Digital Preservation Assessment: Readying Cultural Heritage Institutions for Digital Preservation

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Abstract: *For more than a decade, the preservation of digital content created and acquired by libraries and other cultural and scientific institutions has been discussed at the national and international level. Significant effort has been placed on the development of digital preservation standards and protocols, an auditing and certification process, and several registry systems. In the last several years, model implementations of Open Archival Information Systems have been deployed internationally and more are being tested, but few beyond the national libraries and major museums are actually able to implement long term digital preservation solutions. This paper review two digital preservation readiness surveys which identify where cultural and scientific heritage institutions are as it relates to digital preservation readiness. The paper will also address how the current audit and assessment tools, such as the Center for Research Library's* Trustworthy Repository Audit & Certification (TRAC): Criteria & Checklist, *can be used to assist in planning, and it will highlight common threads and themes that exist across the results, as well as the assessment*

As libraries and other cultural and scientific heritage institutions move beyond the issues of providing access to digital content to managing the complete lifecycle, they are beginning to address issues of digital preservation. When society faces a new challenge, it looks to models that we are familiar with; memory institutions look to book preservation or object conservation. For digital preservation, we need to look outside our immediate community we can find models for digital preservation. Patricia Galloway (2004) notes that there are several excellent examples of digital initiatives that have successfully preserved their data, including the Inter-University Consortia for Political and Social Research, a large data set that has been created and preserved over the last 40 years. Galloway purports that these digital collections have been successfully maintained over these many years because they are encoded in standardized formats, they are well documented, and the community of users has the computational expertise to ensure preservation of the data. But maybe more importantly, the community is legally and contractually obligated to preserve it. Additionally, recreating the content of these collections is "unfathomable" to the users as many of the experiments that created the data sets are unrepeatable and in fact provide the foundations of important bodies of work.

Libraries and cultural heritage institutions historically have approach preservation as rescue work. While these organizations take actions to mitigate the ravages of time—climate and pest control—they also have programs to rescue deteriorating collections (e.g., rebinding a book, microfilming newspaper, or repairing paintings). In the analog world, there is no particular passage of time that indicates an object will require preservation work (for instance, that a book will need to be rebound in 40 years). In the digital world, conversely, digital preservation is a requirement from the time the object is created. Digital preservation faces a number of challenges, including preserving data stream integration, preserving the means to interpret the data streams, and preserving the means by which the resource is experienced. It should be noted that "digital data is in danger because of the continually accelerating rate of replication, adaptation and redundancy of hardware, software, data formats and standards, which may mean that the bit streams may not be readable, interpretable or usable long into the future" (Deegan & Tanner, 2006, p. 6). In a digital environment, preservation is not a matter of if, but

when. In digitization, preservation is part of the digital lifecycle itself and the decisions regarding preservation are made at the point of the determination to add the resource into the collection.

Organizations must first consider processes and intentions for preservation early in the digital lifecycle to ensure longevity, reduce obsolescence and minimize deterioration of the original works due to repetitive efforts at reformatting. A second attribute of digital preservation is institutional commitment. Because digital preservation is an ongoing process rather than an event-driven process, digital preservation must become part of the organization's core mission with all the support that core mission implies. In today's economic climate, few institutions are making the financial commitment to support digital preservation. However, for more than a decade the foundation has been laid.

Maturing of Digital Preservation?

Digital library leaders have addressed the importance of preserving digital content since the early 1990s. The Task Force on Archiving of Digital Information (Commission on Preservation and Access, 1996) defined the problem of at-risk digital resources and identified the first solutions for establishing trusted digital repositories that would store, migrate and provide access to digital collections. Work has continued through the OCLC/RLG *Trusted Digital Repository: Attributes and Responsibilities* (2002) and the recently released *Trustworthy Repositories Audit & Certification: Criteria and Checklist* (2007). Additional work has been done on preservation metadata and development of a global format registry. All of this work notwithstanding, institutions are still at the early stages of moving collections into a managed digital preservation environment. The most notable efforts are found in the preservation of e-journals and electronic dissertations and thesis. European national libraries (Royal National Library of the Netherlands' E-Depot) and U.S. academic and not-for-profit organizations (i.e., LOCKSS-based programs and Portico) have tested and implemented solutions for the preservation of e-journals. In their chapter, "Digital preservation projects: some brief case studies" (Deegan & Tanner, 2006, Chapter 9), Jasmine Kelley and Elisa Mason briefly describe national and university initiatives. The greatest number of initiatives (25 of the 60 discussed) fall within the category of web archiving, followed closely by initiatives that self-classify as digital preservation solutions, digital data archiving solutions, and solutions for the long-term preservation of digital records. At the same time, U.S. federal grant programs have begun requiring evidence of digital preservation. The Institute of Museum and Library Service's National Leadership Grant Application (2007) asks applicants to "describe plans for preserving and maintaining the digital material during and after the grant period. The plan should cover storage systems and media to be used, migration plans, maintenance responsibilities, and commitment of institutional funding support." (Institute of Museum and Library Services, 2006, p. 39). In 2006, the National Endowment for the Humanities introduced a new digital humanities program; preservation of digital content is one component of the project assessment.

At the institution-level, however, the majority of organizations still report that their primary preservation solutions have not moved beyond the copying of master images to CD/DVD, or the backing up of files to tape or another medium. Kenney & Buckley (2005) report that 84% of workshop respondents during the period of 2003-2005 indicated they were using CD or DVD for storage of their master files (and for the 2005 group of workshop respondents, it had dropped to 70%) (Kenney & Buckley, *RLG Digi-News*, August 15, 2005). Similarly, a 2005 web-based NEDCC survey found that removable magnetic media (CD/DVD) at 65%, and the storage of digital collections on networked hard drives at 78% remain the primary preservation solutions amongst respondents (Clareson, *RLG Digi-News*, February 15, 2006). Digital preservation solutions based on the *Reference Model for an Open Archival Information System*

(OAIS) (Consultative Committee for Space Data and Systems, 2002), either locally-implemented or through an outsourced solution, have been adopted by few organizations.

So why are libraries and other cultural heritage organizations not moving toward the OAIS-based digital preservation solutions? There are several possible reasons to consider. The digital preservation advocate needs to make a persuasive argument for digital preservation to those in decision-making positions. Digital preservation requires one to present compelling benefits and solutions to a complex set of public policy issues for which not all solutions have yet been defined or fully established. There is a perception that the digital preservation standards and best practices are still evolving or emerging, which is true for some formats like moving images. However, there are established standards for text, photos, and many other formats. Indeed, more experience is required to develop best practices, so the emergence of best practices and strategies has been slow. Should one use dark archives, light archives, continuous-use archives, or a mixture of all three approaches? Lastly, we have the budgetary and financial issues. Models for cost -effective initial building of the digital repository are emerging and the long-term sustainability costs are still unknown.

Nothing demonstrates more clearly the confusion for decision makers than some of the conflicting information presented in the literature. While Lorna Hughes notes that "digitization should not be regarded as a viable preservation format" (Hughes, 2004), the Association for Research Libraries issued *Recognizing Digitization as a Preservation Reformatting Method "*…endorsing digitization as an accepted preservation reformatting option for a range of materials" (Arthur, et al., 2004). Practitioners need to recognize the contemporary environment and broaden their view on both the role of digital content to aid in the preservation of analog source material, and the need to preserve digital resources and to consider the broader role of digitization in preservation. As Abby Smith, formerly of the Council on Library and Information Resources notes, "As more and more [information/content] is born digital and a new generation of users grows up with digital as the default mode of delivery, resources that are not in digital form will be 'orphaned' over time because they are in 'obsolete' formats" (Deegan & Tanner, 2006).

Digital content has been created by libraries and cultural heritage institutions since the late 1980s. Initially, we had no standards for creation and reformatting of analog resources. Organizations began using community-based practice, which later evolved into established standards. In the digital preservation environment we have followed a similar pattern; however, we have borrowed from another community, capitalizing on the work of the Consultative Committee for Space Data Systems and their Open Archival Information System. Creating community-based best practice, however, comes from pioneers in the field. While originally we viewed solutions as mutually-exclusive alternatives—format migration vs. emulation vs. technology preservation—our current solutions include a variety of approaches based on the need of the digital object, the organizational mission, funding, and the audience served. Third, cultural heritage organizations must anticipate preserving digital objects in perpetuity, much like we preserve analog resources. With the constantly changing technological environment, the risk of digital objects becoming obsolete, and therefore unavailable, is high. Timing of software and hardware obsolescence is difficult if not impossible to predict and uncertainty increases with time. The fourth issue we face is determining the cost of digital preservation. "Costs of digital preservation are hard to calculate due to the lack of hands on data…and the lack of experience with digital preservation costs obstruct a complete picture" (Deegan & Tanner, 2006, p. 26). With less than a decade of experience with digital preservation, we do not have sufficient data to develop economic models. Present models provide different expenses and means of estimation, offering different standards for staffing, benefits, infrastructure, and indirect costs;

some projects have also included the initial investment, while others have left it out. Some models expect return on initial investment, while others do not. The decisions on what expenses to include depend on the business model that has been adopted by the organization and what the parent organization is willing to fund (i.e., the university does not charge the library for legal or accounting services). The expenses included in the economic model will depend on whether the provider of the digital preservation solution is an academic or government entity, a not-for-profit organization, or a for-profit organization that must realize a return on the investment. A pricing strategy must determine if fees are to be charged, what those fees will be, and who will pay them.

In many instances where a university or government operates the repository, budgetary structures are not set up to allow for the breakout of the digital preservation program from the operation of the library or museum budget. Calculation of a multi-year budget, equipment depreciation, and unit costs are not something that a governmental accounting package can accommodate. Creating a mechanism for determining the unit cost to store a digital object requires significant overhead and expertise that many governmental entities, particularly libraries, museums and archives do not have. In *Lifecycle information for e-literature: a full report from the LIFE project.* McLeod, Wheatley & Ayris (2007*)* provide a cost model for determining long-term costs of digital content creation and sustainability. It should be noted that as of this publication date certain aspects of OAIS-compliant repositories were not operational, so complete cost metrics were not available. Despite this missing data, a model has been developed and one can assume that *LIFE* will be able to extend the preservation component.

All this amounts to the reality that laying the groundwork—being ready to implement digital preservation, even at a base level—has been limited to the trailblazing organizations that are willing and able to locally implement infrastructure and technology, develop their own practices, create new policies and procedures, and allocate staff in an environment of high risk, where adaptation and modification is commonplace.

Digital Preservation Readiness Assessment:

One of the largest surveys of cultural heritage institutions' digital preservation readiness was done by the Cornell University Library as part of their 2003 National Endowment for the Humanities Digital Preservation Management Training Program grant. The survey was designed to assess institutional readiness to develop and maintain digital preservation programs and to prepare and encourage the workshop participants to consider their own digital preservation efforts. The Cornell survey was completed by 100 distinct institutions, of which 50% were academic, 27% government, 5.2% museum/institutes, 3.5% public libraries, and 14% other (Kenney & Buckley, 2005). Eight of the institutions were from outside the United States. The Cornell report notes that the greatest threat to digital collections is 'the obsolescence of the file formats, storage of media and hardware/software to access and use digital objects" (Kenney & Buckley, 2005). The Cornell survey reviewed a range of topics from mission and policies to staffing and standards. It asks the workshop attendees to review their digital content storage practices and responses to file format changes. At the time of the study, participants held digital objects in 9-11 formats. Storage was principally on CD/DVD (90%) and online (85%), with 75% using magnet tape. And while 50% of the attendees reported having developed policies in the digital preservation area, only slightly more than 30% reported implementation. The most common means of extending the life of digital collections was to change storage media—a solution of 50% of the respondents, with the second most common response being changes in or migration of file formats.

The Cornell survey found that the organizations felt that in 2005 they had the organizational and technical expertise to support digital preservation. Among these institutions 59% had staff specifically charged with digital preservation responsibilities. This result is in stark contract to the Heritage Preservation's *Heritage Health Index* (2005) report, which found that only 39% of the responding institutions involved preservation officers in digital preservation activities. Funding requirements are most frequently cited as the reason for why institutions have not acted on digital preservation. Thirty-eight percent of the institutions reported that they were funding their programs with institutional funds, though "…an unsettling number of respondents did not know whether there was any ongoing support for the program" (Kenney & Buckley, 2005). This situation could either be because respondents were not aware of the importance of a budgetary approach, or because they truly did not know how they were going to solve their budgetary situation.

NEDCC's Digital Preservation Readiness Surveys

In 2004, the Northeast Document Conservation Center (NEDCC) received an Institute of Museum and Library Services (IMLS) National Leadership grant to develop tools for assessing the preservation needs of digital collections, and to assist administrators in planning for the management, maintenance, and preservation of digital resources in institutions, with particular focus on small and medium size museums. The first initiative was to develop a web-based survey that would assess the current environment of digital preservation readiness. Of the respondents, 33.1% were academic libraries, 14.5% were archives, 9% were museums and 7.8% were public libraries. Twenty-four percent made up the remaining 41 responses from a range of other museums, including historic sites and museums, regional libraries, etc. The majority of the respondents came from institutions with less than 20 full-time equivalent employees (38.8%), with almost an equal number of respondents coming from organizations with 20-100 employees (25.5%) and 101-500 employees (27.9%). Thirteen responses were received from organizations with more than 500 employees. A full report of the study can be found in the February 15, 2006 RLG *DigiNews*, but highlights include:

- Of nearly 175 institutions responding, a majority lacked specific digital collection policies or staff responsible for information policy;
- In 66% of the responding institutions, no one is responsible for digital preservation activities, and;
- Almost 30% of the digital materials held in the responding institutions have been backed up one time, or not at all.

With the results of the survey in hand, NEDCC held a colloquium of digital preservation experts from the cultural heritage community on how to address these concerns and to assist institutions in developing digital preservation policies. Beginning in 2006, a series of digital preservation readiness site surveys were conducted at 11 institutions. Initially, the consultants were asked to survey a target group of small and medium size museums, however after some initial contact with this group, it was decided that the scope had to be broadened, as many small and medium size museums that were doing digitization were focusing on access with no attention to preservation. As a result, the visits included institutions ranging from academic research libraries to art and historical museums, one state library, two state historical societies, one urban public library, and in early 2007, three organizations that had implemented a long-term digital preservation solution.

The term "site survey" is most often used in the context of a traditional preservation survey, where a consultant will look at building condition, collection condition, and policies for

preservation at an institution. Because the staffing and infrastructure of digital programs is often more complex and widespread in an institution, the digital preservation surveys looked at issues of digital collection administration and management (including budgetary and staffing issues), acquisition of digital materials and selection of materials for digitization, metadata and access issues, existing digital preservation policies and strategies, and rights management policies and practices. The surveys included a pre-visit questionnaire on policies and practices related to many of the aspects of the digital lifecycle, including digital preservation, and a day spent interviewing staff involved with the institution's digital initiative. There were two goals of the visits. The first goal was to assess the institutional capacity and infrastructure for digital preservation, with a concentration on policies. The second goal was to test the pre-site visit questionnaire with a variety of audiences.

Findings from the Onsite visits

After six initial visits, the consults identified a series of trends, which included:

- The issue of digital preservation is just now coming to the forefront of discussion and action at cultural heritage institutions.
- Many of the institutions still at the "digital project" stage with one or more distinct projects that may or may not have any cross project coordination. Digital programs are still the goal of many.

In the specific area of digital preservation,

- CD and DVD are the major storage media, but institutions are planning to move to networked hard drives and servers.
- Backing-up is viewed by some institutions as a strategy for digital preservation.
- Quality control of master images is inconsistent at best.
- Written policies and documented digital preservation practices are lacking.
- Nine of the ten institutions surveyed had no disaster plan covering, or focusing on, their digital materials.
- The ability to advocate for digital preservation is challenging for many of the institutions.

As part of the IMLS grant, each site visit was contacted regarding their post-visit actions. As of December 2006, five of the institutions had been contacted. For these institutions, the consultants offered 52 recommendations. Fifty-three percent of the recommendations have been discussed, and the institutions plan to take action on 48% of the recommendations. Only two recommendations were not considered. The type of recommendations that the institutions plan to move forward on include:

- Improved documentation, particularly including digital collections in disaster or emergency preparedness, workflow processes for all aspects of digitization process, etc.
- Review digital preservation activities, including refreshing schedules and procedures.
- Review system back-up procedures, implement offsite storage.
- Review optical media utilization, including storage, retrieval and duplication.
- Incorporate preservation information into metadata.

One of the historical societies commented, "The report has been very helpful in determining future directions for digital preservation. It was also very helpful to have a comprehensive evaluation of our digital library program (beyond just the preservation issues), since digital preservation is linked to so many other aspects of a digitization program."

Audit and Certification Activities

Following the completion of the RLG/OCLC *Trusted Digital Repositories: Attributes and Responsibilities* in 2002, the National Archives and Records Administration and RLG established a task force on Digital Repository Certification to develop criteria to identify digital repositories capable of reliably storing, migrating and providing access to digital collections. *Trustworthy Repository Audit & Certification (TRAC): Criteria & Checklist* (2007) not only facilitates certification, but it can be used as a repository planning document, a guide for internal assessment, analysis of services that an institution can rely on to provide digital content, and an objective third party evaluation of repository or archiving services. "In any use, however it is important to understand that this comprehensive set of criteria has been created to measure digital repositories that have long term access and preservation responsibilities for content they hold." (*Trustworth*y *Repository Audit & Certification (TRAC)*, 2007, p. Foreword)

Since the work began in 2002, there has been significant growth the use of repositories. Today there are institutional and digital repositories, open access repositories, digital preservation repositories, and digital archives. Many of these play multiple roles, particularly when used in a collaborative environment. For example, the Colorado Alliance of Research Libraries is building a Fedora-based digital repository, which for some members will serve as an institutional repository, for some members will serve as a digital repository, and for others will serve as both. But for all it will hopefully serve as a digital preservation solution.

TRAC can serve as a planning and assessment tool for any of these repositories, based on the mission and goals of the repository. This assessment can be done as an internal audit or external third party audit. Some organizations will want or need to go to the next step of certification, depending on the organization's mission, goals and audience needs. With the issuance of *TRAC*, responsibility for the maintenance of the document and the certification process has been assumed by the Center for Research Libraries. As of this writing, no organizations have reached the status of a Trusted Digital Repository.

At the same time that the Center for Research Libraries was testing the *NARA/RLG Audit Checklist for Certified Trusted Repositories,* the UK's Digital Curation Center (DCC) was testing it. Unlike CRL, the DCC used an evidentiary approach, where they solicited specific evidence of activity. Six institutions, three international and three in the UK participated in their test. The DCC provided feedback based on their experience to the CRL. *TRAC* incorporates elements of this evidentiary approach.

Another parallel initiative was being developed, by the German digital content community was under the auspices of the Network of Expertise in Long Term Storage of Digital Resource. In 2004, the nestor project set up a working group on the certification of trusted digital repositories, which developed the *Catalogue of Criteria for Trusted Digital Repository Evaluation & Certification* (Dobratz, Schoger & Strathman, 2007). *The Catalogue* is designed as a guideline for planning and set up of a digital long-term preservation repository. Additionally, it can be an orientation guide for software developers, third party vendors or service providers (Dobratz, Schoger & Strathman, 2007). Unlike *TRAC*, the nestor working group specifically notes in the *Catalogue* "...that is still too early to introduce effective auditing. "For many of the abstract criteria…it is not yet possible to define standards on which an auditing process could be based" (Dobratz, Schoger & Strathman, 2007). As of late 2006, nestor had received additional funding to move to phase II, allowing it to move forward with the development of tool for the audit and certification process. nestor is based on the OAIS framework and includes the concepts of trustworthiness, integrity and authenticity, availability and usability.

Getting Organizations Ready—Audits and Surveys

By necessity, the focus of digital preservation has been on the technology, what institutions can build to manage collections in the future, what standards should be developed and adopted, and how to certify organizations that will manage these collections. For commercial collections, progress is being made particularly where publishers, librarians and the repositories can work together. To manage locally-owned collections of scientific and cultural resources, many organizations are ready for the challenges and opportunities presented by digital preservation, and they now must be prepared to undertake these efforts.

The time is right to expand educational opportunities in the area of digital preservation for current and future practitioners. The educational opportunities must be available at the regional and state-based level for librarians, archivists and museum professionals who are implementing the variety of digital preservation solutions including institutional repositories, digital repositories and long-term digital preservation repositories identified in TRAC. Without the basic educational foundation in digital preservation, institutions will not be able to make maximum utilization of tools like nestor's *Catalogue,* CLR's *TRAC,* DCC's *DRAMBORA*, and LIFE Project's *Lifecycle information for e-literature*. Specialized workshops on these tools will also be required, as the organizations sponsoring these tools are not providing much guidance in their use. Workshops need to address the full range of issues beginning with mission statements and establishment of policies. Both the Cornell and NEDCC digital readiness surveys indicated that policy development is beginning, however the NEDCC onsite visits found that focus was on metadata and content creation policies. Little work has been done in incorporating digital content into collection development policies, digital preservation policies through digital preservation plans have not been developed, except in the case of one institution. Disaster planning generally guided by preservation librarians has not incorporated digital collection requirements. Preservation courses must be expanded to include digital preservation policies and disaster planning and business continuity planning for digital programs. Development and implementations of policies are indications of organizational commitment (Kenney & Buckley, 2005).

While the onsite NEDCC visits provided some insight into the reasons why policies have not yet been developed at the local level, it may actually come down to the fact that organizations just do not know where to begin. Libraries and archives frequently look to other organizations for guidance in policy development. Digital preservation is still in its infancy, and few policies are available. Institutions that have created policies need to make them available for others. The second major issue identified by both the audits and the surveys was the need for documentation. The NEDCC onsite surveys found documentation generally lacking. Organizations drive to get projects done, and documenting projects is not a high priority. In the instance where the project was a multi-institution collaborative, documentation was a priority, as the various partners needed access to the information to assure successful implementation. In those cases the documentation was web-accessible and generally more current. The most commonly available documentation related to decisions on metadata and creation of digital content, and collection development policies. Managers trusted that the information technology units or those responsible for managing the servers or CD collections would secure the digital masters. Few questioned if the processes were written down or if the practices were current. When NEDCC consultants asked for evidence of such documentation, generally none existed.

Monitoring current trends in digital preservation advances was uneven. The major research libraries were aware of such activities as the *NARA/RLG Audit Checklist for Certified Trusted Repositories*, and had reviewed the *Checklist* whether they were planning to become a

trusted repository or not. Knowledge of trends in format changes, adoption and phasing out of formats, was uneven. The organizations that were implementing long-term digital preservation solutions were monitoring current trends. Those that were depending on CD/DVD technology were not even following current information on the longevity of the optical media. Understanding the technological requirements for digital initiatives generally, and digital preservation specifically, varied greatly. While the Cornell survey found that its respondents felt that they had staff who had the capacity to manage digital preservation initiatives, the NEDCC onsite surveys found few dedicated staff, and of those staff the understanding of digital preservation issues was limited. The exception was in the institutions that were locally implementing long-term digital preservation solutions. Backing-up in some cases was still thought of as digital preservation. In some cases, duplicate copies were stored in the same building, and significant periods (often greater than five years) had lapsed between refreshment of files, with both copies of the masters being used as service copies.

So maybe there is a convergence. Digital preservation is coming of age in our cultural heritage institutions. Managers are beginning to understand the need for digital preservation and recognizing that they must act. But for them to act they must have the knowledge to create policies and practices, plan and select solutions, empower staff. All of this requires education.

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