preserve Digital Materials: Roles, Scenarios, and*

Economic Decision-Making. White paper published electronically by OCLC Research. Available online at: http://www.oclc.org/research/projects/digipres/incentives-dp.pdf. [Accessed 11 October 2007.]

Appendix

Areas for further research

Several areas could benefit from additional research as libraries and other organizations in the library community consider the options for housing library print collections in the future.

1. How much redundancy in library print collections is needed to support system-wide preservation and access requirements?

    a. Is it feasible to identify optimal thresholds for different classes of institutions, material formats or disciplines?

2. What are the assumptions and goals of various administrators which affect their attitudes about library storage and willingness to participate in a print repository network?

    a. Conduct a survey or structured interview with collection development managers, library directors, and university provosts among various types of institutions, who participate in decision-making at different levels.

3. What factors do institutions consider in choosing ASRS or Harvard model high-density storage?

    a. Are there characteristics which make one design a better fit for certain kinds of libraries, or is it specifically a local decision each time?

    b. Would operators of different kinds of facilities be more or less likely to participate in a distributed print repository network?

4. What are the storage needs of public and special libraries?

    a. Most library storage facilities are currently operated by academic libraries. Would public and/or special libraries make use of and contribute to storage facilities or a print repository network?

Library Storage Facilities and the Future of Print Collections in North America Lizanne Payne, for OCLC Programs and Research. Â© 2007 OCLC Online Computer Library Center, Inc. All rights reserved October 2007. OCLC Programs & Research Dublin, Ohio 43017 USA www.oclc.org. Future of Library Storage. As a library professional for a large institution or consortium, youâ€™re faced with unique space challenges, including increasing pressure to find more efficient ways to preserve your collection while maximizing valuable library space. You realize that the future management of your library collections likely includes offsite storage, and have likely discovered that a scalable and sustainable solution that meets your preservation requirements is hard to find. Ideal Preservation Service Requires New Innovation. We're well aware of your situation. In 2015 we perform