

ANALOG, THE SEQUEL: AN ANALYSIS OF CURRENT FILM ARCHIVING PRACTICE AND HESITANCE TO EMBRACE DIGITAL PRESERVATION

BY SUZANNA CONRAD

ABSTRACT: Film archives preserve materials of significant cultural heritage. While current practice helps ensure 35mm film will last for at least one hundred years, digital technology is creating new challenges for the traditional means of preservation. Digitally produced films can be preserved via film stock; however, digital ancillary materials and assets in many cases cannot be preserved using traditional analog means. Strategy and action for preserving this content needs to be addressed before further content is lost.

To understand the current perspective of the film archives, especially in regards to the film industry's marked hesitation to embrace digital preservation, the Academy of Motion Picture Arts and Sciences' paper "The Digital Dilemma: Strategic Issues in Archiving and Accessing Digital Motion Picture Materials" was closely evaluated. To supplement this analysis, an interview was conducted with the collections curator at the Academy Film Archive, who explained the archives' current approach to curation and its hesitation to move to digital technologies for preservation.

Introduction

Moving images are a vital part of our cultural heritage. The music, film, and broadcasting industries, as well as academic and cultural institutions, have amassed a "legacy of primary source materials" of immense value. These sources make the last one hundred years understandable as an era of the "media of the modernity."¹ Motion pictures and films were established as vital archival records as early as the 1930s with the National Archives Act, which included motion pictures in the definition of "objects of archival interest."² As cultural artifacts, moving images deserve archival care and preservation.³ However, the art of preserving moving images and film can at times be daunting. Fewer than half of the films made before 1950 survive today, and only an estimated ten percent survive from the 1910s.⁴ Saving these irreplaceable films of the past, and preserving the films made in the last few decades, are major undertakings for any film archives.

Fortunately, many studios and media corporations recognize that film archives can be profitable, especially in a flourishing home media market.⁵ A film can have a commercial lifetime that spans one hundred years, from theatrical release to the “Long Tail” of preservation when the film is re-released in various additional formats.⁶ Those individuals managing film archives also understand the necessity of trained specialists and employ professional archivists skilled in managing cultural heritage materials.⁷

Long-standing practices for preservation in professional film archives involve saving film stock masters in climate-controlled vaults. When stored and maintained properly, film can last over a century.⁸ Few, if any, digital archives have attempted to claim the same reliability with their digital collections.

Due to a viable and reliable preservation medium in film stock, the industry has not wholeheartedly accepted the principle of digitization—unlike their counterparts in broadcasting—or planned for future digitization.⁹ According to the Academy of Motion Picture Arts and Sciences, “the advent of digital cinematography, widespread adoption of Digital Mastering, postproduction workflows, and the studios’ push to deploy digital cinema distribution to theaters means that the cinema industry must reconsider its exclusive dependence on ‘film in a cold room’ for long-term preservation of its motion picture assets.”¹⁰

Furthermore, traditional film preservation methods cannot support the amount of material produced by current digital technologies. Many types of content are not suited for traditional preservation via film stock, such as game characters, scenery, or software, and leading digital cinema archives do not currently have a strategy for dealing with these “born-digital” works.¹¹ These works also face extinction as digital formats have shorter lifespans than film due to changing formats, software, and general life expectancy. Orphan films, for which the copyright holders are unclear or unknown, are at the greatest risk of being lost forever.¹²

Why does the film industry hesitate to embrace digital technology? Jerome McDonough and Mona Jimenez cite film archivists’ common belief that digital technologies have an “unproven status” as a preservation medium.¹³ Often the rate of technological change is so rapid that before expertise can be fully cultivated, the technology has moved in a new direction.¹⁴ The decision to use digital systems is also, according to the Academy, not accompanied by necessary planning or a complete understanding of the “potential impact of the digital revolution.”¹⁵ Simply put, for most archives analog film preservation is better understood.

Scope

To understand the perspective of film archives, this article presents a case study of the archival practices of one film preservation entity. The Academy of Motion Picture Arts and Sciences is one of the most respected non-profit institutions dedicated to the art rather than the business of film,¹⁶ and its responses are representative of the general landscape in industry film archives. In 2007, the Academy published a paper, “The Digital Dilemma: Strategic Issues in Archiving and Accessing Digital Motion Picture Materials,” which explicitly detailed its reasons for not prioritizing digital

stewardship.¹⁷ To confirm that the findings of this paper are still valid five years later, Fritz Herzog, the collections curator at the Academy Film Archive (AFA), shared his first-hand experiences and perspectives in this traditional analog film archive through an interview.¹⁸

The Academy of Motion Picture Arts and Sciences

Founded in 1927, the Academy of Motion Picture Arts and Sciences began curating film materials in 1929. It maintains collections from directorial masters such as Alfred Hitchcock, Cecil B. DeMille, George Stevens, Fred Zinnemann, Sam Peckinpah, and Jim Jarmusch. The Academy Film Archive was established in 1991 and currently holds all “Best Picture” winners from all years, as well as documentary winners and many Oscar-nominated films. The AFA also has a large collection of home movies, documentaries, early cinema, visual effects reels, Academy Award ceremonies and news coverage, and film festival materials.¹⁹

Most of the film collections at the AFA are stored on nitrate and safety stock. The Academy creates preservation or archival masters of the “35mm original camera negatives (OCN), interpositive (IP), and yellow-cyan-magenta (YCM) separations on black-and-white film stock stored in environmentally secure film vaults.”²⁰ Preserving the original film is a normal practice in many film archives, as it is the easiest way to retain all of the information from the original film and minimize copying, which produces degraded quality in comparison to originals.²¹ This “passive preservation” is the preferred method, as it avoids altering originals and ensures survival for future generations. In some cases, however, the film may have deteriorated to a point where it is necessary to duplicate it by implementing “active preservation,” which can include digital restoration, where necessary and appropriate.²² Additionally, the Academy makes copies available for public access that are not preservation or archival masters.²³

Film Preservation in Practice

As detailed by Karen Gracy,²⁴ the process of film preservation includes a number of steps: selection, acquisition of funding and resources, inspection and inventory of deposited items, preparation and duplication at labs, storing master and access copies, cataloging, and providing access to the film. Selection is a key point in this process and is most often a reactive process, as film is prioritized for preservation when it is most threatened. Frequently, decision-makers such as curatorial or management staff and preservationists, determine whether an item is deteriorating, unique, culturally or historically significant, orphaned, already preserved, or adequately preserved in order to ascertain whether or not the item should be preserved within their collection.²⁵ In Germany, Simone Görl reports that archivists are faced with evaluating whether an old and threatened source can be adequately conserved, and furthermore, if the source should or can be preserved.²⁶ Egbert Koppe, from the German *Bundesarchiv*, similarly outlines the necessity of determining the importance and value of the work, while also

listing identification of the material (i.e., type of film), assessment of the condition, and analyzing storage possibilities before acceptance as important steps in the process.²⁷ Essentially, archivists must ask themselves: how will this information be preserved; what is worthy of preservation and who makes that decision; what resources will fund the preservation; and in what form will the film be preserved.²⁸

The Academy uses many, if not all, of these principles to establish its preservation priorities. Its broad mission statement calls for the preservation and protection of films that illustrate the art and science of filmmaking, which allows for the inclusion of many different kinds of films.²⁹ Academy Award “Best Picture” winners and nominees are often included in AFA’s items to be preserved, due to its organizational affiliation with the Academy and the Oscars. Other types of films include Hollywood feature films; short subjects and documentaries; films of historical or cultural significance; abstract experimental films; and orphan films that have “fallen through the cracks” and are not owned by a major studio, or films for which the producers do not have the resources to preserve them properly or store them for the future.³⁰

According to Fritz Herzog, two key questions are asked when determining what items to prioritize at the AFA: what is unique, and what is in danger of being lost due to damage, such as vinegar syndrome and fading color? Projects funded in collaboration with studios or by grant money are frequently prioritized. Funding is limited, and the Academy has a preservation department with just three people, so only a limited number of titles can be processed in any given year. The Academy preserves an average of 50-60 titles each year, including short subjects, home movies, video productions, and feature films.³¹

When handled carefully and stored in a climate-controlled environment, film can be “stored and ignored.” However, many titles have been printed on extremely flammable nitrate or acetate, which can become brittle, curl, and fall victim to vinegar syndrome as they age.³² Best practice at most film archives, including the AFA, has been to transfer to polyester stock when the film is deteriorating and to store the preserved stock in cold vaults.³³

At the AFA, the intake process for any deposits includes the inspection of the “photographic and physical integrity” of the item, sometimes through viewing the print to confirm that all elements are intact, and logging basic asset management information. This log includes: title of the film; information about the reel; element type, such as OCN or IP; version description (director’s or editor’s cut, for example); type of program (theatrical, television, or cartoon); aspect ratio; and unique bar code identifier.

Koppe has published details on how film is handled upon receipt, including classification and cataloging procedures; testing and marking nitrate film; fireproofing for nitrate film; cleaning dirty film; handling shrinkage; and dealing with film stock joined together with tape. Koppe’s archives does not handle any digitization of film; rather, this process is outsourced to a vendor.³⁴

One area where the Academy and others have embraced digital technology for preservation purposes is in the field of restoration. Digital restoration is utilized to address problems that cannot be fixed with traditional photochemical restoration. According to interviews conducted by Arianna Turci, film can be repaired to the smallest image and sound elements, making it possible to recover films in their entirety.

Many archives utilize digital preservation tools and attempt to best represent the original film version wherever possible.³⁵ Herzog also confirms that the Academy uses digital tools to restore segments that cannot be fixed using traditional photochemical laboratory methods. After the film is restored digitally, it is scanned back onto film stock for preservation.³⁶

Problems with Digital Preservation

The practice of analog preservation of film stock is well understood, with processes and guidelines such as those presented in the National Film Preservation Foundation's *The Film Preservation Guide*³⁷ on the British Film Institute archive's Web sites,³⁸ and in Koppe's articles on the German *Bundesarchiv*.³⁹ But digitization as a preservation alternative is not well-understood by film archivists. Although curators acknowledge the importance of digital preservation for the future, they seek a clearer understanding of the prerequisites or existence of standards.⁴⁰

Only three suppliers are currently distributing film: Agfa, Kodak, and Fujifilm. One of these—Kodak—had been developing technology to surpass and out-perform existing high-definition technologies, and the company had been “investing strategically in a broad variety of digital technology”⁴¹ until it filed for bankruptcy in early 2012 because it could not compete with digital film technology. Since 2003, Kodak has shutdown production of film, paper, and chemicals in 13 factories.⁴² The immediate future of stock film production at Kodak, and other similar companies, is currently unclear. According to the Academy, “the demise of film is a long-term eventuality.”⁴³ Charlotte Crofts asserted in 2008 that the traditional film business has only ten more years of growth before digital technology becomes the standard.⁴⁴ The eventuality of discontinued production of film stock⁴⁵ may become a reality before digital preservation becomes “affordable, reliable, and technically adequate.”⁴⁶

Digital assets are extremely fragile. Howard Besser outlines three factors that compromise digital assets' preservation. Firstly, physical storage media require scheduled refreshing, and file formats can become obsolete in less than a decade. Secondly, clear custodians of the content may not be defined, e.g., no specific stakeholders may have been entrusted with the task of ensuring the content's long-term existence and accessibility, nor has it been determined that stakeholders, if identified, have the proper experience to do so. Lastly, translation problems may render the assets less accessible because copies are not originals, screen sizes can change, and other problems.⁴⁷

The Academy has identified a number of technological threats associated with digital assets management, including data integrity, monoculture vulnerabilities, obsolescence, limited or no data compression, and risk of encryption key loss. Digital assets are also susceptible to human errors, including operator error and malicious actions.⁴⁸ Digital assets can often be the solution to current film archives' access problems; however, for many of the above-mentioned reasons, as well as others, digital assets are not as robust for film preservation as are current methods.⁴⁹

The Academy stipulates that in order to consider digitization as a viable preservation route, a digital archives system must meet or surpass a traditional film archives' performance. Such a system should allow items to be accessible for more than one hundred years, thereby allowing a "store and ignore" policy. Other system requirements include the ability to create duplicate masters for future sales, equal quality standards between the digital and film versions, and non-existence of proprietary technology dependencies. Furthermore, it is necessary to establish a standardized set of principles, which can be accepted across the industry as a whole.⁵⁰

The Academy is not the only film archives that is hesitant to implement digital preservation. In a 2008 interview accessible on the UCLA Film and Television Archives Web site, Director Jan-Christoph Horak stated, "[A]t this point we don't do any digital preservation ... we don't even use digital as an intermediate step for film preservation." Furthermore, Horak asserted, "[T]he profession at present does not have a stable, archival digital preservation medium."⁵¹ In November 2010, UCLA held a three-day symposium on "Reimagining the Archive: Remapping and Remixing Traditional Models in the Digital Era." In Horak's introductory letter to that symposium, he admitted that the majority of the archives' more than half-a-million holdings were currently only stored in an analog format. While the archives hoped to initiate a digital laboratory for the scanning of film material, Horak wrote, it needed first to develop methods for digital archiving. He further stated his wish that the conference serve as a means to initiate a dialogue between academics and archivists on these issues.⁵²

Major film preservation institutions, such as the National Film Preservation Foundation and the Association of Moving Image Archivists (AMIA), have notably omitted references to digital preservation as an alternative in their film preservation guides. For example, in its guide, the National Film Preservation Foundation only notes digital restoration technology in passing. The guide was published in 2004 and therefore may be outdated, but it is still the main publication on the foundation's Web site. The omission of digital preservation references may also indicate the foundation's current rejection of digital preservation technology.⁵³ Similarly, the AMIA makes no reference to digital preservation technology in its on-line documentation "Storage Standards and Guidelines for Film and Videotape,"⁵⁴ nor is the topic mentioned in its documentation on home film preservation.⁵⁵ Articles appearing in the organization's publications *The Moving Image* and the *AMIA Tech Review* do discuss digital preservation; however, AMIA does not appear to have adopted any standards in this regard in any of its on-line recommendations.

The Library of Congress (LOC) also appears to be in the research and development phase of digital film preservation, as it is developing a prototype project for digital archiving. According to Ken Weissman, supervisor of the Film Preservation Laboratory, the LOC is prepared to continue operating as a film-based laboratory even when other film laboratories discontinue their use of film stock.⁵⁶ The Library's facility in Culpeper, Virginia, includes 90 miles of shelving, 35 climate-controlled vaults, a conservation building, and a nitrate facility, which demonstrate the LOC's commitment to long-term physical film storage. In contrast, the LOC has displayed an interest in videotape digitization with its System for Automated Migration of Media Archives (SAMMA), and no film equivalent seems to be on the immediate horizon for the LOC.⁵⁷ While the

Library is partnering with film preservation organizations, none of these efforts appear to focus on solving the dilemma of digital film preservation. The LOC's partnership with the Academy of Motion Picture Arts and Sciences is dedicated to authoring the Image Interchange Format, which will provide a toolkit for digital motion picture work flow and color management, not digital preservation.⁵⁸

Many state and university archives are similarly hesitant to embrace digital preservation for film, except in rare cases. At Washington State Libraries (WSL), for example, the digitization of historic films focused on issues of access, not ensuring long-term preservation. In WSL's project, three digital formats were created for on-line films, and a 920 GB hard drive was purchased for temporary storage, with backups to a secure server scheduled weekly. While there were efforts made to create digital redundant copies, it is clear that long-term preservation was not the purpose of the WSL project and digital preservation was not a project goal.⁵⁹ Similarly, the Texas Archive of the Moving Image (TAMI) digitized films with significant historical value for access rather than preservation.⁶⁰ In its on-line resource, the "Home Media Preservation Guide," TAMI stresses that one should not discard originals, as digitization is for access rather than for preservation.⁶¹

Film archives in Europe are more interested in digital preservation technologies, and some archives are actively preserving certain films in digital form. EDCine, which is predominantly a European organization, considers digital film preservation one of its priorities.⁶² In 2006, Arianna Turci surveyed several European film archives' digital preservation efforts. These archives all expressed concerns regarding preservation standards for digital objects, and were at that point wary of adopting a digital-only stance towards both film preservation and restoration.⁶³ In a 2005 interview, the British Film Institute (BFI) stated that it only used digital technology for "restoration and access purposes," not for preservation.⁶⁴ In 2010, the institute's Web site claimed that it was "starting to preserve material in various digital file formats, held on disc or LTO datatape."⁶⁵ In 2011, the German *Deutsches Filminstitut* asserted that in order to address the challenges faced by the movement toward digital formats, it was investing in technologies not only for creating access, but also for long-term preservation.⁶⁶ While there is more of a commitment to digital preservation within the European-based national film archives, the developments still appear to be in their infancy.

Obsolescence

The film industry's hesitance to embrace digital preservation technology has led Charlotte Crofts to conclude that "digital assets are at just as much risk of decay as those originated on film, if not more so."⁶⁷ Obsolescence of equipment and formats is the top reason Herzog cites for not considering digital formats as a current preservation strategy. Keeping a digital copy means "asking for trouble further down the line," Herzog maintains, as the disc, memory card, hard drive, or software required to run it may not be available. Formats may be unrecognizable when accessed in the future. Software is dependent on proprietary systems that "come and go," and many studios that bought into the digital storage systems are finding that archived files are simply not

playable anymore.⁶⁸ It may also be necessary to archive the digital tools along with the digital data or media to ensure access. According to the Academy, “accessing the data stored on digital media requires access to the digital tools that ‘go with’ the archived data.”⁶⁹ In this sense, it is not possible to “store and ignore” a digital asset.

It is also uncertain what stakeholders need in order to prevent corruption and maintain data integrity, especially during migration necessitated by potential obsolescence. Howard Besser suggests three types of approaches be used to deal with the problems of changing file formats; specifically: migration, or “periodically moving files from one encoding format to another that is useable in a more modern computing environment”; emulation or mimicking of old software to show new file formats; and “refreshing,” in which both migration and emulation are both utilized.⁷⁰ It may also be important to make the technical specifications of files available for clarity on how a file is encoded, and also to clearly understand if file migration can be executed without corruption.⁷¹

Storage

Digital media files, especially digital film files, can be exceedingly large, especially if they are not compressed. Although storage costs are falling, it is still expensive to maintain large files. The preservation of digital media necessitates prioritizing either space or quality. Compressed files save space, while non-compressed files preserve the aesthetic qualities of the content.⁷² JPEG 2000 is one alternative for saving both photographic and moving image formats as quality graphics content; however, the economic feasibility of such a large collection is questionable, at least until storage costs become even less expensive.⁷³

Storage solutions are also affected by technological obsolescence. In the case that the storage medium is no longer the market standard at the time of preservation, a suggested preservation method is to copy all moving images to the second system before the new technology has surpassed its predecessor.⁷⁴ Both staff resources and funding must be budgeted for the future at the time of preservation, as the storage and personnel costs extend indefinitely over years.

Even if multiple copies are maintained, there is no guarantee that the items are adequately preserved. Digital assets are susceptible to corruption with no existence of an inviolable master.⁷⁵ Content, even stored in multiple copies, exists without an artifact. Without an artifact, these assets are at great risk of corruption and loss.

Additionally, some scholars, such as Rosemary Bergeron, do not assume that digital media will wholly reproduce motion picture film stock’s aesthetic qualities, and they question the viability of moving to digital media to truly preserve the art of the motion picture.⁷⁶ Others state similar concerns as digitization may lead to a reduction of the data and thereby a loss of the original character of the film.⁷⁷

Costs

According to Herzog, a second long-term issue with digital preservation is cost. He states that archives are conservative with their resources, so there is little room for experimentation, and the technology is too uncertain to warrant heavy investment.⁷⁸ According to the Academy, “The ongoing costs of storage technology trend down while the costs of data management services, labor and power increase as a percentage of the total cost of ownership.”⁷⁹ In general, scholars cite a misconception about the cost of digital collections, since scanning, color correcting, and any other required processes are not cost-neutral.⁸⁰ In 2007, the Academy estimated that a film archival master cost \$1,059 per year, per title, to maintain and store, whereas a 4K digital master might cost upwards of \$12,514 per year per title.⁸¹ It is cost-prohibitive to move to digital solutions when faced with hefty price tags and an uncertain future.

Standards

Due to the rapid development of digital technology, it is difficult to find a “stable and universally accepted digital format, codec, compression rate, and/or associated film playback equipment.”⁸² The Library of Congress established a list of suggested formats to accommodate a wide range of implementations, such as QuickTime, MPEG-4, MPEG-2, SWF-7 for animated shorts dynamically generated, GIF_89a with less frames, DPX_2, and MJ2_FF with frames encoded as separate files or entities. According to the LOC Web site on the sustainability of digital formats, “clarity and fidelity characteristics (bitstream encoding) should be used as the primary consideration; choice of file formats as secondary.”⁸³ Even though national entities are attempting to establish best practices, this is still a work in progress.

In addition to necessary standards for formats and properties, further criteria need to be considered for metadata. Quality metadata are required to support information retrieval, and to date, no “one size fits all metadata” standard has been developed.⁸⁴ Clearly, attention must be paid to developing standards for metadata and educating not only archivists, but also content creators.

Legal Issues

Digital preservation also has its fair share of legal issues, especially because it is unclear if multiple copies are needed to protect against the potential of data loss. In addition to the U.S. Copyright Law’s Section 108 regarding preservation exceptions available to libraries and archives, the U.S. House Report No. 94, which provides legislative background for the 1976 Copyright Law, suggests that preservation copying of film, e.g., from nitrate to safety film, could be considered a defensible “fair use.”⁸⁵ Such copying would be “necessary for the purposes of retention of the material to keep it from physically deteriorating or being destroyed, unless the film was otherwise copied onto safety stock.”⁸⁶ Although employing a fair use defense can be complicated,

it does have advantages in film preservation because when archivists restore films, they may need to modify the content, thereby creating a derivative work, which is not covered by the Section 108 preservation exceptions. Otherwise, as Eric Schwartz has noted, there is no differentiation in copyright law between restoration and preservation. Nevertheless, archives can reference both exceptions from Section 107 on fair use and Section 108.⁸⁷ Section 108 specifically allows for making up to three preservation copies of a work for purposes of replacement, although any digital copy cannot be made accessible to the public outside the preserving library or archives. This section requires that the institution copying the work must own the work, must be open to the public, and must carry forward any copyright notice from the original to the copy.⁸⁸

The Academy Film Archive currently requires depositors to complete an agreement clarifying ownership of the items deposited. Items on deposit are owned by the depositors and are considered to be on loan to the AFA. If the AFA wants to screen the deposited works, written clearance is acquired in advance.⁸⁹ According to Herzog, the AFA physically owns the film prints and deposited items but does not own the rights to the contents (with the exception of the Academy Awards and some home videos deposited by film industry professionals). The AFA cannot make copies or sell any content, but because of fair use doctrine, it can share materials for educational purposes on site. To loan to outside parties, it must get permission from the copyright holder in advance, which generally requires payment of a fee.⁹⁰

While it is apparent that making one copy for preservation purposes is acceptable within the current scope of film archives, it is unclear how copyright laws apply to digital assets, as many scholars suggest that adequate backups are needed to ensure the availability of the content. Archivists need to stay informed about whether or not they have sufficient rights to keep the resource accessible, either by determining if the item is in the public domain, or by clarifying copyright issues with the holder.⁹¹

The Digital Dilemma

Many organizations cannot maintain the pace of preserving their current data, and these needs are only growing.⁹² There is hope of improving. Currently expensive processes can become more cost-effective over time, thereby increasing the likelihood of long-term sustainability.⁹³

Digital assets have to be treated dynamically, and no industry has figured out how to do this without sizable and continual financial backing. Industries that the Academy uses as examples of this inability to find digital assets solutions include other economic sectors, such as medicine, earth science, government, corporate businesses, and supercomputing. Initial forays into digital assets management in these sectors have proven that while every enterprise has similar problems and issues with digital data preservation, “no enterprise yet has a long-term strategy or solution that does not require significant and ongoing investment and operational expenses.”⁹⁴ The Library of Congress may incentivize both public and private institutions in the future to encourage them to undertake digital preservation.⁹⁵ Based on the actions of other economic sectors

as well as the interests of the Library of Congress, digital preservation is a concern not limited to the film industry.

The Academy states that unresolved issues experienced by other industries must be addressed before committing to digital curation as a preservation practice.⁹⁶ These issues include: to curate in-house or to outsource as practiced by the German *Bundesarchiv*;⁹⁷ to determine if data compression is or is not important; to articulate what data should be saved and what can be discarded; to standardize the level of geographic separation necessary to maintain server reliability; to resolve whether both the primary and backup archives should be connected via a network; and to decide if standardized file formats are necessary. Furthermore, the Academy calls for establishing best practices in digital preservation.⁹⁸

The British Film Institute is attempting to balance analog and digital deposits.⁹⁹ Due to problems with digital storage media and rapidly changing storage devices and file formats, the institute produces analog or sub-masters use copies to protect its fragile digital assets.¹⁰⁰ These efforts indicate an acknowledgement that while digital technologies are not as reliable or robust as analog film archiving practices, digital curation will have to become a suitable preservation alternative.

A suggested approach for digital film archives is “systematic digital ingestion, storage, preservation, and access to digital objects that can be indexed and searched.”¹⁰¹ However, no current media, hardware, or software that can ensure long-term access exists at this time. Despite this challenge, archivists must be trained to evaluate new material, structure, and costs; to manage funding over the long term; and to maintain digital archives.¹⁰²

The problem of digital preservation will not get simpler; rather, it will become more difficult. The collection of data and creation of content has accelerated, while digital resources have grown increasingly complex. More and more films are being shot digitally, which means there are more files, more moving image products with ancillary material, and an increasing need to locate digital fragments for reuse and repurpose.¹⁰³ Not only are more films being created, additional ancillary material continues to be generated. The Academy has acknowledged the challenges associated with the preservation of ancillary materials, such as the digital equivalents of “B negatives” (raw footage not included in the original developed film), trims and out takes, and other supplemental digital material.¹⁰⁴ Preserving special effects data, along with the software used to create the data, can be valuable to understanding the history of film. A new paradigm is required by archivists to manage not only digital films, but also items that together complete the work as a whole.¹⁰⁵

According to the Academy, “digital archives are only truly protected by redundant replicas of the structured assets themselves;” thus, the transition to digital will follow the example of audio preservation.¹⁰⁶ Ancillary materials, such as digital tools for visual effects and animation, postproduction files, and others, will need to be preserved in a similar manner. The transition to digital is inevitable, due to the existence of Digital Cinema theaters and digital cameras in commercial use that are equal or better than the quality of 35 mm film.¹⁰⁷

In this uncertain atmosphere, archivists must stay relevant and use their existing skills¹⁰⁸ to transition or balance between analog and digital technologies.¹⁰⁹ Creators

and producers do not necessarily understand the principles of film archiving,¹¹⁰ and it may be necessary to convince rights holders that digital assets and ancillary material need to be preserved if 35mm prints are not suitable for digital projects.¹¹¹ Through discourse with creators and rights holders, the archives remain essential even when digital technologies are embraced. To remain relevant in their fields, film archivists must continue to acknowledge the challenges faced in digital preservation of moving image materials and look for solutions for the future. The academic world is responding by creating educational programs to prepare archivists to deal with digital media materials, as shown in the establishment of New York University's (NYU) Moving Image Archiving and Preservation Program.¹¹² Through education, awareness, and acknowledgement that some transitional strategy may be necessary, film archivists can ensure the need for their skills in the future.

The Future

Is this commitment not to commit to digital preservation enough for the film industry today? Not only are existing digital assets endangered, but film archives themselves also run the risk of becoming obsolete if digital technology is not embraced. According to Dylan Cave, "archives have to sit comfortably in both traditional and digital realms in order to justify the cost of caring for their vast holdings." The film archive should maintain possession of materials already deposited as a means of ensuring advantages during negotiation with rights holders so that forthcoming deposits are protected.¹¹³ Currently, digitization is only a quick answer. A preferable approach is to develop a "unified strategy of stabilization, active conservation, passive subzero storage, and preservation by duplication."¹¹⁴ One suggested simple approach is to preserve ancillary materials on hard drives with a clear migration strategy, which should overcome technological obsolescence until the aforementioned digital preservation strategies have become more stabilized.

The pressure to create distribution libraries for digital platforms in the film industry is palpable. Sony and Warner are both establishing digital libraries for distribution purposes (ATLAS and DETE, respectively). Unlike digital media distribution libraries, digital media archival materials will likely be "full pixel count, full bit-length, uncompressed, and unencrypted."¹¹⁵

Current Academy collaborative projects include: research on issues encountered with digital preservation; the development of standardized digital file formats; the creation of an established system for reporting case study successes and failures with digital preservation; and the move to encourage increased and positive interactions amongst shareholders.¹¹⁶ Timelines for developing solutions to these issues were not addressed within the Academy's report, nor was any commitment made to even partially move to digital preservation.

The Academy is continuing to create film separation masters from any and all content, including digital assets received which are transferable to film stock. It is also monitoring other industries' experimentations with digital preservation and the resulting best practices. The Academy would like to see other industries establish

rational strategies for digital stewardship. Once these strategies are developed, the Academy will encourage open discussion in the film industry to facilitate studios' agreement on best practices. In the meantime, the Academy recommends that digital assets be actively protected by robust systems developed for continual evolution, which possess a diminished risk of technical obsolescence.¹¹⁷

Conclusion

Film archives hold materials of immense cultural value, and many institutions, such as the Academy Film Archive, are committed to preserving the art of filmmaking. Current practice ensures that 35mm films, documentaries, short subjects, and any materials that can be transcribed onto film stock remain available and accessible for at least one hundred years. Few other industries have the means or materials to compete with this kind of reliable preservation strategy. It is therefore understandable that this industry hesitates to embrace the tumultuous and ever-mutating technologies for digital preservation. However, due to the prevalence of digital technologies in filmmaking, both in production and postproduction, eventually the industry will have to develop solid strategies for digitally preserving this content.

While digital films can be curated via film stock, the additional ancillary materials and assets cannot, in many cases, be preserved in this way. These ancillary materials are also culturally valuable and instrumental in documenting this generation's filmmaking practices. Strategy and action for preserving ancillary content and assets must be prioritized to ensure that no further content is lost.

A review of literature from multiple sources, an interview with the Academy Film Archive's collection curator Fritz Herzog, and a review of the Academy's literature, make clear that a transitional strategy of balancing between analog and digital preservation is needed to ensure maximum coverage of moving image data. Meanwhile, continuing to preserve digital and 35mm films, documentaries, and short subjects on film stock will ensure that these data remain safeguarded for the future. The experience gained from preserving content with both analog and digital technologies can guide the eventual shift to complete digital preservation, whether in the next decade, or in the next one hundred years.

ABOUT THE AUTHOR: Suzanna Conrad is a recent graduate of the G.S.L.I.S. program at the University of Illinois, Urbana-Champaign, and is an independent information professional based in Los Angeles. Her recent projects include taxonomy and search for Guitar Center, and the implementation of a city documents database for the City of Sierra Madre, CA. She is the current chair of the Information Technology Interest Group for the California Library Association. Conrad has completed internships in digital project management at Monterey Park Bruggemeyer Library, instructional Web site design and development for Purdue University Libraries's Data Curation Profiles (DCP) Toolkit on-line workshop, and digital reference at the Library of Congress. Her corporate background includes mobile media product management for RTL interactive

GmbH in Germany; content acquisition and content back-end integration for Mobile-XL, a Los Angeles-based mobile application developer; and business development for multiple telecommunications and games industry companies in the U.S. and abroad. Conrad also holds an M.B.A. from the University of East London and a bachelor's degree in history from Cornell University.

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