
Expanding the Preservation Network: Lessons from Portico

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ABSTRACT

Portico, a digital preservation archive for the scholarly community and a National Digital Information Infrastructure and Preservation Program (NDIIPP) partner, has successfully extended the NDIIPP network to include a diverse and broad set of publishers and libraries through the development of a model that encourages institutions of all sizes to participate in digital preservation. Over the past two and a half years of archive operations, Portico has learned a number of lessons—most importantly that responsiveness to community needs is key to successful preservation.

DEFINING THE RISK: ASSURED ACCESS TO SCHOLARLY RESOURCES REQUIRES NEW INFRASTRUCTURE

In recent years, academic libraries' expenditures to purchase or license digital content for their communities have increased dramatically. Between 1993 and 2006, electronic materials expenditures at the libraries of the Association of Research Libraries (ARL) increased over five times more rapidly than total library materials expenditures (LME), and in the 2005–6 academic year, these libraries spent an average 41 percent of total LME on e-resources. Twenty-three ARL libraries spent more than 50 percent of their materials budget on electronic resources (fig. 1; Kyriillidou & Young, 2008).

The average percentage of LME that the Association of College and Research Libraries (ACRL) institutions devoted to e-resources in the 2003–4 academic year was only slightly smaller than the ARL institutions (see fig. 2).

These expenditures are driven in part by the dramatic increase in faculty reliance on digital resources over the past decade, which can be seen through responses to various faculty surveys over the past thirteen years:

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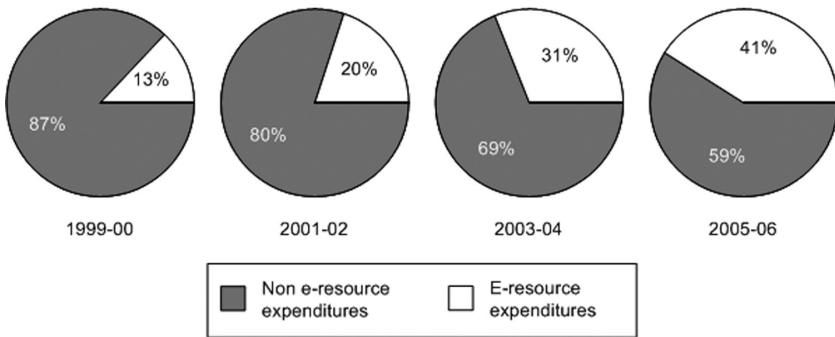


Figure 1. ARL E-Resource Expenditures as Percentage of LME over Time¹

- A 1995 cross-disciplinary survey of faculty concluded that the respondents were beginning to use networked resources but had “lack of trust in” e-journals (Budd & Connaway, 1997).
- But a 1999–2001 survey by the Electronic Publishing Initiative at Columbia (EPIC) of faculty and students in the fields of international affairs, environmental science, and political science found that “40% [of respondents] somewhat or strongly agree that they would rather settle for what they can find online, even if it is not quite what they wanted, in order to save making the trip to the library” (EPIC Faculty Survey, 2003).
- A 2000 survey by JSTOR of over four thousand faculty in the social sciences and humanities found that more than 60 percent of the faculty who responded considered electronic databases to be invaluable (Guthrie, 2001).
- A 2003 follow-up survey by Ithaka of faculty found that over 80 percent of faculty respondents believed that “electronic research resources are invaluable research tools” (Guthrie & Schonfeld, 2004).
- A 2006 faculty survey by Ithaka found that in some disciplines over 85 percent of faculty agreed very strongly with the statement that “I will become increasingly dependent on electronic research resources in the future” (Guthrie, 2008).

Students, even more than faculty, are dependent on electronic content, with the majority of 18–24-year-olds more willing to give up television or radio than to give up the Internet (Zogby International, 2007). In a paradigm shift from older generations, today’s students are accessing their information over a large variety of electronic devices (simple cell phone, desktop computer, laptop computer, MP3/MPG player, handheld game device, PDA, or smart phone) with over 90 percent of students owning more than three of these devices (Caruso, & Salaway, 2007). As Joan Lippincott of the Coalition for Networked Information notes, students today are producers of digital content, not simply consumers; they interact

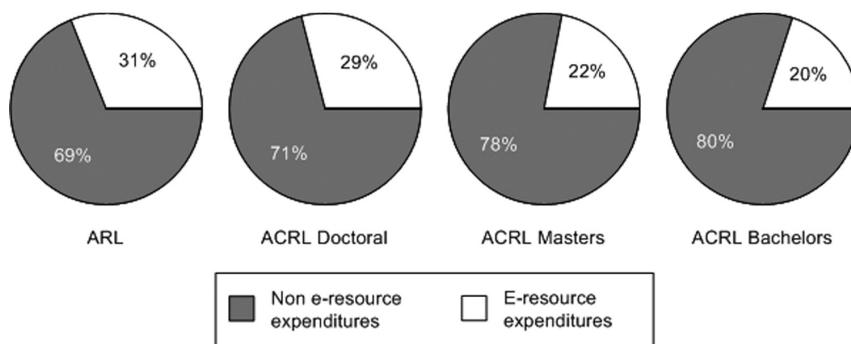


Figure 2. ARL & ACRL Expenditures as Percentage of LME, 2003–4²

with multimedia, not simply text; they use computers and electronics as social and participatory activities, not simply individual activities; and this all makes them very visible in the digital world, not invisible (Lippincott, 2008).

A serious question is raised by the transition to this new academic world where the scholars of today and tomorrow and the libraries and publishers that support them are highly dependent on electronic resources: how will access to e-resources be assured over the long term? Over centuries, libraries developed substantial, institutional, physical infrastructure—real estate, buildings, and shelves—to ensure ongoing access to print resources. But as is stated in the 2006 European Commission report, *Study on the Economic and Technical Evolution of the Scientific Publication Markets in Europe*, “the electronic era has brought a major paradigmatic change in the provision of access to back issues of journals: in the print era, libraries were acquiring print journals and took in charge their preservation so that they remain accessible to their user community in the long term. In the digital era, libraries and their user community are licensed online access to electronic journals for a determined and limited duration” (Dewatripont et al., 2006). As such, “unless and until it creates digital archiving services, the academy cannot fully shift to electronic-only journal publishing, and cannot fully achieve the system-wide savings and benefits associated with such a shift” (Digital Library Federation, 2006), a reality noted in the “Urgent Action Needed to Preserve Scholarly Electronic Journals” statement issued by academic community leaders in September 2005.

Yet even as reliance to e-resources grows, many libraries do not wish to take possession of the digital files comprising electronic publications, even when publishers allow it, as it requires significant technological infrastructure and “there are no practical means in place for [a vast major-

ity of these] libraries to exercise their permanent usage rights” (Digital Library Federation, 2005). The capacity to implement the technological infrastructure to provide long-term access to e-resources locally is only financially and technologically possible at a handful of the world’s largest institutions as institutional resources and capacity vary significantly. A review of average and median LME across institutions provides one illustration of the wide variance that currently exists, if LME is taken as a proxy measure of capacity.

The average LME of the ARL institutions in the 2005–6 academic year was 18 percent more than the average LME of ACRL doctoral institutions and 640 percent more than the ACRL bachelor institutions (see fig. 3). Nonetheless, as we saw in figure 2, institutions of all sizes are spending an ever-growing portion of their LME on e-resources and they, consequently, must protect the investment they have made in e-resources key to fulfillment of their institutional missions.

RESPONDING TO THE RISK: BUILDING AN APPROACH WITH THE COMMUNITY

The need for the preservation of electronic scholarly content without incurring the burden and expense of creating many local instances of complex and costly technological infrastructure was clearly highlighted in the statement, “Urgent Action Needed to Preserve Scholarly Electronic

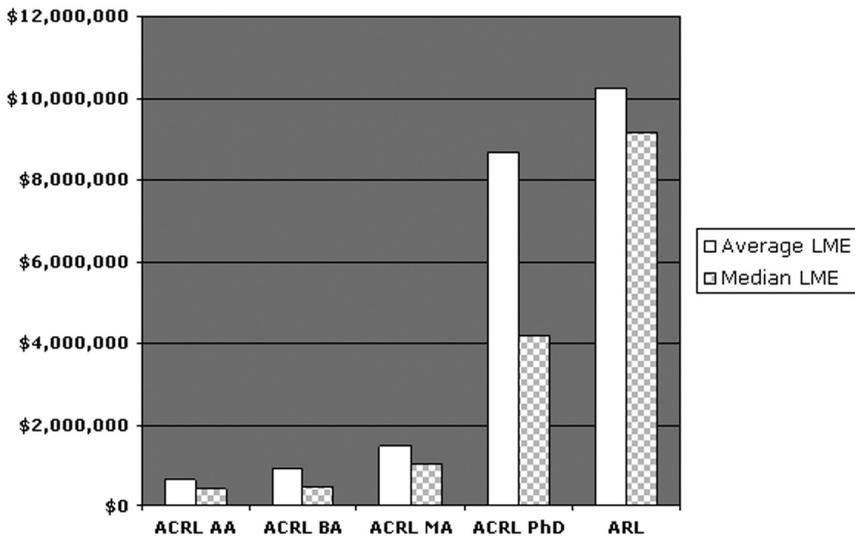


Figure 3. Average & Median LME by Class in 2005–6³

Journals,” endorsed by the Association of Research Libraries, Canadian Association of Research Libraries, and many others. The statement observed that

libraries must invest in a qualified archiving solution. A library may itself operate a qualified archive . . . Otherwise, research and academic libraries may collaborate in the form of an insurance collective, or mutual assurance society. Such an entity may be governed in a variety of ways, but libraries would exercise their preservation obligation, in part, by paying fees to support the archive. In the event of a loss of access to an archived journal through the publisher, only paying participants would be able to have access to lost content through the archive. The collective would institute financial and other measures to ensure that potential participants who might choose initially to withhold support would pay their full fair share should they eventually need access to preserved materials. (Digital Library Federation, 2005)

The library community was also clear in asserting that e-journals were regarded as the content most at risk.

In response to this expressed need in 2004, Portico (originally known as the JSTOR Electronic Archiving Initiative) began to work with the community to build a technological and economic model that could support the development, operation, and maintenance of a third party digital preservation archive. For the first two years, Portico staff worked on the development of technologies necessary to meet the project’s objectives. Simultaneously, staff engaged in extensive discussions with publishers⁴ and libraries to craft an approach that would balance the needs of both communities while researching what would be necessary to build a sustainable business model for the archive.

What emerged from Portico’s analysis and community discussions is a model for the long-term preservation of e-journals built on two keystones that balance the needs of libraries, publishers, and scholars.

Access Must Be Limited to Well-Defined Instances

Digital content tends to be valuable to content owners for a much longer period than traditionally true for print because it can be packaged in new ways and as new products. To encourage participation in preservation arrangements by content providers, the archive cannot threaten the content providers’ business needs. Yet library needs for assured long-term access must also be addressed. To balance the needs expressed by the community, Portico’s model provides a “dark archive” with clearly defined and limited access conditions. E-journal content preserved within Portico is made accessible for broad use by faculty, staff, and students only at participating institutions and only in the case of a trigger event: when a publisher ceases operations, ceases to publish a title, no longer offers back issues, or suffers catastrophic and sustained failure of its delivery

platform. To address post-cancellation access concerns, publishers may also designate Portico as a method of meeting the post-cancellation needs of their library subscribers.

The Costs Must Be Shared Across the System

Portico's operating costs are covered from diversified funding sources in order to avoid the vulnerability that comes from reliance on any single source of support. The chief beneficiaries of the archive, libraries, and publishers participate in and make an annual contribution to support the preservation service. For e-journals, publishers' annual contributions are tiered and vary according to the size of a publisher's annual journal revenue. Libraries' annual contributions are also tiered and vary according to a library's total LME. This model allows the costs of digital preservation to be spread across the broad scholarly community, including libraries and publishers of all sizes, with no single institution required to bear all the costs of digital preservation alone. In addition to savings for individual institutions by distributing the costs broadly, constrained budgets of individual institutions do not threaten the future preservation of and access to the scholarly record.

Portico was launched in 2005 with support from JSTOR, Ithaka, the Andrew W. Mellon Foundation, and a three million dollar grant from the Library of Congress's National Digital Information Infrastructure Preservation Program (NDIIPP). Portico began active preservation of e-journals in early 2006. Twenty-nine months later, 469 libraries from 13 countries and 57 publishers participate in Portico. The Portico archive preserves nearly 8 million articles from over 4,500 journals in its archive and another 4,400 journals are committed to the archive. Portico has the capacity to ingest and preserve an additional 1 to 2 million articles every month.

EXTENDING THE COMMUNITY'S LONG-TERM ACCESS PROTECTION

While the preservation of e-journals is a complex challenge, the digital preservation needs of the scholarly and library communities extend well beyond e-journals as does Portico's mission to preserve scholarly literature published in electronic form and ensure that these materials remain accessible to future generations of scholars, researchers, and students. Over the past year, Portico has begun exploring with the community how it might address other preservation needs and continue to extend the community's preservation infrastructure and network. A sampling of these activities is described below.

E-Books

Even as Portico built preservation infrastructure and began the work of ingesting and preserving e-journal content, we received queries from

publishers and libraries about the preservation of e-books. As the Portico e-journal preservation process matured and the queries from our community of publishers and libraries increased, we leveraged our earlier experiences designing a preservation service for e-journals to develop preservation for e-books. In late 2007, Portico undertook an e-book preservation study that included conversations about content formats and preservation needs with six publishers, three e-book aggregators, eleven libraries, and one library consortia. In addition, Portico made a technical assessment of e-book data provided by the publisher survey participants. We found that publishers are now actively seeking preservation arrangements for their growing e-book collections, and they hoped that Portico would provide a way to meet this need. From the sampled e-book data it was clear that the e-journal preservation infrastructure could readily be extended to receive e-books. In addition we learned that libraries desire e-book preservation, even as they strive to establish collection development policies for this still young genre.

As a result of these discussions, Portico has extended to e-books the model developed for e-journals, including trigger event driven access, which limits access to archived content to well-defined instances and audiences. As with e-journals, costs are shared by libraries and publishers across the system. As of August 2008, Elsevier has signed an e-book agreement with Portico, committing more than 4,400 e-books to the archive, and discussions are under way with several other publishers.

Digitized Collections

As our discussions regarding e-book preservation progressed we found that libraries, publishers, and aggregators also had significant concerns about preservation of large digitized collections such as historical newspapers or early texts. These collections present specific and deep collections of historical content, and individual digitized collections can often exceed more than one terabyte in size. In our discussions to date, Portico has received suggestions that the e-journal and e-book model would also be appropriate for this content, and our discussions with publishers and aggregators are moving ahead as of this writing.

Locally Created Content

As Portico has engaged with librarians about digital preservation and how best to meet this challenge, librarians have regularly expressed concern about how best to preserve locally created or digitized content. Preservation of locally created content via an external party will likely require an approach that differs from that taken with e-journals, e-books, and digitized collections. For example, "trigger events" may not be a relevant concept and different cost sharing models may be required. To investigate what technologies and models are most appropriate, Portico is working with fifteen libraries⁵ to explore the preservation needs and potential

models to support preservation of locally created or digitized content. This exploration is expected to conclude in mid-2009, and Portico will share its findings on this project with the community as it progresses.

SUPPORT FOR COMMUNITY PRESERVATION TOOLS

To meet the need of guaranteeing long-term access to scholarly digital content through digital preservation, Portico relies upon a variety of policies and tools. Wherever possible, Portico engages with the community on standards and tools development to secure the advantages that knowledge sharing and collaborative tool development offers. Portico has participated in projects ranging from the PREMIS (PREservation Metadata: Implementation Strategies) Working Group (2005), the National Library of Medicine Journal Archiving and Interchange DTD (National Center for Biotechnology Information, 2004), and JHOVE (JSTOR/Harvard Object Validation Environment; <http://hul.harvard.edu/jhove/>) development and each of these projects has informed Portico's approach.

A key policy at Portico is that all content should be preserved within a single, generic content model that has sufficient metadata to manage the long-term preservation of digital, scholarly content. The Portico metadata has been heavily influenced by PREMIS and Portico's Chief Technology Officer, Evan Owens, worked with the PREMIS Working Group to develop the Data Dictionary for Preservation Metadata. Portico is currently revising its content model and metadata gathering requirements, and one of the goals of this process is to assess our working experience with each of the PREMIS data elements. As our analysis is concluded, we will share lessons learned with the PREMIS community and gather input on any adjustments that may be useful to enhance PREMIS.

Portico also participated in the original development of JHOVE and with the California Digital Library and Stanford University Library is now engaged in the NDIIPP-supported JHOVE2 project to further develop this tool. JHOVE is a tool that can be used to identify the format of a file, to determine whether the file is valid to its format specification, and to characterize the file in order to determine its format specific significant properties. Every file Portico preserves in the archive is processed by JHOVE, and JHOVE has been widely adopted by other preservation entities for similar purposes.⁶

LESSONS LEARNED

At Portico, as with many projects, as we have gained experience we have made adjustments and drawn conclusions about lessons learned. Our hope, as we continue our digital preservation work, is to continue to learn and to share helpful findings with the community. From our experience to date, the lessons described below have been important in shaping our ongoing work and may offer value to other members of the preservation

network.

Models Must Be Responsive to Community Needs

The initial model Portico explored with publishers and libraries proposed a light archive where content was made available to participants after an extended predetermined time period. Upon discussion with the community, however, it became clear “that preservation of electronic journals is a kind of insurance, and is not in and of itself a form of access. Preservation is a way of managing risk: first, against the permanent loss of electronic journals and, second, against having journal access disrupted for a protracted period following a publisher failure” (Digital Library Federation, 2005). Based on our discussions, Portico revised the initial proposed model to arrive at the current trigger event driven approach. This adjustment has yielded a model that more closely targets libraries’ most pressing needs for long-term access without threatening publishers’ revenue models and creating unacceptable barriers of entry for content providers.

While e-books and digitized collections also appear to fit well into a trigger event oriented model with the broad community sharing the preservation costs, a different model may be required for the preservation of locally created content. As we continue our initial discussions with libraries about local preservation needs, building from our model development experience, we expect to be open to revisions and adjustments to the model as the community’s needs become clearer. As in the start-up of any new endeavor, there must be willingness and ability to take risks, try new ideas, and make adjustments.

Identify Policies through Practice

A preservation service with a long time horizon must be able to modify its processes and procedures over time. Portico did not start production in early 2006 with a formal set of preservation policies; rather we entered production with a set of guiding principles, including:

- The integrity of the scholarly record must be preserved.
- Source files reliably capture the intellectual content of electronic scholarly journals.
- Preservation can be achieved through migration.
- Reliance upon accepted standards enhances archival reliability.

These guiding principles have been enacted in numerous ways and have enabled us to develop more specific policies. For example Portico maintains the original publisher-supplied files in the archive, in addition to all migrated copies. Whenever we determine that the publisher may have erroneously supplied extraneous files that should not be maintained in the archive, a review and decision-making process is invoked to determine the proper course of action (retention or rejection of the files). We

are now codifying the rules and processes we have developed over more than two years of experience into formal preservation policies and procedures that can be more readily shared with the community.

Infrastructure and Scale Can Be Extended

As Portico began its work the community clearly expressed preservation of e-journals as the most pressing priority. From a technical perspective, e-journals were a particularly challenging beginning point due to the extensive diversity and complexity of data structures in use over time and across the publishing community. However, because Portico's initial, generic content model and infrastructure were developed specifically to support this diverse and challenging content, it is now possible at much less effort to extend this work to new content types such as e-books and digitized collections, and possibly to locally created content. The lesson learned is that sometimes it is best to begin with the complex case. Although the costs to initially develop preservation infrastructure were significant, this investment can now pay ongoing dividends as the generic content model is extended to the preservation of additional content types.

Impact of Scale

In order to process content at scale, it is impractical and cost prohibitive to make decisions on an article-by-article basis. Instead, the supplied content must be analyzed in automated ways and tools developed to handle the majority of cases noting exceptions only as needed. For example, when content includes extraneous files that cannot be clearly determined as erroneously supplied nor associated with a specific article, Portico's system collects these and preserves them as a single content unit. While this conservative approach may result in unusual files being retained (U.S. Postal Service forms, for instance), it also helps to ensure that content is not inadvertently lost.

Preservation Work Is Constant

Although much yet remains to be learned about preservation costs and their distribution over time, at least one model, the LIFE Project, proposes that ongoing preservation costs will include low, steady ongoing technology watch costs with occasional peaks of expenses to implement preservation actions (see fig. 4).

Our preservation work at Portico thus far would indicate that preservation actions will be less intermittent and more steady than proposed. Digital preservation will require ongoing, active management. The archive requires steady maintenance to keep it secure, including regular processes to check the fixity of files to determine if content has been corrupted and is in need of repair, to ensure successful replications, and to prepare for audits. In addition, there is a need for regular projects to maintain the archive. Portico's current review of our content model to

tion service that can expand the network of entities supporting digital preservation beyond those who have the technological and financial ability to participate in digital preservation in a hands-on manner.

As shown in figure 2, even very small academic institutions are spending over 20 percent of their LME on e-resources and the Portico model, which distributes the costs of the archive broadly, allows even small institutions to participate in—and benefit from—the preservation network that NDIIPP has helped to establish. Libraries participating in Portico range from large U.S. university systems to the University of Chittagong in Bangladesh. Similarly, the Portico model encourages participation from scholarly publishers from across the spectrum. In building this broad participant base Portico has extended the NDIIPP preservation network to a diverse set of more than 450 libraries and nearly 70 publishers. Through formal agreements these contributors to the network are positioned to remain engaged well past the duration of the NDIIPP grant program.

CONCLUSION

Through its collaborations with the community Portico has demonstrated that a model can be developed and operationalized that enables community supported preservation that begins to address the needs of the academic community for reliable preservation infrastructure. With nearly eight million articles preserved, Portico now serves as one node within the network of preservation entities necessary to ensure that digital scholarship available today will remain so for future generations. As the community continues to develop new forms of e-scholarship, new digital preservation challenges will continue to emerge, and Portico looks forward to working with the broader preservation network to address these as they arise.

NOTES

1. These percentages are from the annual ARL Statistics—Research Trends sections (Association of Research Libraries, n.d.).
2. These percentages were computed by Portico from the ACRL statistics dataset that underlies the ACRL 2004 Academic Library Trends & Statistics print volumes (American Library Association, 2004).
3. The ACRL averages are drawn from data available in the ACRL 2006 Statistical Summaries (American Library Association, 2006). The ARL averages come from an analysis of the ARL Statistics dataset for 2005–6 (Association of Research Libraries, 2005–6).
4. The contributors to the initiative were drawn from a broad range of the scholarly publishing community and included formal participation from ten publishers including the American Economic Association, the American Mathematical Society, the American Political Science Association, the Association of Computing Machinery, Blackwell, the Ecological Society of America, the National Academy of Sciences, the Royal Society, the University of Chicago Press, and John Wiley & Sons.
5. The libraries participating in this exploration include American University, Baylor University, Binghamton University, Brigham Young University, California State Polytechnic University—Pomona, City University of New York, Colorado State University, McMaster University, Middlebury College, Northwestern University, Trinity College—Dublin, University of British

Columbia, University of Notre Dame, University of Queensland, and Vassar College (see <http://www.portico.org/news/preservation.html> retrieved on August 22, 2008).

6. Per e-mail communications of the JHOVE working group, JHOVE is in use at: Deutsche Nationalbibliothek (German National Library), Ex Libris, Fedora, Florida Center for Library Automation, the Global Digital Format Registry project, Koninklijke Bibliotheek (National Library of the Netherlands), DSpace, U.S. National Archives and Records Administration, the National Library of Australia, the National Library of New Zealand, and the U.S. Library of Congress.

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