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Finding Access and Digital Preservation Solutions for a Digitized Oral History Project: A Case Study

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Finding access and digital preservation solutions for a digitized oral history project: A case study

Abstract

Purpose – The purpose of this paper is to examine affordable access and digital preservation solutions for digital collections developed by under-resourced small and mid-size cultural heritage organizations.

Design/methodology/approach – The paper presents a case study of *Jeffco Stories*, a collection of digitized oral histories created by the Jefferson County Public Library in Colorado.

Findings – This paper describes how the Jefferson County Public Library undertook a migration project of its oral history digital collection into an open access platform, Omeka and selected DuraCloud as a hosted digital preservation service.

Research limitations/implications – As a case study, this paper is limited to one institution's experience with selecting access and digital preservation solutions.

Practical implications – This paper is relevant to librarians and archivists who are exploring access and preservation solutions for digital collections and to those who are considering migrating to open access content management systems and cloud-based digital preservation solutions.

Originality/value – This paper presents a case of a public library and the challenges in finding affordable access and digital preservation solutions for small digital collections.

Keywords: Public libraries, Digital collections, Digitized oral histories, Content management systems, Digital preservation, Omeka, DuraCloud, Cloud-based solutions, Under-resourced cultural heritage institutions

Paper type: Case study

Introduction

Oral histories play a unique role in documenting cultural heritage and in preserving memories of historical and everyday events. They are vital to building public understanding of the place and social life of local communities (Tebeau, 2013). Traditionally, oral histories were recorded on audiotapes and stored in archives and historical societies. Digital technology has opened up new possibilities for recording, organizing, and sharing these valuable oral testimonies (Boyd, 2011; High, Mills, & Zembrzycki, 2012). Digital recording tools provide new means of capturing and telling life stories, while digital collections make them available to wider audiences. The

digitization of oral histories also addresses preservation concerns, since many analog recordings were originally created on fragile and deteriorating tapes.

Cultural heritage institutions digitize and build digital collections of oral histories to mitigate the preservation risks and to expand access to these unique resources that give voice to underrepresented groups and preserve historical and social memories (Bond, 2004; Daniels, 2009; Stevens & Latham, 2009; Weig, Terry, & Lybarger, 2007). Many collections have been created by university and audiovisual archives with well-established digital infrastructures or through grant-funded, multi-institutional collaborations (Warren et al., 2013). However, fewer public libraries and small historical societies undertake these digitization projects. The digitization of sound recordings, if following best practices, generates a large volume of digital assets, including preservation-quality master files and smaller derivatives for access (IASA, 2009). The projects rely in part on a robust digital infrastructure to deliver online collections and to ensure the long-term preservation of master files. Cultural heritage institutions with restricted resources build digital collections of oral histories less frequently because of the relative lack of technical expertise at their disposal and the challenge of acquiring affordable content management systems and digital preservation solutions.

The development of open source content management systems and preservation services, especially those with hosted options, has enabled smaller cultural heritage institutions with limited technical infrastructure to participate in building digital collections. This article presents a case study of *Jeffco Stories*, a collection of digitized oral histories created by the Jefferson County Public Library (Jeffco Library) in Colorado. The collection was created in collaboration with local historical societies and with assistance from faculty and graduate students from the Library and Information Science (LIS) program at the University of Denver. This article outlines the challenges encountered when evaluating possible access and digital preservation solutions for *Jeffco Stories*. It goes on to describe the migration of the content to an open access platform, Omeka, and the selection of DuraCloud as a hosted digital preservation service. The online collection is available at: <http://jeffcostories.omeka.net/>.

Background

The digitization of oral histories contributes to the ultimate goals of increasing access to and preserving these valuable resources. Deteriorating audio tapes and the obsolescence of playback equipment pose serious preservation risks to analog recordings of oral histories. The preservation of audio content held on analog carriers has become increasingly urgent as technology for audiovisual media has transitioned into digital recording (Casey, 2015). Digitized copies will very likely serve as the only representations of the original content, as many analog recordings will not be accessible in the future. Thus, it's extremely important to create high-quality digital versions of analog audio recordings and to follow best practices for the long-term preservation of master files. (Brylawski et al., 2015; Council on Library and Information Resources & Library of Congress, 2010; Xie & Matusiak, 2016, pp. 99-112).

The digital library environment offers a wide selection of open source and proprietary content management systems with different levels of functionality for organizing, managing, and providing access to digital collections. Content management systems (CMS), often called digital asset management systems, rarely provide support for the preservation of master files. The

primary function of CMS's is to build digital collections for access, which in many ways reflects early conceptions of digital libraries as access platforms and the resulting lack of attention to digital preservation. The landscape of CMS's has evolved since the first dedicated digital library management systems were developed in the mid-1990s. Several software packages, such as Omeka (open source), CONTENTdm and Luna (proprietary) offer hosting options for small and mid-size digital collections. In recent years, libraries and archives have been migrating from the first generation of open-source or proprietary software, such as DSpace or CONTENTdm, towards more robust and scalable open source solutions (Gilbert & Mobley, 2013; Stein & Thompson, 2015).

Long-term preservation of digital assets requires technical infrastructure and significant investment in resources and expertise. Master files created as a result of digital capture or analog-to-digital conversion require a secure and stable storage environment that monitors bit-level integrity. The semantic relationships between preserved bit streams and representation information, that is information about the context of the digital collection, should also be maintained (Ross, 2012). Small and mid-size cultural heritage institutions face many challenges when engaging in digital preservation initiatives. Small staff sizes, a lack of specialized expertise, dated technical infrastructures, and limited budgets can limit an institution's ability to adequately preserve their digital content (Schumacher et al., 2014).

Hosted preservation services provide viable alternatives to developing and managing an in-house repository (Brown, 2013, pp. 74-76; Schumacher et al., 2014; Xie & Matusiak, 2016, pp. 273-276). Cloud-based, hosted preservation services, such as Preservica or DuraSpace's ArchivesDirect and DuraCloud have emerged in recent years as scalable solutions for institutions with limited digital curation infrastructure. Han (2015) comments on a significant drop in cloud storage pricing and identifies several benefits of using cloud services for digital preservation in libraries. Oliver and Knight (2015) note that outsourcing digital preservation to cloud-based services allows cultural heritage institutions to take advantage of the vendor's experience and ensures high-quality bit-level preservation. While hosted preservation systems vary in the degree to which they comply with the Open Archival Information System (OAIS) reference model, most at least perform regular integrity checks. The OAIS Reference Model is a national standard for digital preservation that offers a conceptual framework and consistent terminology for developing and maintaining preservation information systems (Lee, 2010; Corrado & Moulaison, 2014, pp. 43-53).

Due to the rapidly evolving technological environment of which digital libraries are a part, regular evaluation of newer content management platforms and approaches to digital preservation is required in order to consistently meet the recommended standards. Often, migration to new platforms and systems is necessary to provide consistent access to high quality content. The change can be unsettling and overwhelming (Rinehart et al., 2014). As mentioned before, the trend in the field is to migrate from proprietary toward open source platforms (Stein & Thompson, 2015). The case study of *Jeffco Stories* presented here is unique insofar as it represents a transition from a hosted open source platform to another open source software.

Jeffco Stories: Building a Digital Collection of Oral Histories

The Jeffco Library has been actively involved in collecting and digitizing the oral histories of its community members since 2010. The *Jeffco Stories* collection was developed in collaboration with several local cultural heritage institutions that were interested in having their oral histories digitized, including the Ken Caryl Ranch, North Fork and Lakewood Historical Societies. The partnering historical societies provided the initial set of oral histories on audiocassettes and some digital recordings on physical carriers, such as CDs and DVDs. The initial digitization process was outsourced to Safe Sound Audio in Philadelphia. The primary goal was to expand access to the analog recordings, but the project also addressed a preservation goal, as the content was transferred from deteriorating tapes to a digital format and high-quality master files were created. The Jeffco Library also added a set of born-digital oral histories that were collected at community events between 2010 and 2015. The collection currently includes 163 oral histories accompanied by transcripts and photographs.

In 2014, the Jeffco Library decided to work on audio conversion in-house and began collaborating with the Library and Information Science (LIS) program at the University of Denver. LIS students worked on digitizing the tapes or extracting files from CDs or DVDs, creating metadata records, and uploading the files and associated metadata to the content management system. The in-house processing of the digitized files and the creation of access files was completed using the open-source software Audacity. The project followed best practices for audio digitization and the team created high-quality archival master files for preservation purposes, service masters as a source for access files, and smaller access files for Web delivery (Collaborative Digitization Program, 2006; IASA, 2009).

The Jeffco Library undertook the project to provide access to digital collections to its community members, but initially had no infrastructure for digitization, delivering digital collections, or ensuring the long-term preservation of digitized objects. However, as a member of a regional interlibrary loan consortium, it was able to secure a contract for hosting services. A regional repository agreed to host an online collection and to provide preservation services for archival master files for a fee. The repository used the Islandora/Fedora platform with Metadata Object Description Schema (MODS) as its core metadata standard. It provided a user interface designed in a collaboration between Jeffco Library and the repository support team. The regional repository charged separate fees for hosting the online collection and for storing master files. This solution proved financially unsustainable for the Jeffco Library, which operates with a relatively limited public library budget and does not have resources that can be easily allocated to digital initiatives.

Migration: Selecting Access and Preservation Solutions

In early Spring of 2015, the Jeffco Library began to explore other options for hosting *Jeffco Stories* and reached out to the University of Denver LIS program to collaborate in the pursuit of a more sustainable model. A second-year graduate student from the LIS program with a strong interest in digital preservation began working collaboratively with the Jeffco Library to gain an understanding of the collection and the Library's needs, and to help find sustainable solutions for both the digital preservation of the master files and for public access to the collection. The selection of appropriate access and digital preservation solutions was complicated by a number of factors. First, near the beginning of the student's work on the project, the regional repository

announced that they would be ending their service and would be assisting clients with migration to new systems or simply returning the files and accompanying metadata to the client. This decision ultimately defined the timeline for the selection process and added a sense of urgency to a decision that had been, until then, primarily financially driven.

Based on research into available access and digital preservation services and in light of financial constraints, two solutions were recommended for providing access to *Jeffco Stories* and ensuring long-term preservation of the project's digital assets:

- DuraCloud, <<http://www.duracloud.org/>> a hosted, cloud-based preservation service offered by DuraSpace, a not-for-profit organization, was identified as the best solution for digital preservation.
- Omeka, an open source content management system, was selected to host the new digital collection; Omeka.net <<http://www.omeka.net/>> was recommended as it provides a hosting service and does not require a server installation.

A number of factors influenced the selection of DuraCloud as a preservation solution. Budget limitations necessitated the prioritization of inexpensive and open-source solutions and eliminated the consideration of several “out-of-the-box,” fully OAIS compliant options such as Preservica and DuraSpace's ArchivesDirect. While fully open-source options were considered, it was determined that the Jeffco Library did not have the dedicated staff time and expertise to make solutions requiring complex processing workflows viable. Many of the available free and open-source solutions require significant time investment as well as knowledge of preservation terminology, tools and workflows. As is the case with many under-resourced small to mid-size cultural heritage institutions, the Jeffco Library could not commit a full-time staff member to digital preservation initiatives. Beyond these practical limitations, the Jeffco Library's lack of access to a server on which to store the files necessitated a hosted solution.

While many options were considered, DuraCloud quickly presented itself as the best solution for the digital preservation of *Jeffco Stories*. While DuraCloud is not fully OAIS compliant on its own, it provides some services that extend beyond basic cloud storage and allow it to align more closely with national standards for the digital preservation of archival materials. For example, automatic fixity checks that help to ensure the bit-level integrity of the master files over time are performed quarterly. DuraCloud offers several different options for storage and a tiered pricing model, making it a relatively flexible solution (DuraCloud, 2016). For the *Jeffco Stories* project, the “Preservation Plus Plan” was selected, as it includes the option for geographically distributed copies to be stored at a minimal additional cost. DuraCloud also provides a simple interface for library staff to access the archived files. Ultimately, DuraCloud offered a relatively high level of fully-hosted digital preservation services for roughly one-sixth the cost of the local repository that had previously managed the materials.

The hosted version of Omeka (Omeka.net) was chosen to provide access to the *Jeffco Stories* collection, as it met all of the Library's highest priorities for a content management solution. Omeka.net is an open source, hosted service that, in addition to a free option, offers four paid plans, each increasing in price as they offer more storage, additional integrated plug-ins, and extra pre-packaged “themes” (Omeka.net, 2016). The Jeffco Library selected Omeka's Platinum Plan offering 25GB of storage space for \$999.00 a year. The administrative interface is simple

enough for LIS students and the Jeffco Library staff to add and edit content and metadata and make aesthetic and organizational changes to the front-facing user interface (see Figure 1). Omeka provides support for audio files and has a standard CSV import plug-in that can facilitate batch uploads. Because the project necessitated a large migration of content in a relatively short amount of time and because there were only a few individuals who were able to dedicate time to the migration process, support for batch uploads was a practically important consideration when evaluating content management systems. Finally, Omeka's built-in themes provided the Library with some flexibility as to how they wanted the site to look and feel, which allowed them to consider their community members' needs and expectations when designing the user interface.

The image shows the Omeka administrative interface for editing a resource. On the left is a vertical navigation menu with the following items: Dashboard, Items, Collections, Item Types, Tags, Exhibits, Map, and LC Suggest. The main content area is a form with the following sections:

- Title:** A name given to the resource. Input field contains "Interview with Jordan Gortmaker, October 21, 2012". Includes an "Add Input" button and a "Use HTML" checkbox.
- Subject:** The topic of the resource. Input field contains "Lakewood, CO". Includes an "Add Input" button, a "Remove" button, and a "Use HTML" checkbox. Below this is another input field containing "Restaurants" with a "Remove" button and a "Use HTML" checkbox.
- Description:** An account of the resource. Input field contains "Jordan Gortmaker discusses the history of Casa Bonita restaurant on West Colfax Avenue. Mr. Gortmaker's essay Fiesta on the Front Range: A History of Casa". Includes an "Add Input" button and a "Use HTML" checkbox.
- Creator:** An entity primarily responsible for making the resource. Input field contains "Gortmaker, Jordan". Includes an "Add Input" button and a "Use HTML" checkbox.
- Publisher:** An entity responsible for making the resource available. Input field contains "Jefferson County Public Library, Lakewood, CO". Includes an "Add Input" button.

On the right side of the form is a sidebar with the following elements:

- A green "Save Changes" button.
- A dark blue "View Public Page" button.
- A brown "Delete" button.
- Checkboxes for "Public" (checked) and "Featured" (unchecked).
- A "Collection" dropdown menu currently set to "Jeffco Stories".

Figure 1. Administrative interface in Omeka.

While both DuraCloud and Omeka are imperfect solutions, they fit within the very real limitations of the project and provide standards-based, fully-hosted options for digital preservation and access. The constraints posed by tight budgets, the lack of dedicated staff, and a relatively undeveloped local technical infrastructure limited the options available for both digital preservation solutions and access. The challenges, while limiting in some ways, allowed stakeholders to conceive of solutions that are truly sustainable and practically manageable for the Jeffco Library.

Migrating Jeffco Stories Collection

The migration of *Jeffco Stories* began in September 2015 and was completed in February 2016. The process of transition from the regional repository to the Omeka and DuraCloud platforms consisted of three phases, including:

- Uploading access files and metadata to Omeka
- Transferring archival master files and other digital assets to DuraCloud
- Developing an interface for the public-facing Omeka collection.

With the exception of a set of newer oral histories created by a community partner, all files were stored on an external hard drive provided by the regional repository service. These included access audio files, images, and transcript files that were to be made available through the Omeka collection, as well as the archival and service master files to be preserved in DuraCloud. Table 1 provides a list of digital assets created as a result of this project and transferred to DuraCloud.

Table 1. Digital files created as a result of the project and stored in DuraCloud

File Type	File Format	File Size (Range)	Number
Audio master files	WAV	220 MB – 1.87 GB	208
Audio service files	Mp3	20 MB – 230 MB	199
Audio access files	Mp3	4 MB – 70 MB	508
Image master files	TIF	15 MB – 28 MB	15
Image access files	JPG	2.1 MB – 7 MB	6
Text transcript files	PDF	28 KB – 534 KB	90
Total			1026

Jeffco Stories includes 163 oral histories but the total number of files created as a result of this project is 1026. Oral histories that originally spanned multiple tapes are represented by two master files. File segmentation had to be performed on many of the access files to make them small enough for upload to Omeka and to allow for online streaming. This resulted in a high number of Mp3 access files. In addition to the three versions of digital sound files, the collection also includes transcript files in the PDF format and documentary photography that was collected and digitized for the project. The photographic images are in the TIFF and JPEG formats. Transcripts for 90 oral histories were created during the first phase of digitization. In total, the files occupy 184.7 GB of space in DuraCloud.

Once the Omeka and DuraCloud services were contracted, an LIS student from the University of Denver was hired to complete the three phases of the migration. The priorities included creating the metadata records for each oral history and then uploading the access audio files and any

associated images and transcripts. Omeka limits the maximum file size a user can upload to 128MB. However, files larger than 70Mb would time-out during the upload because of the limited capacity of the Jeffco Library-provided computer. Thus, the student used the open-source Audacity audio processing software to create multi-part audio files in the MP3 format to ensure complete, successful uploads of the files. The archival master files were retained as WAV files. Once all of the Omeka records were created, the remaining two phases were completed in parallel, with work alternating between DuraCloud uploads and the design and testing of the Omeka collection site. The final design features were completed in collaboration with the Jeffco Library Digital Experiences team, who also ensured that the collection was accessible from the main Library website and was in compliance with Library policies (see Figure 2 for the collection's homepage).

Jeffco Stories

Browse Items Browse Exhibits Contact Us jeffcolibrary.org

A collection of oral histories, transcripts, and photographs of Jefferson County, Colorado. Oral history interviews are conducted by Jefferson County Public Library, University of Denver, and local historical society volunteers, and are available to the local community via the Jefferson County Public Library's website.

Jefferson County
PUBLIC LIBRARY

Featured Item

Interview with Darrell Arndt, August 14, 2010

Mr. Arndt was interviewed as part of the Jeffco Stories Oral History Project. Mr. Arndt was interviewed at an open house for the restored No. 25...

Featured Exhibit

World War II Recollections

A turning point in American and global society, the impacts of World War II are still seen today. Throughout the...

Recently Added Items

Interview with Mark Kopatz, February 9, 2015

Mark Kopatz discusses his experiences as one of the original developers of Ken Caryl Ranch and Village homes and his role in Terraspec.: 1 streaming...

Interview with Dolores Ebner, November 9, 2011

Interview with Ken-Caryl Historical Society member Dolores Ebner. The interview focuses on the methods she used to research local history. Ebner...

Figure 2. Homepage of *Jeffco Stories* in Omeka. The collection is available at: <http://jeffcostories.omeka.net/>

Challenges and Lessons Learned

The migration of *Jeffco Stories* to Omeka and DuraCloud posed a number of technical and metadata-related challenges. The primary technical difficulty resulted from insufficient computer memory for multitasking during all phases of the transition. Individual record creation in Omeka allowed for both metadata creation and access file migration to be done in the same upload process. However, if any file failed to upload to Omeka, the entire record would need to be restarted when the error occurred. For this reason, metadata and file uploads could not occur at the same time. At a later stage of the transition, 597 additional files needed to be transferred into DuraCloud. These included the larger WAV master files, which took over an hour to upload. The other technical challenges of the project resulted similarly from the inability to work on multiple records simultaneously as the computer was very slow to shift between tasks in different programs such as Microsoft Word, Microsoft Excel, the internet browser windows, and Audacity. Institutions intending to maintain a digital collection as well as conduct in-house audio/visual processing should consider including separate, dedicated work stations in their budget. Oral histories, whether born digital or converted from analog tapes, need some level of audio processing, which requires computers with sufficient memory.

The mapping of MODS to the Dublin Core schema posed another challenge. The original metadata was created in the MODS standard, whereas Omeka uses Basic Dublin Core. The regional repository crosswalked the metadata from MODS to Dublin Core before the collection was returned to the Jeffco Library, which saved time when rebuilding the collection in Omeka. However, the CSV file included a number of errors, such as a mismatch of unique identifiers with recordings, the duplication of line items, and the offsetting of column entries. This was exacerbated by an inability to correct and save a new CSV file that could then be imported directly into Omeka through its CSV Import Plugin. Moreover, the subject headings were not consistent across records about similar topics, nor were many of the records adequately described in the description element. Due to these errors, the metadata had to be entered one record at a time, and time was lost that could have been spent improving and validating the subject headings.

Finally, robust metadata is critical to resource discovery and to providing a useful digital collection. Improving the quality of metadata in the *Jeffco Stories* collection was hindered by the problems with cross-walking metadata from MODS to Dublin Core. The robustness and accuracy of the searchable subjects vary by record, and there was little time in the transition process to improve them. Only 90 of the 163 oral histories have transcripts. It was not possible in the timeframe of the transition to listen to each of the remaining histories and develop additional subject headings and keywords. For new oral history collections and other digital collections, time must be dedicated to developing subject access points and confirming that the subjects align with the appropriate controlled vocabulary tools.

Discussion

Building digital collections is part of libraries' community-building mission and fulfills their role in preserving local cultural heritage. The Jeffco Library, in collaboration with community partners, was able to highlight regional history through recorded personal memories in *Jeffco Stories*. Migrating the collection to Omeka and DuraCloud allowed for continued access to these valuable

historical records. Moreover, the migration gave the Library greater control over the collection and digital assets. The Library had limited input and control over the design of the publically accessible website when it was hosted by the regional repository. While the Omeka.net platform is not perfectly customizable, as collection sites are built using display modules and cannot be further modified using HTML, there are options available to present the collection in a way that fits both Jeffco Library and user needs. The migration to DuraCloud also increased the Jeffco Library's control of their digital collection, as the Library staff is able to manage the files from an administrative interface.

While the preservation of the digital content was an important concern, the driving mission of the project was to provide the community with access to the invaluable oral histories that comprise the collection. Many of the considerations that directed the choice of a digital preservation solution also impacted the selection of an appropriate content management system for the online collection. For example, the Library's limited budget put a strict limit on the kinds of systems that could be realistically considered. A system that was both inexpensive and provided a user-friendly administrative interface was of primary importance to the Jeffco Library so that the building and long-term maintenance of the site would be practically and sustainably manageable for the Library. The solution also needed to support standard metadata schemas to facilitate the discovery of the content and it needed to provide a user interface that was intuitive and allowed for some level of customization. Because the Library did not have a developer on staff or a local server on which to store access copies, only hosted options were considered for the access solution.

While DuraCloud and Omeka were both practical choices for the preservation and access of this collection, both present some limitations. The selection of DuraCloud was based on the specific priorities of the Jeffco Library with consideration of both national standards for digital preservation and the digital preservation needs presented by the audio files themselves. In consideration of all of these sometimes-competing priorities, DuraCloud was a strong, but by no means perfect solution for *Jeffco Stories*. Audio files present a complex set of digital preservation concerns, not all of which are addressed by DuraCloud's offerings. A solution with file format monitoring and migration would have been preferable, as format obsolescence is a relatively high risk factor for audio files (Brylawski et al., 2015; Council on Library and Information Resources & Library of Congress, 134-135). Full OAIS compliance would require the creation of submission, archival, and dissemination packages, which would contain significantly more metadata that would aid in providing context, provenance, etc. for the files' future use. While these features would have been preferable, DuraCloud provides a basic level of digital preservation at a low cost to the Jeffco Library and does not require the Library to make any significant investments in local technical infrastructure or staffing.

Omeka.net is a lightweight solution designed with non-IT specialists for hosting smaller digital collections and exhibits and as such, has some limitations with regard to scalability and metadata customization. For the relatively small collection of 163 oral histories, these hosted services are sufficient, but for larger collections, Omeka may not be an ideal option due to its limited scalability. Basic Dublin Core provides a limited number of metadata elements, and those elements are not customizable in Omeka. Furthermore, while the more expensive service plans offer more themes and customization options, they too may be insufficient, as they do not allow

for further HTML and JAVA modifications of the code. Institutions intending to use more robust or more specialized metadata schemas will be required to crosswalk their metadata into Basic Dublin Core at the risk of losing the specificity of their data. Omeka does offer a local server platform downloadable from Omeka.org that has greater flexibility.

Conclusion

The case of *Jeffco Stories* demonstrates that building sustainable digital collections requires ongoing efforts in selecting and maintaining access and digital preservation solutions. In the changing technical environment, cultural heritage institutions need to be aware that digital collections cannot be maintained on the same platform forever and will eventually need to be migrated in order to monitor cost, maintain accessibility, accommodate new functionality, and comply with new standards. Evolving digital library technology poses many challenges associated with migration to new systems, but also offers new cloud-based solutions that enable smaller cultural heritage institutions with limited resources to participate in digital collection building and to manage their digital assets in standards-compliant digital preservation systems.

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