HARMONIZING HUMAN INFRASTRUCTURE

A case study of bringing preservation workflows of a library, archive, and museum into alignment

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Abstract – The Hesburgh Libraries and Snite Museum of Art at the University of Notre Dame were awarded a 3-year grant that provided funding for a unified discovery and exhibition platform. Although many digital preservation concerns were outside the scope of the grant, one beneficial output of the project has been renewed discussion and interest around robust digital preservation implementations appropriate for each units' specific needs. In this paper, we will discuss how our efforts to bring together different types of cultural heritage materials were informed by digital preservation needs. We will describe the flexible, human-centered workflows that the team developed to prioritize education and collaboration, while leaving space for future preservation initiatives. This case study will provide concrete examples of how to bring workflows from disparate library, archive, and museum units into harmony while being sensitive to both current local practices and perceived future needs.
Keywords – Libraries, Archives, Museums; Workflows; Conference Topics – Enhancing the Collaboration; Building the Capacity & Capability.

I. INTRODUCTION

In 2017, the University of Notre Dame received a grant from The Andrew W. Mellon Foundation to support the development of an application that would provide access to rare and unique digitized materials from the Hesburgh Libraries and Snite Museum of Art [1]. The resulting product was named the Museum, Archives, Rare Books, and Library Exploration platform, or Marble, to demonstrate the collaborative, cross-institutional nature of the project. Included in the Mellon Foundation grant narrative was a goal of addressing digital preservation concerns of the partnering units. However, as the team turned the grant narrative into an actionable plan, it became clear that the most pressing need for the campus community was online access to the rich materials held in the Libraries and Museum. As a result, the grant team focused the majority of their efforts on digital asset curation and display workflows rather than a more technical approach to digital preservation during the grant period. At the same time, the grant team decided to evaluate and document the current preservation activities of the project partners and build out the human infrastructure necessary to support robust preservation while leaving room for future efforts. These activities included advocating for digital preservation support and articulating future opportunities for collaborative preservation. The following sections explain the state of preservation activities before the grant and how collaboration benefited each partner.

II. BACKGROUND

The Snite Museum of Art, Hesburgh Libraries' Rare Books & Special Collections, and the University of Notre Dame Archives formed a partnership for the grant project. Each of these partners entered the grant with previously established workflows that ranged from minimal to robust preservation support, as well as varying degrees of preservation awareness. This disparity in preservation activities follows wider trends among cultural heritage institutions. Libraries have been practicing digital preservation in the United States since at least 1990 [2] and library and information science professionals are keenly aware that digital assets require active management [3]. In contrast, the museum world has generally been slower [4] to implement robust digital preservation programs [5] than their library [6] and archive [7] counterparts, particularly evidenced by a lack of internal policies. [8]

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Marble provided an opportunity for cross-sector collaboration where library, archive, and museum professionals could benefit from sharing knowledge about digital preservation.

The Snite Museum of Art is a mid-sized, academic art museum with an encyclopaedic collection. Prior to this grant, only Museum staff could access descriptive metadata or digital images from the Snite's holdings. During the grant, management of digital assets, *i.e.* digital surrogates of collection objects and descriptive and administrative metadata, was divided between two positions: the term-limited Collections Database Coordinator and the permanent Digital & Special Projects Program Manager. The Program Manager developed the Museum's current preservation practices for digital assets, but this is only one part of his job responsibilities, and the internal policy had not been documented. The preservation workflow employs the "Lots of Copies Keeps Stuff Safe" (LOCKSS) [9] method for ensuring long-term access to preservation-quality, digital surrogates. Preservation files are stored in Wasabi, a hosted cloud storage solution that performs fixity checks on files as they are deposited. Access images are replicated to Google Drive and named using the objects' unique identifier. With regards to the metadata, the Collections Database Coordinator initiated nightly backups of the content management system at the beginning of the grant. These backups are stored in a proprietary format on the vendor's hosted server.

Hesburgh Libraries includes both the Rare Books & Special Collections (RBSC) department as well as the University of Notre Dame Archives (UA). Both units leverage a tape-storage system for storing inactive materials and preservation copies. For active materials, they use a network-attached storage space that is backed up nightly by the University's Office of Information Technology. Metadata for these units is stored in a wide variety of places, including ArchivesSpace, an open source archives information management software; Aleph, an integrated library system; and in spreadsheets and proprietary data formats. Access to digital files was developed over twenty years in an ad-hoc fashion. With several different access platforms--many of which are boutique/one-off sites, as well as numerous internal storage and sharing options--users often had to know the right person to ask for access to the content. For both the Snite and Hesburgh Libraries, the grant enabled a means of providing better access for users to digitized content across campus.

The core team considered building a digital asset management system (DAMS) with preservation support during the funding period, but instead, decided to focus on the human infrastructure [11] critical for the successful preservation [12] of digital assets. [13] Neither the Libraries nor the Museum have had a DAMS and it was originally thought that such a system would fill significant gaps in the management and preservation of digital assets for each partner. The reasoning not to build a DAMS was manyfold. The goal was not to force units into one practice or preservation system, but rather, to articulate the importance of preservation, identify the varied needs of campus partners, and bring workflows into harmony. Additionally, the grant team was dedicated to flexible technology solutions, which would allow digital preservation tools to be connected in the future. In lieu of adopting a DAMS, the grant team used the grant period to conduct a gap analysis of current practices and preservation needs; they communicated to leadership the missing pieces of digital preservation that had been identified and the areas that would be a threat to the long-term success of the collaborative access platform.

III. METHOD

In order to ensure project success and optimal collaboration among the library, archive, and museum units, the grant was steered by a core team, composed of the technical lead, one of the product owners (PO), and the project manager. This core team established several working groups with overlapping participation (Figure 1). There was a content selection team, helping to identify items with thematic overlap among collection holdings; a workflow team to document the methods for loading content into the Marble site, including prepending the workflow for digitization efforts; and a metadata team to reconcile the various metadata standards used by the custodial departments for seamless display online. These teams were complemented by the technical team, who was tasked with developing

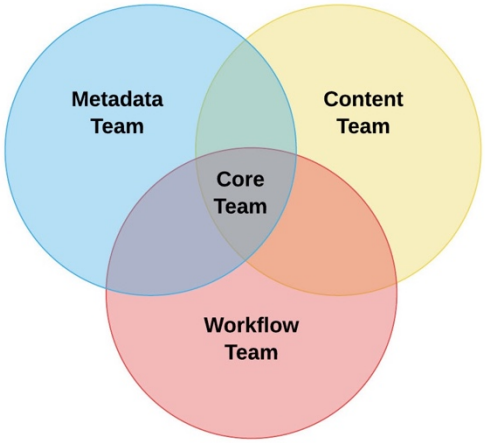

Figure 1: Visual representation of the team distribution of the Marble Project.

the front-end, open-source site. There were many areas of crossover among these teams; tech representatives served on all teams, metadata members were also on the workflow team, and the two POs often attended meetings to keep a pulse on progress and provide input on users' needs. There was also overlap in knowledge areas: each team had both a library and museum professional. This highly-collaborative working environment was critical. The diverse knowledge present in the makeup of each team allowed problem-solving to occur in small groups of subject experts, including related to issues surrounding digital preservation.

In the final year of the grant, the core team led a multi-faceted approach to meet the following preservation goals: documenting current practices, identifying campus partners' needs through a risk assessment, and communicating the missing digital preservation components to leadership. Grant participants collaborated to document current activities in the form of extended interviews with staff tasked with digital preservation. The two POs initiated the conversations with a set of questions. Then, one led the discussion while the other took notes. Interviewees were asked to demonstrate any software that they used, explain workflows, and list the types of content they steward. It is worth noting that each of the grant partners create and steward digital materials that will not be accessible via the unified display and exhibition platform because they fall outside of the scope of Marble. These were excluded from the assessment and instead, the team focused on materials that had been or could be added to Marble. The POs compiled this information into an internal document that articulated the current practices of the project partners.

Next, the POs conducted a risk assessment of the materials. This information was drawn largely from the previously mentioned conversations. The grant team used the National Digital Stewardship Alliance Levels of Preservation Matrix [14] to assess activities and identify new avenues for growing preservation support. The partnering institutions, though varied, tended to score between 1-3 on the functional matrix (level 1 is the lowest score and 4 is the highest). The widest disparity was in the areas related to storage options and control (Appendix A). This provided a shared understanding of the level of preservation among the units and helped articulate areas for improvement.

Lastly, each unit communicated the preservation needs identified during the creation of Marble to their respective leadership. At Hesburgh Libraries, requests for digital preservation support were funneled through the Digital Preservation team led by the Digital Preservation Strategist, who frequently interacted with library leadership. At the Snite Museum of Art, the Collections Database Coordinator, the Digital & Special Projects Program Manager, and one of the POs drafted a memo that introduced the relatively new topic of digital preservation (Appendix B). The memo is a one page summary of the current status of preservation, future opportunities, costs associated with participation in a digital preservation program, and risks associated with not engaging in digital preservation activities. The authors of this memo--a combination of library and museum professionals--benefited from the grant's collaborative nature to investigate preservation activities at the Museum. They used the grant as an opportunity to explain how preservation supports key institutional values as well as the continued maintenance of Marble.

IV. Results

The pivotal decision to prioritize the display of digital assets proved beneficial for focusing grant activities. While digital preservation and asset management remained a critical part of the grant, the team found solutions that maximized the grant's resources. Through documenting current practices, identifying partners' needs in a risk

assessment, and advocating for preservation support to leadership, the team met each partner at their level of preservation awareness. The cross-institutional collaboration of the working groups also ensured that particulars unique to each institution were shared and considered. The flexible, human-centered workflows that the team developed harmonized human infrastructure, not by dictating the same workflow to all three partners, but by ensuring that each workflow functioned in cooperation with each other.

A. Documenting Current Practices

The POs compiled the current preservation practices of the project partners into a single document based on their internal interviews with preservation practitioners. This document was critical for evaluating risk, clarifying responsibilities, and identifying gaps in both technical infrastructure and human workflows. These current practice conversations launched future preservation activities.

The grant team conveyed the information from these conversations to each institution. At Hesburgh Libraries, this information was handled by the recently formed digital preservation team. Tasked with tackling preservation activities of RBSC and UA, it is composed of several staff who have deep knowledge of digital preservation practices. Team members worked on a unified digital preservation policy and implementable strategy. This policy, which articulated the variety of digital surrogates managed by Hesburgh Libraries, demonstrated the varied needs of assets and underscored the importance of multiple technical solutions. While these solutions were beyond the scope of the grant, documenting existing human workflows and technical solutions provided a solid launch point for these conversations across the Libraries, especially to leadership. Digital preservation at the Snite continues to rely on the Digital & Special Projects Program Manager and the documentation is available for future preservation activities.

B. Risk Assessment

The risk assessment illuminated that, for the Snite Museum of Art, the Marble content is of low-to-medium risk. While these materials do not present a risk from a legal or ethical standpoint, the primary risk is loss of content, which would be difficult, if not impossible, to recreate. The majority of items could be re-photographed if the digital surrogates were lost or damaged, but it would be an intensive effort. The Museum employs only one full-time staff person for imaging activities and the size of many objects requires that staff from other departments assist. A small subsection of the Museum's digital assets represents a higher risk level. The Snite Museum captures images before and after conservation treatment to document the history of an object. Images taken before treatment are inherently at higher risk because the Museum cannot re-photograph the pre-conservation state of an object. Similarly, re-photographing fragile objects would place items at higher risk of damage. In both cases, these digital assets are at a slightly higher risk because of the inherent difficulty of recreating digital files.

For Hesburgh Libraries, which includes RBSC and UA, Marble assets are at low risk. Both units upload high-resolution derivative access files to Marble. These images can, for the most part, be recreated by re-photographing or re-scanning the original item. While this would be a time-intensive process if the original images were lost, the Libraries has the resources to undertake this effort. There are a few cases where the poor physical condition of the items would not be conducive to re-photographing, but that content represents a minority of the items.

Given the distinct workflows for preparing, processing, and managing digital assets, each partner will retain custodial control over preservation practices for their content. Marble provides minimal additional technical preservation support to all units, remaining as a primary storage for duplicate copies of content loaded into the IIIF manifest pipelines as well as creating backups in AWS S3, which provides offsite storage for platform partners.

C. Communicating to leadership

The Museum and Libraries took different approaches to communicating with leadership. This was a result of the different working

environments and different levels of preservation awareness and implementation between the two institutions. The Museum benefited from collaborating with preservation experts from the Libraries to widen preservation awareness beyond the Digital & Special Projects Program Manager. The Libraries' internal working group created a shared space for preservation discussions that had previously been decentralized. Knowledge of the Museum's low-tech preservation (*i.e.*, replication to Wasabi) solution energized the Libraries team to brainstorm a unified naming structure to organize their digital assets. While the preservation activities are different among the grant units, the collective effort of documenting current practices benefited the partnership on a whole.

With regards to advocacy for digital preservation support, the grant team established a foundation on which future work can be built. Although there is still extensive advocacy work remaining, the collaborative nature of the grant, especially the cross-institutional working groups, helped to share digital preservation information and best practices across campus. However, it is worth noting that the two institutions relied on employees with different work statuses for digital preservation. At the Snite Museum of Art, there were three people tasked with advocating for and articulating digital preservation requirements. Two of these individuals were temporary hires that departed at the end of the grant. While the woes of digital preservation and contingent labor [15] have been, and continue to be, researched, [16] it is worth highlighting that Hesburgh Libraries is the only partner that tasked permanent, full-time staff with digital preservation matters. The disparate staff resources may affect the sustainability of the platform, but it is still too early in the post-production life of the project to make any future predictions.

V. Conclusion

It has been widely established and acknowledged in the digital preservation community that the most valuable contribution to digital preservation is the labor and time of employees. Indeed, throughout this process, the most impactful preservation discussions revolved not around technical solutions, but rather the human infrastructure. The grant allowed for the formation of sub-teams with members that overlapped the project partners. These teams benefited from the shared expertise of its members, especially when dealing with diverse collection items and differing organization structures. Moreover, the project demonstrates a commitment to the idea that technical solutions can, will, and should continue to change overtime. By focusing energy on the collaborative spirit of the grant and continuing robust documentation and education, staff tasked with working on the grant, who were not in positions of leadership in their organization, were able to use the grant resources to raise awareness of preservation issues upward. While we were unable to purchase or develop a DAMS during the grant, the team has opened the proverbial door and initiated conversations about the importance of digital preservation for the maintenance of Marble.

Each grant unit benefited from the shared resources the collaboration provided in knowledge sharing and technology infrastructure, especially as it relates to preservation expertise. Over time, as more robust digital preservation activities become necessary, the combination of a flexible technical environment as well as documentation of local practices will simplify the process when swapping in tools, workflows, and personnel. While both the Snite and Hesburgh Libraries used the grant as an opportunity to raise awareness about preservation needs, the institutions used a different mix of their labor force. Not only were the majority of the advocates on the Snite team term-limited positions, the PO for the Snite was also a grant-funded position. Hesburgh Libraries leveraged the expertise of their permanent staff, which allowed greater continuity and encouraged staff buy-in to sustain the work beyond the grant period. The Libraries also established a sustainability plan for Marble after the grant period which commits to amending documentation to reflect changes in workflows.

The work completed in this grant period is a foundational starting point that will allow the Marble team to build in ways that respect the individualized needs of each grant partner while setting the stage for the robust preservation of content that users can access through the unified platform.

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APPENDIX A:

The following copies of the NDSA Levels of Preservation were drafted by Workflow Sub-team members in January 2021 to articulate the different capabilities of each unit. Custodial department names have been removed and units have not been reassessed since completion. These charts are included here to demonstrate our current capabilities and room for additional growth.

Levels of Digital Preservation

Functional Area	Level			
	Level [illegible] (Know your content)	Level 2 (Protect your content)	Level 3 (Monitor your content)	Level 4 (Sustain your content)
Storage	Have two complete copies in separa[illegible] locations Document all storage media where content is stored Put content into stable storage	Have three complete copies with at least one copy in a separate geographic location Document storage and storage media indicating the resources and dependencies they require to function	Have at least one copy in a geographic location with a different disaster threat than the other copies Have at least one copy on a different storage media type Track the obsolescence of storage and media	Have at least three copies in geographic locations, each with a different disaster threat Maximize storage diversification to avoid single points of failure Have a plan and execute actions to address obsolescence of storage hardware, software, and media
Integrity	Verify integrity information if it has bee[illegible] provided with the content Generate integrity information if not provided with the content Virus check all content; isolate content for quarantine as needed	Verify integrity information when moving or copying content Use write-blockers when working with original media Back up integrity information and store copy in a separate location from the content	Verify integrity information of content at fixed intervals Document integrity information verification processes and outcomes Perform audit of integrity information on demand	Verify integrity information in response to specific events or activities Replace or repair corrupted content as necessary
Control	Determine the human and software agents that should be authorized to read, writ[illegible] to content	Document the human and software agents authorized to read, write, move, and delete content and apply these	Maintain logs and identify the human and software agents that performed actions on content	Perform periodic review of actions/access logs
Metadata	Create inventory of content, also documenting current storage locations Backup inventory and store at least one copy separately from content	Store enough metadata to know what the content is (this might include some combination of administrative, technical, descriptive, preservation, and structural)	Determine what metadata standards to apply Find and fill gaps in your metadata to meet those standards	Record preservation actions associated with content and when those actions occur Implement metadata standards chosen
Content	Document file formats and other essential content characteristics including how and when these were identified	Verify file formats and other essential content characteristics Build relationships with content creators to encourage sustainable file choices	Monitor for obsolescence, and changes in technologies on which content is dependent	Perform migrations, normalizations, emulation, and similar activities that ensure content can be accessed

Levels of Digital Preservation

Functional Area	Level			
	Level 1 (Know your content)	**Level 2 (Protect your content)**	**Level 3 (Monitor your content)**	**Level 4 (Sustain your content)**
Storage	Have two complete copies in separate locations Document all storage media where content is stored Put content into stable storage	Have three complete copies with at least one copy in a separate geographic location Document storage and storage media indicating the resources and dependencies they require to function	Have at least one copy in a geographic location with a different disaster threat than the other copies Have at least one copy on a different storage media type Track the obsolescence of storage and media	Have at least three copies in geographic locations, each with a different disaster threat Maximize storage diversification to avoid single points of failure Have a plan and execute actions to address obsolescence of storage hardware, software, and media
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Levels of Digital Preservation

Functional Area	Level			
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APPENDIX B:

The following memo was drafted by Workflow Sub-team members from the Snite in November 2020 to succinctly describe what digital preservation is, current practices, risks associated by electing not to preserve content, and how to improve preservation activities for Museum leadership. It has been included here as a template for other institutions or individuals to articulate needs, risks, and costs.

Digital Preservation at the Snite Museum

The following memo was drafted by Workflow Sub-team members from the Snite in November 2020 to succinctly describe what digital preservation is, current practices, risks associated by electing not to preserve content, and how to improve preservation activities for Museum leadership. It has been included here as a template for other institutions or individuals to articulate needs, risks, and costs.

What is Digital Preservation and why should the Snite Museum engage in it?

As a Museum, we are committed to "building, preserving, and providing access to collections for students, faculty, and the community." (Strategic Plan, 5) A large part of this mission includes facilitating digital access to collections, exhibitions, and other Museum-created content. This increased focus on digital access is even more important in the context of a multi-year public health crisis. Undergirding any meaningful access to the Snite Museum's digital content is the ability for users to access that content over time, even as technologies and file formats rapidly change. In order to ensure that continuity, the Snite Museum of Art is currently engaged in digital preservation activities but could implement some additional, relatively low-cost measure to improve the long-term accessibility, integrity, and usability of its digital assets over time.

At the core, digital preservation includes the following activities:

- Policies, workflows, and storage locations for maintaining multiple copies of digital files in different formats and in different geographic locations.
- Policies, workflows, and processes to regularly verify the integrity of digital files in storage locations to guard against obsolescence and decay and ensure authenticity.
- Policies, workflows, and storage solutions to maintain sufficient administrative, technical, structural, and descriptive metadata to manage preservation and access to digital assets.

How does the Snite currently preserve its assets?

- System of distributed back-ups for collection images on Wasabi (cloud-based), Google Drive (access copies), and harddrive in vault (no longer updated as of summer 2020).
- Wasabi performs fixity checks when the files are deposited but not on a regular basis thereafter.
- Connection between metadata and files maintained through EmbARK, which is preserved by Gallery Systems. (what would happen if Gallery Systems went out of business overnight?)
    - Metadata for Marble objects is also stored/copied in Hesburgh Libraries' AWS service.

How could the Snite improve its presentation activities?

- Document digital preservation policies that would define content that is most at risk and worth preserving, processes for preparing and depositing digital assets.
- Deposit files in a digital preservation system that would run regular checks to ensure long-term integrity and accessibility for digital assets.

What are the risks associated with not improving digital preservation?

- Inability to collect and access digital art, time-based media, or born-digital museum files (including museum archives, exhibition documents, labels, videos, etc) long-term.
- File format degradation or obsolescence, meaning it's difficult or impossible to retrieve data.
- Loss of contextual information (metadata) resulting in a loss of meaning for digital files.
- Loss of files and data would result in time and labor costs to retrieve or remake data.

Costs of proposed activities

- Time costs for documenting and defining digital preservation policies and workflows.
    - Time costs for preparing and depositing digital files in a preservation system on a regular basis.
- InDiPres = $1,850-2,350 per year based on amount of storage required.
    - $350 membership fee per year, $.59/gigabytes per year