

# Digital Preservation: Best Practice for Museums

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## **Abstract**

*Conservation of collections has long been part of the traditional domain of museums. As creation of digital collections becomes prevalent, museums need to learn about the issues of conserving these new digitally created artifacts that are in fact digital surrogates of objects in their collections. These digital collections range from small, focused collections of digital images created specifically for a CD-ROM or Web-based Virtual Exhibition project to digitization of entire collections. Project planning for digitization should not only encompass the pre-digitization phases, but should also put in place plans for preserving these digital collections, once they are created. Various international organizations have looked at issues of digital preservation in the last few years. Few of the papers produced have directly examined the issues from the museum perspective.*

*This paper will consolidate the recommendations of past research papers in the context of digital artifacts in the museum environment. The paper will propose recommendations that take the theoretical issues raised in the past and propose a checklist, or prototype to allow museums to implement a preservation strategy.*

Since the advent of computers in the early part of the 20<sup>th</sup> Century, our society has been moving into the electronic world at an increasingly rapid pace. With this comes the transformation of our cultural materials from their traditional forms into digital forms, a change that has caused some alarm given the ephemeral nature of the digital environment. In 1994, the Commission on Preservation and Access and the Research Libraries Group launched a task force on digital archiving whose mandate was “to investigate the means of ensuring ‘continued access indefinitely into the future of records stored in digital electronic form’” (Waters and Garrett, 1996). The need for the taskforce grew from the realization that our culture and knowledge was in danger of being lost because of the short lifetime of the electronic environment (AHDS Executive, 2001, Hodge, 2000). Within a very short period of time, burgeoning collections of vital cultural artifacts have been created, stored and transmitted in digital form but are housed in cultural institutions ill equipped to preserve them.

The rapidly evolving nature of the electronic medium (Martin and Coleman, 2002) renders technologies obsolete in a remarkably short time and the ability to access older electronic documents disappears before our very eyes. As Besser points out, “[t]he artifactual value of electronic art is much different than the artifactual value of more conventional art forms. Because of changing technologies, electronic art originals can only be accessed/viewed/played for a very short time period” (Besser, 2001). Libraries in particular have struggled to address these issues given the ease of creating electronic texts driving the resultant growth of electronic scholarly publishing but these problems are rapidly catching up to museums as digitization projects take hold and creators begin to experiment with the unique properties and abilities of the digital medium.

Of particular concern are artifacts that are born digital and have no physical instance to transcend the digital limitations; that is, artifacts which are “created digitally and [have] functionality which requires use of appropriate hardware and software.” (Hanna, 2001) To understand a born digital artifact is to rely heavily on its technological context for meaning (Lee, Slattery et al., 2002) and saving the digital bits while losing the technical context is still losing the artifact forever. Even the ability to save the digital bits is in doubt as the physical media on which they are stored may become obsolete in as little as five years (Rothenberg, 1995). And if it is difficult to save one format, consider how the difficulty is compounded when faced with the incredible array of formats that currently exist. This is a real problem for the majority of institutions surveyed in 1998 (Hedstrom and Montgomery, 1998) as most had 6 or more digital formats in their collections at the time of survey. Given the rapid increase in digital collections since 1998, it is not unreasonable to suggest the number of formats has also grown at a comparable pace.

Spurred by this, an assortment of national and international projects are trying to find viable solutions to the digital preservation problem. The Victorian Electronic Records Strategy project, PANDORA, Cedars, CAMiLEON, NEDLIB, Kulturarw Heritage, InterPARES and PRISM (Lee, Slattery et al., 2002, CLIR 2002) have all lead the way in exploring digital preservation. But in most cases, their attention has been focused on electronic records and documents and less on the types of digital objects that museums will encounter in the future. Therefore, we need to look at the breadth of the literature to understand the state of the art and practice in digital preservation before narrowing the focus to museum related issues.

## **The Current Literature**

A point that is continually emphasized in the literature is that creators and publishers must take the burden of digital preservation more seriously (Beebe and Meyers, 1999, de Lusenet, 2002, Hodge, 2000, AHDS Executive, 1998). Jones and Beagrie note that “[t]he implications of allocating priorities are much more severe than for paper. A digital resource which is not selected for active preservation treatment at an early stage will very likely be lost or unusable in the near future” (Jones and Beagrie, 2002). Therefore, it makes sense that “creation is where long-term archiving and preservation must start” (Hodge, 2000). Creators and publishers, when selecting format and media, need to align their decisions with the support capacities of institutions which are charged with the task of their preservation.

Also consistent in the literature is the need for a distributed approach. A virtue of decentralized preservation is broader cost sharing and redundancy (Reich and Rosenthal, 2001), necessary given the enormous scope of digital preservation. Moreover, expertise is unlikely to be concentrated in one institution but tends to reside over a broad spectrum of institutions and corporate entities. Indeed, the view of digital preservation as a distributed responsibility is strong enough that the National Library of Australia has enshrined in its statement of principles the idea that “location, selection, identification/cataloguing and retention of digital objects will be best achieved through the coordinated distribution of responsibilities” (NLA, 1997). As a result, most projects have emphasized cooperative approaches to digital preservation with interoperability critical to the solution.

A third area of emphasis is the necessity of preservation metadata. “Effective management of all but the crudest forms of digital preservation is likely to be facilitated by the creation, maintenance, and evolution of detailed metadata in support of the preservation process”

(RLG, 2001). In the case of both the Cedars (Cedars, 2001) and the NEDLIB (Lupovici and Masanès, 2000) projects, one of the first tasks was to develop a preservation metadata standard to facilitate the rest of the work.

Finally, most digital preservation efforts model their activity on the Open Archival Information System reference model. Initially proposed by the Consultative Committee for Space Data Systems for use with space datasets, the reference model has been embraced by the broader digital preservation community as a way digital archives should work. Both Cedars and NEDLIB have adopted the OAIS model to build their research prototypes. In fact, the joint RLG/OCLC report on the attributes of a trusted repository (RLG/OCLC, 2002) goes so far as to make compliance with the OAIS reference model the first attribute of a trusted repository. However as the OAIS model is a high-level conceptual model, implementation details are not specified and institutions wishing to comply with the OAIS model must invest heavily to develop a local implementation as off-the-shelf OAIS compliant systems are not readily available.

### **Best Practices Guides: A Typology**

After establishing the general issues of digital preservation, we can proceed to developing a typology for comparing and categorizing current best practices documents based on those issues. It is possible to identify eight focus areas addressed in the literature:

- Conceptualization of digital preservation issues
- Organizational recommendations
- Assessment of preservation strategies and recommended methodology
- Analysis of storage media and digital formats, including lifespan assessment and recommendations
- Metadata standards and practices

- Issues of resource discovery, persistent identification and verification of authenticity
- Intellectual property rights issues and approaches to rights management
- Cost/resource recommendations and forward looking statements

As part of the literature survey, a number of guidance and best practices documents were identified as noted in the bibliography and using the above typology, their recommendations categorized. Although this survey not exhaustive, the goal is to identify key documents representing either the advice of organizations leading the digital preservation enterprise or commonly recommended in discussions of digital preservation. It is also important to note that most of the best practice guides are recent and the recommendations may not have empirical support yet. Indeed, the Arts and Humanities Data Service notes a lack of information about how standards and methodology may be applied effectively (AHDS, 2001).

### **Conceptualization of Digital Preservation Issues**

Almost all guides identify the primary problems associated with digital preservation as media deterioration/obsolescence and technology obsolescence. In particular, the NINCH guide suggests preservation faces two types of long-term accessibility challenges: machine accessibility (bit integrity) and human accessibility (semantic integrity) (NINCH, 2002).

Similarly, the Visual Arts Data Service guide distinguishes between physical reliability and continued usability (Grout, Purdy and Rymer, 2002). There is also general consensus on digital archiving or preservation as a continuous activity in the form of a series of managed activities (RLG/OCLC, 2002) or as a lifecycle management approach (Beagrie and Jones, 2002). On the other hand, the source of digital objects is an area of divergence. A number of guides focus on digitized surrogates of physical objects while others encompass both digitized and born-digital objects with the preservation recommendations biased accordingly.

## **Organizational Recommendations**

In the area of organizational recommendations, the pressing need for institutional policies on digital preservation is king. As Howard Besser argues, “our community needs to develop a concrete set of guidelines that can be used by people and organizations wishing to make information persist” (Besser, 2000). NINCH goes even further to suggest that “[i]nsufficient institutional commitment to long-term preservation can create digital resources with limited sustainability” (NINCH, 2002). Beyond the creation of policies, digital preservation needs to be incorporated into the organization as a whole, as in the case of the National Library of Australia where digital preservation is “part of existing core operations and systems ... [as opposed to developing] a special or separate undertaking requiring its own infrastructure” (Gatenby, 2000). Finally, most guides reference OAIS as the model for developing a digital preservation architecture as noted in the literature survey.

## **Assessment of Preservation Strategies and Recommended Methodology**

There is relative uniformity identifying the two dominant strategies in digital preservation as being emulation and migration. However, some guides only identify these two strategies while others present them as two in a wider spectrum of possibilities. In most cases though, there appears to be an implicit acceptance of migration as the primary strategy, ranging from presenting migration as the only strategy (Hodge, 2000) to identifying a list of strategies but explicitly recommending migration (NINCH, 2002). The Cedars guidance documents are unique in presenting a more nuanced migration with an emphasis on the retention of the original digital object supplemented by migration upon request (Cedars, 2002). In contrast, the NINCH guide suggests migrating with every version of a format (NINCH, 2002), an undertaking requiring the application of greater resources over the long-term. One reason given for why migration is



avored is that emulation-based approaches are experimental (Besser, 2000); while emulation may be the best hope for complex digital objects in the future, there are few institutions with the technological expertise to create emulators in the short term. In general, there may not be a best strategy but rather efforts should be focused on refining existing strategies (Kenney, 2000) with an emphasis on providing a suite of digital preservation tools.

While there is not a clear answer as to which strategy to choose, there is agreement that all digital preservation strategies require that the digital bits be available for future use. To this end, refreshing is identified as the best practice for long term machine readability. Refreshing can be implemented in a number of ways from immediately moving files onto a common media maintained for all digital objects (Cedars, 2002) to more traditional approaches emphasizing environmental stability and routine maintenance and migration of the media (Grout, Purdy and Rymer, 2000).

### **Analysis of Storage Media and Digital Formats**

In comparison to strategies, there is less consensus in recommending specific media or formats. This can be attributed to the need to support the significant properties of a broad range of artifacts, often requiring specific formats and media. Even with more general issues such as whether or not to use a compressed format, there is little consensus. While some (NLC, 1998) are explicit about holding only non-compressed items, others (Grout, Purdy and Rymer, 2000) only recommend the format be lossless to retain maximum fidelity. One argument for why compression of any type (including lossless) is problematic for archival files is the introduction of an additional level of complexity (Besser, 2000) which only serves to increase the recovery/migration problem in the future. One recommendation that is agreed upon is the use of

a standard format that is non-proprietary (NLA, 2002, Kenney, 2000) as these kind of formats are more likely to have a preservation path in the future.

One recommendation to handle media issues is to create backups (Cedars, 2002, Kenney, 2000, IMLS, 2001, NINCH, 2002) using more than one kind of backup software to write the copies so as to safeguard against software bugs. In this scenario, at least one copy should be maintained in an offsite location and the media periodically checked as per the refreshing methodology.

### **Metadata Standards and Practices**

There is general recognition of the importance of metadata in an overall strategy for digital preservation (NINCH, 2002, Hodge, 2000). However, as there is no single standard for preservation metadata widely accepted, many organizations and projects (Cedars, 2002, Gatenby, 2000) have created their own schemes for local use. Fortunately, there are enough common factors between the local schemes that convergence should be possible (RLG/OCLC, 2001) with appropriate crosswalks to convert existing metadata to the emerging standards.

For resource discovery metadata and structural metadata, there are emerging standards which have some degree of consensus. Most guides that identify the need for structural metadata recommend the usage of the Metadata Encoding Transmission Standard (METS) (RLG/OCLC, 2001, Cedars, 2002, NINCH, 2002) while Dublin Core is often recommended for resource discovery (Hodge, 2000, IMLS 2001, Jones and Beagrie, 2002, Grout, Purdy and Rymer, 2000, Cedars, 2002). However, identifying these standards does not imply endorsement and the relative newness of METS (2002) means that implementation guides may not be available for some time.

### **Resource Discovery, Persistent Identification and Authenticity**

The need for a persistent identifier to track the object is raised by a number of guides, with proposed systems including PURL (IMLS, 2001, Gatenby 2000, Hodge, 2000, Kenney, 2000), DOI (IMLS, 2001, Hodge, 2000, Kenney, 2000), ISBN/ISSN (IMLS, 2001) and local persistent identifiers (Cedars, 2002). What is interesting is the surprising number of guides (NINCH, 2002, Grout, Purdy and Rymer, 2000, Jones and Beagrie, 2002) that make no mention of the need for a system of persistent identification. Related to the persistent identifier is the need to ensure that the object has not been corrupted or altered. Unfortunately, while the need has been identified, little work has been done except for verification of authenticity at a bit level. For instance, recognition between authentication (integrity of the record) and authenticity (the quality and context of the record) is made (Jones and Beagrie, 2002) but typically only authentication of the object recommended with the common practice to calculate a value such as a checksum to ensure bit-level integrity (Kenney, 2000, IMLS, 2001, Jones and Beagrie, 2002). It should be noted that even for this recommendation, the issue of standardization is problematic as checksums can be computed through a number of algorithms and verification requires the algorithms be identical for the checksum to be useful.

### **Intellectual Property Rights and Rights Management**

The issue of intellectual property rights and rights management is consistently raised with the primary emphasis on ensuring that institutions have sufficient rights for digital preservation activities. Current and proposed changes to copyright laws may prevent preservation either by preventing copying or preventing modifying the digital object (Besser, 2000, Gatenby, 2000) and represent a possible future barrier to preservation. Ideally, an arrangement needs to be made with

the copyright holder but as noted in the experience of the National Library of Australia (Gatenby, 2000), the amount of work this represents can be daunting.

### **Cost/Resource Recommendations and Forward Looking Statements**

Finally, there has not been much discussion in terms of how much these recommendations will cost or even the overall cost of digital preservation. The CAMiLEON project does identify types of costs but the general consensus is that future costs are currently unknown and cannot be well predicted.

### **The Museum Context**

It is one thing to have a series of high level recommendations; it is another thing entirely to be able to implement these recommendations. Technology in a museum context can be scarce and current projects developing digital preservation infrastructures assume a level of technical sophistication not commonly available to museums. A recent survey of technology in museums (IMLS, 2002) found that 67% of museums in the United States have a budget of less than \$250,000 and 20% reported having no funding for technology. In Canada, the situation is even worse (CHIN, 2001) with 60% of the museums having an overall annual budget less than \$100,000 and 85% of museums having a staff of ten or less. To place this in context, one cost estimate (Hendley, 1998) suggests that it would take 2-4 fulltime staff members to manage a digital archive with 100,000 images and receiving 10,000 new images per year. The obvious conclusion is that any recommendation put before the museum community must restrict itself to action items which are within the constraints of the community.

## **Recommendations for Museums**

Based on the overall recommendations provided by the best practices guides and placing into context the environment in which museums operate, two kinds of recommended actions can be provided. Actions that can be implemented at an institutional level are those that each individual museum should be doing immediately. Broader recommendations may require either collaboration or an umbrella organization to execute or is only relevant in the context of a longer-term view of activities.

Action recommendations:

- Establish a set of policy documents governing activities related to digital preservation within the institution. A possible checklist of questions to help establish a digital preservation policy is provided in appendix A.
- Inventory existing digital holdings and quantify their significant properties; maintain that inventory as the collection grows.
- Assign at least 1 staff member clear responsibilities for overseeing digital preservation activities and mainstream digital preservation activities into the operations of the institution.
- Consolidate and reduce the number of media types in the collection and create at least 1 additional copy for storage in an offsite location.
- Prioritize the relative importance of each format type and the resources allocated to supporting that format. Identify formats that the institution will not support and ensure creators/depositors are informed of this.

- Ensure that each digital object in the collection is assigned a persistent identifier with an eye to ensuring that the persistent identifier mechanism is viable beyond the institution.
- Develop a timetable for evaluating holdings including integrity checks of the bit-level data, media refreshing and retention evaluation.
- Identify a metadata standard that fits with the institution's community of practice and develop local implementation procedures or adopt an available usage guide to formalize the institutional approach to the usage of the standard.

Broader recommendations:

- Implement a technology watch protocol to ensure that no media type, file format or standard becomes obsolete before objects associated with any of the above have been addressed sufficiently.
- Establish collaborative links with other institutions to share expertise and resources; create clusters of expertise in handling particular kinds of digital objects
- Identify and endorse standards and formats with broad support and sustainable potential and encourage creators to use those standards and formats for digital objects with enduring value.
- Adopt a system that automates much of the lifecycle management of the digital objects.
- Secure from copyright holders rights in perpetuity to copy and modify the object in support of preservation activities.

## **Conclusion**

Given the overall fluidity with which the digital landscape changes, it is doubtful that the techniques of today will be sufficient for the problems of tomorrow. However, the real solution for digital preservation may lie less in technology and more in policy. As Margaret Hedstrom points out, “[t]his challenge is as much a social and institutional problem as it is a technical one, because for long-term preservation, we rely on institutions that go through changes in direction, purpose, management, and funding” (CLIR, 2002). For museums, having sound policy that maintains human accessibility to the digital objects is critical. The preservation of digital cultural objects will ultimately be found in the overall commitment to preserve our society’s culture and heritage regardless of technical issues.

## **Appendix A: A Possible Checklist for Creating Preservation Policy**

### Organizational

1. Selection/Acquisition
  - a. Is the object important in the context of the institution's core holdings or collection strengths?
  - b. Does the object fit into the current or planned digital preservation infrastructure of the institution?
2. Roles and Responsibilities
  - a. Is the institution the primary holder of record for the digital object?
  - b. Has the institution incurred any responsibilities or restrictions for access to the object?
3. Retention/Deselection
  - a. Are there other institutions with greater capacity or expertise in the type of the object at hand?
  - b. Does the object fit with the continuing mission of the institution?

### Media

1. Choosing a media type to use:
  - a. Does the media type have multi-vendor support for hardware readers and media manufacturing?
  - b. Is the media resilient to environmental fluctuations? What are the recommended environmental conditions for long-term preservation and does the institution have the capacity to provide those conditions?
  - c. How vulnerable is the media to accidental alteration?



- d. Can the media withstand handling? What are the handling conditions of the media?
2. Management of the media:
    - a. How long between checks for media readability and integrity? Between media replacement?
    - b. Is there an identified offsite location? How often will the offsite store be updated?
    - c. Is there an asset tracking system in place for media and how will media be labelled/identified?

## Formats

1. Choosing archival formats:
  - a. Does the format have broad support in viewers/editors?
  - b. Is the format open/non-proprietary and does it have published specifications?
  - c. Does the format have support for including metadata?
  - d. Does the format support for significant properties of the original (if a digital surrogate)?
  - e. Does the format support lossless compression or no compression/encryption?
2. Management of files:
  - a. Is the version of software that created the file recorded? Is the current version recorded?
  - b. How often are format emulators/migrators identified and investigated?

- c. What data loss would constitute a loss of a significant property for the format?

## Metadata

1. General
  - a. Can the digital objects use a global standard or is there a compelling reason to create a local standard?
2. Resource Discovery/Descriptive
  - a. Does the standard meet the discipline or domain requirements?
  - b. Does the standard chosen address interoperability/general resource discovery needs?
3. Structural
  - a. Does the standard chosen address the types of aggregation important to the collection?
4. Administrative/Preservation
  - a. Is there an authenticity indicator (e.g. a checksum) that can be applied to the object?
  - b. Can the change history and technological context of the object be traced sufficiently to ensure human readability and authenticity?
5. Persistent Identifier
  - a. Has the object been assigned an identifier that ensures locally uniqueness?
  - b. Is it important for the institution to have a universal or global persistent identifier for its objects? If so, which mechanism (e.g. PURL, DOI)?

## Intellectual Property Rights

1. Is the right's holder information tracked and stored as part of the metadata?
2. How are the rights of the rights holder protected from abuse (e.g. limited public access, attribution statement)?
3. Are the usage restrictions consistent with institution policy and mandate?
4. Does the institution have sufficient rights for a preservation regimen?
5. Will the costs of securing rights for long-term access be sustainable over the period of enduring value?

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