

The New Nitrate:
Scaling the Inequity of Digital Film Preservation

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Abstract

This thesis project will examine the ways in which Hollywood's adoption of digital filmmaking and distribution over the past two decades has created unforeseen inequalities between two groups: on one side, the major film studios, music labels, and other entertainment companies, and on the other, independent filmmakers, musicians, multimedia artists, and online content creators. Specifically, it will highlight how digital technology has made it harder for independent creatives to archive and preserve their work, due to a number of factors related to budget; a lack of resources and education; a lack of assigned responsibility as to who should be archiving digital films; and an ever-changing technological landscape where important tools and devices reach obsolescence more quickly than ever before, and where there is pressure to adopt new technologies for creative work before they can be properly implemented and standardized. An important aspect of this as well—one that is often overlooked when discussing archiving digital films—is how the line between professional and amateur content has blurred thanks to the internet, and how it cannot be solely the responsibility of professional archivists to determine which digital content should be preserved, let alone take on the task of actually preserving it. I hope that by acknowledging the differences between digital archives at major film studios versus the archival practices of independent filmmakers—besides the obvious differences in budget—I can bring awareness to how valuable digital assets are in this day and age, and how by sharing this information with filmmakers, we as archivists can, I think, more helpfully impart some of our knowledge unto them and normalize basic preservation strategies among everyone who creates digital video.

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Introduction

Why did I title this thesis "The New Nitrate"? If you've read up to this point, you've likely figured out that this is not really a paper on nitrate film at all, but rather a research project focused on digital preservation for filmmakers—and, hopefully, one that could be legible to filmmakers with little to no experience in digital preservation as well as seasoned archivists.

My title feeds into that idea of outreach and communicating important archival concepts to filmmakers and digital content creators. I wanted to come up with a historical, analog film comparison for the ongoing digital preservation crisis that we face today, and honestly, nitrate is about as evocative as you can get. If you only know one thing about nitrate film, it's likely the fact that nitrate is highly flammable and is known to deteriorate quite easily. This is why it's estimated that 80-90% of the films made during the silent era, including studio films, are completely gone—that, and also, what constituted the film industry back then did not possess the same knowledge or care when it comes to film preservation that the studio behemoths do today.

But truthfully, nitrate is far from the only vulnerable film or moving image format to have ever existed. Looking back at the 100-year history of film, the likelihood of a film's survival isn't always determined by the material it's made out of. In fact, more often than not, it has had more to do with who made the film, on what budget, and whether or not there was any sort of institutional or corporate apparatus that ensured its long-term preservation. In the world of audiovisual media, amateur home movies have historically been the most vulnerable materials when it comes to preservation, and with the onset of the digital age, we are now producing more home movies than ever through the use of smartphones and social media platforms, in which video has become the dominant form of communication.

Because social media and other emerging technologies have become such a dominant force in our lives, it's no wonder that many artists, including filmmakers, have utilized these platforms for their work. This is partially a matter of convenience—all it takes to shoot a video now is to press a button on your smartphone—but it also makes logical sense why filmmakers and artists would want to adopt our primary form of communication for their creative work. Sean Baker famously shot the entirety of his 2016 film *Tangerine* on an iPhone, but since then, there have been countless examples of films, documentaries, advertisements, music videos, art installations, TV news segments, and more that were fully or partially shot using phone cameras, especially during the Covid-19 pandemic, when smartphone photography offered a cheap, relatively safe option for film production.

Additionally, filmmakers and artists have formed partnerships with online platforms such as YouTube and TikTok in order to not only receive funding for their work, but also to utilize the software from those proprietary platforms in unique and creative ways. While interning at the Los Angeles County Museum of Art in 2022, I helped document and map out a preservation plan for Ada Pinkston's *The Open Hand is Blessed* (2021), an installation centered on the Black entrepreneur Bidy Mason that was created using Snapchat's proprietary augmented-reality software. Virtual reality artworks have similarly proliferated over the past few years; Alejandro Iñárritu's *Carne y arena* (2017), also exhibited at LACMA, is sure to be one of many examples of VR installations by prominent filmmakers. Even filmed works created with more conventional video technology may still be distributed through online platforms with innovative rollout strategies, such as Spanish music artist Rosalía's *Motomami* short film, created as a tie-in to the 2022 album of the same name. Shot entirely on iPhones, the high-budget music video production premiered on TikTok Live (albeit as a prerecorded, edited work), and later was uploaded in full

to Rosalía's YouTube page. In the past few years, the ongoing Web 3.0 explosion and developments in blockchain technology have created even more ways for filmmakers to distribute their work, with 2021's *Zero Technology* becoming the first feature film to be released as an NFT. While it's easy to write these developments off as a fad, it goes to show how we cannot predict the myriad ways that digital film will be distributed to consumers in even the near future.

But all of this comes at a cost, which is that filmmakers become bound to the ephemerality of digital media. Content on these platforms will only last as long as these platforms. Furthermore, digital video is not built to last in the same way that physical film or even magnetic tape formats are built to last, and this is the case no matter the quality of the filmmaking equipment or digital file formats. On top of that, this problem has only gotten worse as the line between professional-grade and consumer-grade continues to blur. Even as digital video platforms such as YouTube and Vimeo allowed for filmmakers and content creators to share their projects more freely than ever, these distribution platforms are often mistakenly treated as archival libraries. This means that, unless filmmakers are taking responsible archiving into their own hands, much of this content that we currently can access on proprietary platforms may be lost to the future. All of this is to say, it's important to recognize the many facets of digital filmmaking as it currently stands before examining how best to archive it going forward.

In this paper, I will first give a brief overview of the history of digital filmmaking and distribution in Hollywood, followed by an analysis of why studios put so much investment into their archival assets and how digital preservation and distribution has allowed them to extract as much value from these assets as they can. I'll go over the benefits and drawbacks of digital preservation on a large scale and why studios continue to preserve both digital files and, in some

cases, physical film, though there's some evidence to believe they'll abandon the latter practice in the coming years. Then I'll compare the studios' strategies to that of independent filmmakers and content creators, highlighting the challenges they face in preserving their born-digital work. Finally, I will give some short-term and long-term recommendations for archival practices for independent filmmakers, but I will also share some of my thoughts about how archivists can conduct outreach into these industries so that people understand the value of preserving their digital work.

I want to note that my thesis is focused primarily on the American film industry, aka Hollywood, and also that my topic mainly focuses on born-digital works, although most if not all of my recommendations could apply to digital scans and copies of works that were originally shot on film. It also goes without saying that any recommendations on digital works are inherently welded to the time at which they are written. Digital and web-based video technology is constantly changing and, subsequently, providing new foundations for creative works, and many of my observations and recommendations may need updating, or even be outdated, in the span of just a few years. That's why I want to stress that digital archiving, by its very nature, requires staying up-to-date on current technologies and future-proofing digital works as best as one can.

I. Capital in the Archive: Or, Why Studios Are Saving Everything

1. A brief history of Hollywood's transition to digital

When Hollywood began its serious transition from film to digital distribution in the early 2010s, it was through a coordinated effort that had been ironed out for years, in meeting after meeting, between major studio executives and film exhibitors. But while the actual switch between film and digital projection happened very quickly in just a span of a few years in the early 2010s, the build-up to it was a long time coming.

Technically, the first entry point for digital in the film industry was through writing—by the 1980s, screenwriters were very accustomed to writing their scripts on word processing programs. Computer-generated imagery showed up on film screens much more gradually. Stanley Kubrick adopted very early motion stabilization software for *2001: A Space Odyssey* in 1968, and the first *Star Wars* film in 1977 perfected this technique, along with other breakthrough digital effects. By the 1980s, digital audio production and engineering had become standardized, and was quickly adopted by theatrical sound manufacturers like THX. In 1984, George Lucas introduced a nonlinear editing software called EditDroid to the market. An initial flop, EditDroid was then sold by Lucas to Avid Technology in the early 1990s, retooled, and rebranded as the Avid editing software, becoming a commercial success, if not the industry standard for editing.¹ Eventually, editing softwares allowed users to color-grade their scanned films on the computer, which made the products even more attractive to studios and amateur

¹ Scott Kirsner, *Inventing the Movies: Hollywood's Epic Battle Between Innovation and the Status Quo, from Thomas Edison to Steve Jobs* (CreateSpace Independent Publishing Platform, 2008), p. 82.

filmmakers alike. And of course, there was Pixar, a division of Lucasfilm that developed a landmark computer-image rendering software, RenderMan, and which pushed the boundaries of CGI technology with their short films and TV commercials, and eventually with their first feature-length film, *Toy Story*, in 1995.

Even with all these integrations of digital technology into the film production workflow, by the late 1990s, movies were still being shot on film, and movies were, by and large, still being projected in movie theaters on film. George Lucas, not yet satisfied with his numerous contributions to digital cinema, wanted to change that. When he started production on the first *Star Wars* prequel film, 1999's *The Phantom Menace*, he asked Sony to design a prototype HD camera for the film. The cameras weren't ready in time for production—they wouldn't be available until *Attack of the Clones*—so Lucas ended up shooting the movie on 35mm, but rather infamously manipulated nearly every shot with computer-generated effects and touch-ups. And when it came time to distribute *The Phantom Menace*, Lucas wanted it to be shown on digital projectors. In June of 1999, he managed to convince four theaters to digitally screen the film as a demonstration of new digital projection technology. At the time, this was largely scoffed at in the industry. Theater owners saw the implementation of the new technology as a waste of time, the digital projectors did not surpass film in terms of image quality, and studio executives agreed that this felt like a vanity project.

But there was one thing that got the film industry to rethink digital distribution: piracy. Just as with music, torrenting websites were emerging where consumers could illegally download movies for free online. It was the combination of these sites along with the arrival of consumer digital recording devices, such as handheld MiniDV cameras, that really pushed Hollywood over the edge. Bootleg VHS tapes of films had long been a piracy problem for

studios, but now, anyone with a video camera could go to a movie screening, document the film that was being projected, and then upload that digital footage online. These so-called "auditorium versions" of films were as poor-quality as you can imagine, but they became popular in Eastern European and Asian markets, where official home video releases of these films in native languages were hard to come by. Other, better-quality forms of piracy came from film prints that projectionists could smuggle out and print to video, and still more came from post-production houses, where anyone with access to the in-progress film files could download them and send them out over the internet. So really, it *was* the advancements of digital technology that forced Hollywood to adopt it, but those advancements were in the savvy implementations of digital technology by consumers, not in any supposed jump in image quality with digital film.

In May 2002, Disney, 20th Century Fox, Paramount, Sony, Universal, and Warner Bros. all banded together to form the corporation Digital Cinema Initiatives (DCI), which would strategize how to implement digital projection to their advantage. The studios had three main goals for this project. One, standardize the projection technologies that were coming to market and being implemented by theater owners. Two, ensure reliability and minimize the performance issues that had been exhibited by digital projectors so far. And three, tackle piracy by ensuring that the distribution system was airtight. Digital copies of films would be transported to and from theaters in what came to be known as digital cinema packages, or DCPs, which were encrypted to prevent piracy during transit.

There was another goal that was inherent to this entire strategy, which was to strongarm theaters into adopting the studio-approved technology en masse. This proved to be difficult without the adoption of digital technology by leading industry creatives—in other words, leading industry moneymakers. Around the time that the DCI wrapped up their negotiations in 2005,

theaters were still dragging their feet on adopting digital projectors, but luckily for the studios, several big-name directors stepped in to champion the implementation of digital filmmaking. Lucas, of course, had long been on the digital bandwagon, but other directors such as Peter Jackson, Robert Zemeckis, and Robert Rodriguez promised theater owners to release their upcoming digital films in 3D in order to entice audiences to their multiplexes, as long as theaters held up their end of the bargain and installed digital projectors in their auditoriums. James Cameron made similar promises to theater chains by claiming that if they let him release his upcoming, very ambitious digital film project, *Battle Angel*, in 3D, he would make them a billion dollars. Of course, *Alita: Battle Angel* would not be released until 2019, as Cameron realized that CGI technology had not fully caught up to his vision for the project. So he turned to a script he thought would be slightly more manageable: *Avatar*, which, with breakthrough special effects that made an immersive spectacle out of its digital world, went on to become the highest-grossing film of all time.²

In 2005, 330 screens in North America were outfitted for digital projection. By the end of 2010, bolstered by the success of *Avatar* the previous year, as well as other, more modest but still very successful digital films like *Transformers*, *Alice in Wonderland*, and various Pixar films, that number had jumped to over 16,000. John Fithian, then the President of the National Association of Theatre Owners, declared in March of 2011 that distributors would no longer be releasing film prints by the end of 2013. Sure enough, Twentieth Century Fox decided to pull the plug a year earlier, at the end of 2012, and the other majors followed suit.³ The effect this had on theaters was significant. While the digital changeover was a nightmare for venues who couldn't afford to switch out all their film projectors to the new digital standard, the larger chains saw big

² “Avatar (2009),” Box Office Mojo, <https://www.boxofficemojo.com/title/tt0499549/>.

³ David Bordwell, *Pandora's Digital Box: Films, Files, and the Future of Movies* (Irvington Way Institute Press, 2013), p. 9.

benefits with the new digital technology. The most obvious was that theaters no longer had to hire trained, unionized film projectionists to exhibit their movies—they could hire teenagers, if they wanted to. Projecting on digital with DCPs was as simple as queuing up a playlist and pressing a few buttons, and that alone was enough to convince Regal and AMC to never go back to celluloid projection. The DCI timeline worked exactly as intended.

2. Digital filmmaking: convenient until it's not

Today, there is no easy timeline that exists today for predicting how new digital technology will integrate into the film industry. In her book *The No-Nonsense Guide to Born Digital Content*, Heather Ryan, Assistant Professor and Director of Special Collections & Archives at University of Colorado, Boulder, states that the implementation of digital technology is “forever catching up to the present,” and that we are unlikely to “land in a new normal, or if there is a new normal, it’s to expect a constantly changing digital knowledge ecosystem.”⁴ Just as cinematographers, editors, visual effects (VFX) artists, film exhibitors, and digital archivists gain a grasp on how to work with and implement digital tech, a new device, software, or distribution platform becomes widely available and in use, and while this can be a boon for creativity, it inevitably leads to a period of disruptions, setbacks, and mistakes within existing industry workflows. Sometimes these changes can occur literally overnight, as we saw with the major shifts in Hollywood production protocol during the Covid-19 pandemic that required modified cinematography for social distancing.^{5 6} This is why digital archiving arguably requires more

⁴ Heather Ryan and Walker Sampson, *The No-Nonsense Guide to Born-Digital Content* (Facet Publishing, 2018).

⁵ Chris O’Falt, “A First Glimpse at the 30-Page Hollywood Safety White Paper Being Drafted for Governors — Exclusive,” *IndieWire*, May 21, 2020, <https://www.indiewire.com/2020/05/hollywood-safety-white-paper-film-tv-back-to-work-1202232613/>.

⁶ “The Safe Way Forward: A Joint Report of the DGA, SAG-AFTRA, IATSE and Teamsters’ Committees for COVID-19 Safety Guidelines,” June 2020, https://www.sagaftra.org/files/sa_documents/ProductionSafetyGuidelines_June2020EditedP.pdf.

varied expertise than traditional film archiving, as the technology involved—file formats, digital asset management softwares, storage methods, and even the exact medium for the moving image—is constantly in flux.

Unfortunately, digital filmmakers rarely make production decisions with long-term preservation in mind, and it's hard to blame them for it. For independents especially, their priority is getting a film completed as quickly and cheaply as possible, and then to find a distributor, before moving onto their next project. Digital production has made this accelerated timeline easier to achieve than ever. As a result of the widespread adoption of digital projection, film production on celluloid reels in Hollywood decreased rapidly in the early 2010s, and digital outpaced it by 2012; it was simply easier to shoot on digital cameras when the rest of the production workflow was also done on computers.⁷ While production on 35mm film is still present⁸ (certainly moreso than film projection), filmmakers realized that digital had major advantages to them as well. Shooting a take on a digital camera meant you could instantly play it back and review it, and what's more, you could shoot many more hours on digital film versus celluloid for the same cost. As soon as you were done shooting, you could immediately export the footage into an editing software, as opposed to sending film off to a lab and waiting for it to get developed. And for low-budget and amateur filmmakers especially, digital seemed like a godsend. Digital cameras were rapidly getting cheaper and cheaper, movies could be edited and rendered on a laptop, and with online video platforms like YouTube and Vimeo, newcomers could bypass traditional distribution routes and industry gatekeepers to get their work out to an intended audience almost immediately. These days, with iPhone camera quality nearing almost to

⁷ Stephen Follows, "Film vs Digital – What Is Hollywood Shooting On?," *Stephen Follows* (blog), January 11, 2016, <https://stephenfollows.com/film-vs-digital/>.

⁸ And in some cases, even smaller gauges—in the past five years or so, 16mm and Super 8 have become popular formats for music videos and advertisements in order to invoke a nostalgic aesthetic. See Olivia Craighead, "Super 8 Film Has Taken over Music Videos," *The Fader*, September 14, 2018, <https://www.thefader.com/2018/09/14/music-video-super-8-drake-in-my-feelings-beyonce>.

the level of professional cameras, it feels like anyone can go out and shoot professional digital content.

While digital allows a filmmaker to produce a higher volume of content, more efficiently, on a cheaper budget, that extra coverage is useless in preventing loss of media due to age or obsolescence. In contrast to polyester film, which is expected to last for 500 years if stored in a cool, dry climate, digital hard drives last, on average, between three to five years. In order to access the files on that hard drive for the next decade, if not a whole century, those files must be migrated continuously, from hard drive to hard drive, before each one fails. Digital files may get corrupted through what's known as "bit rot," where data may decay as a result of leaking electrical charges, loss of magnetic orientation, or, again, the breakdown of the physical carrier itself, such as in optical media like CDs and DVDs. Even on a working drive, improper file organization or metadata entry caused by human error can inhibit the utility of the digital assets stored there.⁹

There's also the issue of obsolescence, where we are losing information as a direct result of outdated file formats, hardware, and software that are incompatible with current devices. The concept of the "digital dark age" or "digital black hole" stems from this issue, and unfortunately, encrypted files, such as those found on DCPs, only exacerbate existing issues of obsolescence and file access that digital archivists are already facing. The fragile nature of digital files, and their carriers, means that films are much more likely to be completely lost due to hard drive failure or obsolescence before bit deterioration is even detected. Even a simple organizational

⁹ Morgan Oscar Morel, "A Guide to Approaching Audiovisual Digitization for Artists and Arts and Culture Organizations" (Bay Area Video Coalition, 2019), https://web.archive.org/web/20200930220934/https://bavc.org/sites/default/files/wysiwyg-uploaded/BAVC_Guide_To_Audiovisual_Preservation_2019_0.pdf.

error, like changing the file path of a VFX asset used in an Adobe Premiere work file, can do irreparable damage to digital video in an instant.

Digital media contained on physical media, such as DAT, DVD, or Blu-Ray, is at even greater risk due to obsolescence. A 2021 guide on preserving moving images from the Digital Preservation Coalition warns: “Large volumes of moving image recordings on analogue carriers are at risk of loss due to media degradation and obsolescence as hardware necessary to playback and/or digitize is no longer available or becomes prohibitively expensive,”¹⁰ citing Mike Casey’s white paper “Why Media Preservation Can’t Wait: The Coming Storm.”¹¹ Dennis Doros, co-founder of independent distributor Milestone Films and board member of Missing Movies, expressed a similar sentiment to me regarding born-digital materials, referring to the oncoming preservation crisis as the “digital tsunami.” “It is an amazing achievement that with the modern cell phone, nearly everyone in the world has or will have the technology to record their personal history through moving images and audio,” he wrote to me in an email. “Feature films have already been created using them. More elaborately conceived independent films are currently being stored on hard drives which [have] an approximate lifespan of five years unless properly migrated. How are we, as a world community, going to communicate the need for, and provide access to, proper digital storage that will save this cultural history for generations to come?”¹²

One of the biggest selling points for digital media in its history has been how easy it is to generate copies of works and distribute them, particularly over the internet. But despite the egalitarian nature of what was promised about the digital age, uploading a file to an online server is not the same as directly providing a digital file to the consumer. We’ve all had the experience

¹⁰ “Preserving Moving Images” (Digital Preservation Coalition, July 2021), <https://www.dpconline.org/docs/technology-watch-reports/2477-preserving-moving-images/file>.

¹¹ Mike Casey, “Why Media Preservation Can’t Wait: The Gathering Storm,” *IASA Journal*, no. 44 (January 2015), <https://mdpi.iu.edu/doc/storm.pdf>.

¹² Dennis Doros, email message to author, “Quote for MIAP Thesis,” April 26, 2023.

of clicking on a link to a video embedded in an article, blog post, or email, only to find that the video is no longer available. More official avenues for digital distribution such as streaming don't provide any further clarity. Temporary licensing agreements between studios and streamers like Netflix have created a content industry of "What's Coming to [Streaming Platform] This Month" articles in online publications, providing what's become a necessary tool for consumers to hunt down the movies and TV shows they want to see across a hodgepodge of platforms. More ominously, as the streaming economy has faced a downturn over the past year, platforms like HBO Max have begun removing their original streaming shows without warning in an effort to cut costs.¹³ As a result, pirating and torrents have become necessary yet highly imperfect methods for preserving these materials, with online forums like the r/DataHoarder subreddit providing guidance on how to store droves of digital content at home.¹⁴ Yet even if file-sharing practices were legal, the task of preserving vulnerable digital material cannot be left solely to amateur archivists and enthusiasts to tackle.

Another reason digital presents such a challenge is through the aforementioned storage. The digital storage required to shoot, edit, distribute, and archive Hollywood productions has ballooned significantly over the past decade. This is caused not only by advancement of the digital technology itself—with ever-increasing file sizes from higher resolutions, dynamic range, expanded color space, and computer graphics—but also by digital filmmaking trends. When shooting on film reels, directors only have so much physical film stock that they can use before it runs out, leading them to be conservative with when they let the camera roll. Digital has given filmmakers the illusion of greater capacity, resulting in "a mountain" of footage and additional

¹³ Alexi Horowitz-Ghazi, "Dozens of TV Shows Are Disappearing from Streaming Platforms like HBO Max. Here's Why," *NPR*, March 17, 2023, <https://www.npr.org/2023/03/17/1164146728/why-are-dozens-of-tv-shows-disappearing-from-streaming-platforms-like-hbo-max>.

¹⁴ "r/DataHoarder Wiki," Reddit, <https://www.reddit.com/r/DataHoarder/wiki/index/>.

takes that then get dumped on post-production houses.¹⁵ As the costs and physical sizes of large-capacity hard drives and server farms decrease, digital storage appears infinite, and so everything gets saved.

In 2009, *Avatar* notoriously broke the one petabyte barrier of total video production content. In 2014, *The Amazing Spider Man 2* required 2.4 PB of storage to scan from film to 4K. Even non-franchise films, like David Fincher's *Gone Girl* that same year, required a not-insignificant 261 TB of storage, generated from 500 hours of raw footage during its multi-camera 6K (4:1) Red Dragon production.¹⁶ Now, these storage numbers are the norm, if not below average. 2022's *Avatar: The Way of Water* required a whopping 18.5 PB of storage, stemming from its motion-capture digital effects, 3D cinematography, and higher frame-rate, with the film oscillating between 24 fps and 48 fps. And while exact storage numbers for the latest Marvel films are unknown, the total footage for *Avengers: Endgame* and *Avengers: Infinity War*, which were shot simultaneously, clocked in at around 900 hours altogether, despite the films' final runtimes being only 2 hours 30 minutes and 3 hours, respectively.¹⁷

Even smaller productions are working with a large mix of raw output files that quickly eat up storage. A typical Paramount Pictures workflow, for instance, as cited in Soojin Park's "The Never-Ending Digital Dilemma," involves "TIFF and DPX sequences, a huge volume of ProRes files, the original camera files from different cameras like RED and ARRI, [...] output files from different software such as Avid or Premiere, as well as different transcoder projects." Independent studios might use a mix of ARRIRAW files for larger projects and either ARRI Alexa Mini camera recordings (MOV files with a ProRes 422 (HQ) or ProRes 4444 codec) or

¹⁵ Drew Magary, "Inside Hollywood's Visual Effects Crisis," *Defector*, August 2, 2022, <https://defector.com/inside-hollywoods-visual-effects-crisis>.

¹⁶ Tom Coughlin, "4K, HDR, HFR: Calculating the Storage Impact in Media Workflows" (Coughlin Associates, 2016), https://landing.quantum.com/rs/561-AAR-658/images/Tom_Coughlin_Whitepaper_2016.pdf.

¹⁷ Iain Blair, "Avatar: The Way of Water: Weta's Joe Letteri on VFX Workflow," *PostPerspective*, January 5, 2023, <https://postperspective.com/avatar-the-way-of-water-wetas-joe-letteri-on-unique-vfx-workflow/>.

C300s (MXF with an XF-AVC codec) for smaller ones.¹⁸ 4K UHD formats are now being used by even mid- and low-budget productions, offering a higher dynamic range that may benefit preservation but also costing even more storage space.

Plenty of other preservation challenges exist beyond the raw camera formats or master files of films. Digital effects, and their increasing ubiquity throughout the industry, introduce further complications, as new CGI workflows with numerous assets and a myriad of digital file formats are not being treated as archival material. These will only get more complicated in the next few years as volumetric capture stages, aka virtual sets, become accessible to a wide range of different productions.¹⁹ When taken together, visual effects represent a huge volume of digital data that's also a gray area for even experienced digital film archivists. There's also the Interoperable Master Format, or IMF, which has become the go-to digital distribution format for streaming services such as Netflix and the ones operated by major studios (Disney+, HBO Max, Peacock, etc.). These formats allow for multiple versions of a work, such as those with foreign-language subtitles and dubs, to exist within a single codec wrapper and deliverable. These greatly simplify the distribution workflow, and may even offer benefits for archivists (especially as an alternative to the lossy compression found in DCPs),²⁰ but it is still too early to tell if compatibility or content-security measures will create issues with these files down the line. However, having been standardized by SMPTE in 2013 and used in circulation since 2016 onward, IMFs are now beginning to enter the archival space; it is now common practice for studios to send IMF copies of materials to the U.S. Copyright office for registration, and those in

¹⁸ Soojin Park, "The Never-Ending Digital Dilemma" (New York University, 2020), https://miap.hosting.nyu.edu/program/student_work/2020spring/20s_thesis_Park_deposit_copy_y.pdf.

¹⁹ Janko Roettgers, "Inside Intel Studios, the World's Largest Volumetric Capture Stage," *Variety*, October 7, 2019, <https://variety.com/2019/digital/features/intel-studios-volumetric-capture-holograms-ar-vr-1203358126/>.

²⁰ For more information, see chapter on IMF technology in Park, "The Never-Ending Digital Dilemma."

turn become the default copies sent to the Library of Congress' National Audio-Visual Conservation Center (NAVCC) for preservation.

3. Control of distribution

In his book *Pandora's Digital Box*, David Bordwell explains that Hollywood's push towards digital cinema was driven in part by the major studios' desire for more control over access to their products. "For about a hundred years, film distributors have sought to control exhibition," he writes. "The advantages are obvious. Controlling exhibition keeps competitors off screens, it yields more or less assured revenues, and it allows vast economies of scale. If you can count on 2000 to 4000 screens playing your movie, as is common for Hollywood releases today, you can budget your production accordingly."²¹

While the vertical integration of the studio era might be gone, the shift to digital has allowed for studios to have unprecedented control of content distribution and exhibition once more. This started with theatrical runs: after the major studios came together in 2002 to form Digital Cinema Initiatives, they created the concept of the Digital Cinema Package (DCP), a collection of a film's assets stored as files on an industrial-grade encrypted hard drive. These hard drives would take the place of projected film reels as the primary form of exhibiting movies in theaters. In addition to preventing piracy, the DCP also gave studios much greater involvement in the digital projection process, as DCPs require patented technology to read their files. As Will Tavlin writes in *n+1*, "the DCP guaranteed that [the studios would] have full control over the circulation of their films in perpetuity, while permanently yoking theaters to their technological whims."²²

²¹ Bordwell, *Pandora's Digital Box*, p. 48.

²² Will Tavlin, "Digital Rocks," *N+1*, Spring 2022, <https://www.nplusonemag.com/issue-42/essays/digital-rocks/>.

In the 1980s, cable and home video provided a new way for studios to maintain “tiers of price discrimination.” During the studio era, films’ theatrical lifespans were divided up into “first-run,” “second-run,” and “later-run” periods, each designated by the quality and reach of the movie houses they were exhibited in (e.g. “first-run” in major urban markets, “second-run” in smaller towns and suburbs, “later-run” in rural areas and cheaper theaters, etc.). With VHS, theatrical runs shortened, becoming a loss-leader that earned less income but drummed up buzz for the home video market, which became the new “second-run” release. “Today, the windows are even more numerous,” Bordwell wrote in the early 2010s. “A movie becomes available on Pay Per View, then VOD and/or DVD, then premium cable, and so on. The windows’ lengths and sequence have changed over the years, but throughout, by carving up the market by price discrimination the studios continued [to] govern the cycle of exhibition.”²³ Now, studio-owned streaming services such as Hulu, HBO Max, and Peacock function much as studio-owned theaters did in the 1930s and 1940s, but with the added power to dictate the exact distribution cycle of a film through fine-tuned data on audience demographics and viewership.

4. The value of digital archival content

When you consider how franchises and intellectual property (IP) are built over time and made recognizable to consumers, the value of archival content is a no-brainer. As we’ve seen from everything from *Star Wars* to *Harry Potter* to *Top Gun: Maverick*, existing footage can be reworked into documentaries, sequels, advertising material, behind-the-scenes features, interactive media, theme park rides, and more, as long as it is archived and accessible to studio productions. Digital production makes this fluidity of content even easier, and was identified as

²³ Bordwell, *Pandora’s Digital Box*, p. 50.

such even all the way back in 2007, when the Academy of Motion Picture Arts and Sciences published its first *Digital Dilemma* report as an overview of the challenges of digital integration in the film industry. On the value of corporate entertainment archives, the report reads:

The creation of “private” archives owned by corporations for the purpose of making money is a relatively new phenomenon in archiving history. But in Hollywood, private film archives have emerged as valuable corporate assets that can appreciate in value over time and can be bought and sold for large sums. The “library” is one of the most valuable assets possessed by a studio. Assets are preserved so they can be exploited to create new media products for future markets. Making new revenue from old assets is a very profitable approach when it can be done without incurring undue new costs in adapting the old media format to the new market demand.²⁴

Video-based internet platforms such as YouTube, Instagram, and TikTok mean that now, there are even more opportunities for studios to recycle existing footage for promotional material on social media. And then there is the untold footage that is kept around just on the basis of what it could *possibly* be used for in the future. In an interview, a digital preservationist who works at a production company for reality TV shows stated that they kept a surplus of surveillance-camera footage from each television shoot; even if a clip isn’t used right away in a show’s current season, it’s kept in digital storage, taking up space, on the off-chance that it could be used in a reunion special several years down the line. Anecdotally, this appears to have become the norm for so many kinds of production houses.

Beyond franchising, the explosion in archival documentaries on streaming services is one symptom of a growing market for nostalgic content. We can especially see this growing market for nostalgia through how the music industry has repurposed its archival assets over the past few years—and yes, even in the music business, this revolves as much around visual content as it

²⁴ Milt Shefter and Andy Maltz, “The Digital Dilemma: Strategic Issues in Archiving and Accessing Digital Motion Picture Materials” (Academy of Motion Picture Arts and Sciences, 2007), p. 5.

does around audio. Publishing rights and artists' back catalogs have turned into cash cows for the industry since the pandemic, so much so that upstart music publishing companies such as Hipgnosis Songs Fund and Primary Wave have snatched up entire artist catalogs for eight or nine figures each.²⁵ The end goal for these enterprises has been to repurpose and redistribute the artist's work across a plethora of media in order to bring them back into the public consciousness and, ultimately, monetize assets that were either once sitting untouched in an archive or only available as fan-distributed bootlegs. This was Primary Wave's strategy when it purchased Whitney Houston's archive, as outlined extensively in a *Billboard* profile of the company:

For many artists, says [Rob Dippold, head of digital at Primary Wave], the record labels are monetizing official videos on YouTube, but user-generated content—uploaded videos with recordings in the background or bootleg performance videos—aren't being monetized at all, much less incorporated into the artist's larger brand, which was the case for Whitney. "YouTube is the biggest global streaming service, and through it, you can sell merchandise, you can sell tickets, you can communicate with the fans," he says. "No one's using it as a social media channel. They just upload the video, and they're done. No one's optimizing videos, putting hologram tour dates in the descriptions. No one is thinking outside the box, leveraging new outlets — TikTok, Songkick, Bandsintown, YouTube, Google SEO, Wikipedia. And we clean it up, building one massive following instead of it all just being disconnected."²⁶

In addition to upgrading Houston's music videos on YouTube to 4K, Primary Wave released rare high-definition performance footage of the singer to her official YouTube page, including her 1987 Top of the Pops appearance²⁷ and her performance of "It's Not Right (But It's Okay)" at

²⁵ Tim Ingham and Amy X. Wang, "Why Superstar Artists Are Clamoring to Sell Their Music Rights," *Rolling Stone*, January 15, 2021,

<https://www.rollingstone.com/pro/features/famous-musicians-selling-catalog-music-rights-1114580/>.

²⁶ Dan Rys, "Can Primary Wave Transform Whitney Houston's Legacy – And Her Estate's Fortunes?," *Billboard*, November 3, 2022,

<https://www.billboard.com/music/features/whitney-houston-estate-legacy-primary-wave-1235165011/>.

²⁷ "I Wanna Dance with Somebody (Who Loves Me) (Live on Top Of The Pops 1987)," YouTube video, January 20, 2023, <https://www.youtube.com/watch?v=6g220K3N630>.

MTV Pride Pier Dance 1999, which was uploaded during Pride Month 2022.²⁸ There are also now a dozen highly-produced lyric videos of Houston's most popular songs on the channel, ensuring that when anyone goes to search for the songs on YouTube, they'll be directed towards the Houston estate's official revenue stream. Other projects of theirs are more transformative; in addition to the biopic *Whitney Houston: I Wanna Dance With Somebody* (2022), which Primary Wave helped produce, the company was behind the chart-topping remix of a previously rare Houston track, a cover of Steve Winwood's "Higher Love." Remixed by popular EDM producer Kygo, the new version was released in 2019 and spent nine weeks on the Billboard 100. (Unfortunately, as of 2023, Houston's original 1990 version still isn't on streaming and is only available via YouTube bootlegs, or on the Japanese CD release of her third album *I'm Your Baby Tonight*.²⁹)

At the 2022 Association of Moving Image Archivists conference in Pittsburgh, Tim Knapp, COO of archival media facility PRO-TEK Vaults, and Jason Zito, an archival director at Universal Music Group, presented a panel titled "Universal Music Archive and the Restoration of Guns N' Roses." The presentation highlighted a recent project to restore 16mm and 35mm footage of a 1991 Guns N' Roses concert as part of a massive box set re-release for *Appetite for Destruction*, but it represented only the tip of the iceberg for Universal's recent high-profile restoration efforts. In June, 2019, UMG unveiled over 1,000 brand-new 4K upgrades to their music video library on YouTube.³⁰ This was seemingly a way to deter from a wave of negative publicity brought on a *New York Times* investigation published only a week earlier; in the expose, it was revealed that a 2008 fire on studio property had done much more damage to

²⁸ "Whitney Houston – It's Not Right (But It's Okay) (MTV Pride Pier Dance 1999)," Youtube video, June 29, 2022, <https://www.youtube.com/watch?v=wJht8UvZPzE>.

²⁹ "Whitney Houston – I'm Your Baby Tonight," Discogs, <https://www.discogs.com/release/1126480-Whitney-Houston-Im-Your-Baby-Tonight>.

³⁰ Gavin Edwards, "That Glitchy Music Video on YouTube? It's Getting an Upgrade," *New York Times*, June 19, 2019, <https://www.nytimes.com/2019/06/19/arts/music/youtube-universal-video-upgrade.html>.

Universal's music archive than previously believed, including the destruction of countless master tapes and original recordings from best-selling artists.³¹ The fact that the studio had so many high-definition digital versions of their videos ready to go during a PR crisis points to UMG sitting on a treasure trove of digitally remastered video content, and Zito seemed to imply as much in his presentation.

5. Preserving digital-to-film

In an ideal preservation scenario, audiovisual material is not only preserved in its original format, but also reformatted to avoid known issues with instability, obsolescence or deterioration. Archives that store large volumes of nitrate and acetate materials, such as the Library of Congress, have made it a priority to digitize those films to ensure that, even if their physical copies decay to the point of being no longer projectionable, the content of the films can still be preserved and viewed.

Reformatting for digital archives is especially vital because of their fragility. As stated in *The Digital Dilemma*, "An archive that stores digital materials has long-term objectives. By current practice and definition, digital data storage is short-term."³² LTO tapes are used as a preservation measure for digital storage because unlike digital hard drives, the physical properties of tape can store data for up to 30 years. And even as digital has become the norm for production and distribution in the industry, studios still archive their assets, including born-digital assets, onto stable polyester film stock as an additional measure for preservation. This applies to everything from the Marvel films to Justin Bieber concert footage, and as one

³¹ Jody Rosen, "The Day the Music Burned," *New York Times*, June 11, 2019, <https://www.nytimes.com/2019/06/11/magazine/universal-fire-master-recordings.html>.

³² Shefter and Maltz, "The Digital Dilemma," p. 1.

might imagine, it's an enormous upfront cost that studios have continued to pay for, even while simultaneously utilizing digital preservation workflows for the past two decades.

Studios commonly preserve their assets on film through what is known as a YCM separation master process. This involves the footage being printed onto three black-and-white film negatives, each containing a separate color filter: blue, red, and green, each corresponding to the yellow, cyan, and magenta tones used to create a color film positive. The three strips thereby collectively contain as much color information about the film as possible for future prints, and because the negatives are in black-and-white, there is no risk of color fading over time. When digitally scanned, these three negatives can be recombined to create a high-definition full-color digital master.³³

Another color separation method used by studios and archives is the sequential exposure (SE) process. Pioneered by Disney back when the studio was producing their first color animated films, the printing process records each frame's three color components in succession on a single film strip. Frame 1 gets printed as three frames—Frame 1 Blue, Frame 1 Red, Frame 1 Green—followed by Frame 2's three frames, followed by Frame 3's, etc. This allowed for Disney's animation productions to bypass using the bulky three-strip Technicolor cameras that were widely used for color films at the time.³⁴ Decades later, after digitally scanning their nitrate film collection, Disney used the sequential exposure process to print their digital masters onto black-and-white polyester negative film strips, resulting in a physical copy with much more longevity than the original nitrate.³⁵

³³ Eric A. Taub, "Riding to the Rescue in Final Scene: Restoring Movies," *New York Times*, March 25, 1999, <https://archive.nytimes.com/www.nytimes.com/library/tech/99/03/circuits/articles/25howw-side.html>.

³⁴ "Preserving Our Movies," Disney Digital Studio Services (blog), March 24, 2016, <https://www.disneydigitalstudio.com/preserving-our-movies/>.

³⁵ "Preserved for the Future," Disney Digital Studio Services, May 20, 2012, <https://www.disneydigitalstudio.com/preserved-for-the-future/>.

Conservative estimates put the lifespan of color-separated black-and-white polyester negatives at 100 years, but polyester film is thought to be capable of lasting 500 years or more.³⁶

³⁷ When compared to the average three-year lifespan of a hard drive, it's easy to see why studios continue to invest in film as a backup plan, even for properties that were shot on digital. But that investment comes at a steep price: whether YCM-separated or sequential, these archival masters clock in at around \$100,000 per film to produce—roughly the cost of a low-budget independent film production today.³⁸

Of course, many studios including Disney also pay to preserve their original physical film assets, such as nitrate negatives and prints stored within the Library of Congress vaults in Culpeper, Virginia. In the case of the LoC, the cost comes not from the preservation itself but from two full-time archivists that Disney hires to oversee its collection. If studios choose to store in their own private vaults, or with a third party such as Iron Mountain, the costs increase exponentially. In contrast, digital storage only continues to get cheaper and more beneficial to economies of scale, with the vast majority of studios and third-party vendors relying on LTO tapes as an efficient method for large-scale digital storage. This is why producing archival film prints may soon be on the way out as standard practice in Hollywood, at which point digital will fully take over as the dominant means of long-term preservation despite its major shortcomings.

³⁶ “Architectural Papers (Unidentified),” Preservation Self-Assessment Program, <https://psap.library.illinois.edu/advanced-help/paper-unbound-architectural-unidentified>.

³⁷ James M. Reilly, “IPI Storage Guide for Acetate Film” (Image Permanence Institute), https://s3.cad.rit.edu/ipi-assets/publications/acetate_guide.pdf.

³⁸ Tavlin, “Digital Rocks.”

II. The Cost of Digital Preservation for Independent Filmmakers

1. How are filmmakers archiving?

In 2012, the Academy released a follow-up to their *Digital Dilemma* report that included a survey of 150 independent filmmakers. They found that of the respondents who possessed digital materials for their work, only 8 percent reported migrating their data on a regular basis, with 26 percent reporting that they migrated data “occasionally.” Over 60 percent did not migrate at all, and nearly half reported that they had not given much thought to the data migration process.³⁹

The survey results demonstrate that, even if filmmakers do have an interest in more secure preservation workflows, they are held back by a myriad of factors stemming from lack of education, funding, the ease in which digital data is created compared to the challenge of storing it, and the goals set at the beginning of production that prioritize getting the film made and distributed, with little oversight given into its long-term shelf life. Rachael Stoeltje, Director of the Indiana University Libraries Moving Image Archive and one of the leaders of the Association of Moving Image Archivists’ Preservation for Filmmakers program, noted in an interview that filmmaker negligence when it comes to the archival process is not a new phenomenon. She recalled once having to process an Academy Award-nominated director’s films that arrived at the archive not in proper canisters, but on loose cores, resulting in a mess of film reels that had to be rehousing.⁴⁰ However, the added complication with digital storage is that it’s more likely for a

³⁹ Milt Shefter and Andy Maltz, “The Digital Dilemma 2: Perspectives from Independent Filmmakers, Documentarians and Nonprofit Audiovisual Archives” (Academy of Motion Picture Arts and Sciences, 2012), p. 2.

⁴⁰ Interview with Rachael Stoeltje, March 1, 2023.

filmmaker to forget what exactly they're saving, or how it's being stored. Content creators prioritize getting their film or video made above all else, and so file and folder organization is based around an ongoing production workflow, rather than long-term preservation. Work files and rough cuts are often haphazardly named without file-naming conventions, and different projects may exist across multiple computers and hard drives. And because the actual production elements (i.e. the files) are not physically taking up space, it's much easier for filmmakers to forget about what they're saving, whether it's 1 gigabyte or 100 gigabytes.

Chris Osborn is an independent filmmaker who also works as an editor on short films, music videos, documentaries, and branded content, and who curates a screening series of web-based works titled D E E P.⁴¹ When it comes to distribution, Osborn says that they and many of the filmmakers they work with are always aiming to get their works played on the festival circuit, but that afterwards, particularly for short films, there's a huge question for what is to be done with the finished product. "More often than not, it just kind of lives as a Vimeo link that gets posted," Osborn says. "Maybe it gets picked up by a few publications to spread it even further. But a lot of the distribution is really self-reliant. Both distribution and archiving that work, and making sure that it stays safe, really falls upon our shoulders, and especially for short films, or just short-form content in general, there's not a real viable marketplace for them."⁴² Even if a film manages to find a distributor through festivals and strike a deal, the original elements of the film get passed on to that distributor, and the creator may lose track of those assets unless they make a concerted effort to keep copies.

It's clear that filmmakers understand the basic importance of keeping a digital record of their work, and have even put personal financial investment into it: Two-thirds of the *Digital*

⁴¹ Chris Osborn, D E E P, <https://memory.is/deep>.

⁴² Interview with Chris Osborn, March 31, 2023.

Dilemma respondents stated that they paid for their own preservation. But going by that metric, “preservation” could be as simple as going out and buying an external hard drive to keep digital files on in perpetuity. And the survey results demonstrate that, even if filmmakers do have an interest in more secure preservation workflows, they are held back by a myriad of factors stemming from lack of education and funding, the ease in which digital products are created, and the goals set at the beginning of production that prioritize getting the film made and distributed, with little oversight given into its long-term shelf life.

So let's go over what I believe to be the primary challenges for independent digital archiving: lack of knowledge or education, an overabundance of data, unassigned responsibility, the fragility of digital distribution platforms, and lack of financial or communal support.

2. Lack of specific knowledge or education

Digital archiving decisions are made from the moment of a file's inception—what is its resolution? Its container format or codec? Its aspect ratio? With production using digital video, these decisions are largely made with only one goal in mind: completing the final product and getting it distributed. As video technology advances, high-resolution formats like RAW files are chosen to produce the best image quality possible from the start; the finished film, edited from these production files, is rendered into the form of a high-quality master file (at least 4K, if not 6K or 8K), from which digital derivatives such as DCPs, digital masters for projection (such as ProRes), and other mezzanine/access files can be made.

Unfortunately, most filmmakers and creators are not considering other uses for their master files beyond sourcing their distribution copies. Many DIY filmmakers, especially those who make web-based work, may only have one rendered copy of their film at all that they use

for distribution as well as long-term storage. For most undergraduate or graduate film programs in the United States, archival practices are simply not part of standard filmmaking education. NYU Tisch is just one example of that—unless you're in MIAP or taking an elective in MIAP, archiving and preserving your films won't be part of your formal educational training.

How different people approach digital preservation largely depends on their filmmaking background and their own personal experience with archival practices. Osborn explained to me that they take a comprehensive approach to saving their work; they keep multiple copies of all their work on hard drives as well as cloud storage, and each project includes both a high-quality preservation master (ProRes 4444) and distribution masters (ProRes 422 HQ for DCPs and MPEG-4 for online). But much of this comes from their experience as a freelance editor where, by the very nature of their job, they have to organize and keep track of lots of digital assets for different projects. “I've known the pain of a drive failing on me, or a drive being on an obsolete connector, and I don't have the adapter for it and then it fails,” they said. “It's hard-fought knowledge of knowing how painful it is to lose something like that, [so] I always try to back it up as much as possible.” Osborn’s curatorial background and interest in vulnerable media from the digital age, such as music videos, has also given them a unique perspective on the importance of preserving this form of media. “It's usually platform-based, [but] platforms fail. Hard drives fail. And people's memories are short. It's important that we're thinking about the ways in which our films aren't just released into this world, but in which they could be preserved for the future.”⁴³

Meanwhile, others who work with digital video, especially internet content creators, may not be as thorough with their storage and organizational practices. It's not uncommon to hear about YouTubers who “stumbled into” their profession, and while some may have a background

⁴³ Interview with Osborn.

in videography and editing, those who don't end up learning as they go through trial and error. One of the creators I spoke with, Ray Delahanty, is the YouTuber behind CityNerd, a channel focused on urbanism and transportation with over 150,000 subscribers. Before starting his YouTube career, Delahanty actually worked professionally as a project manager on city planning initiatives—in other words, he's no stranger to spreadsheets and organization, and his data-driven videos reflect this. Yet his video storage setup is bare-bones by archival standards. “The professional background I was coming from, you always had a server and a backup server and a whole protocol for how you stored documents,” he told me. “Now that I'm doing things on my own, it's much less formal than that.” Delahanty stores his video files locally on his laptop and on Microsoft OneDrive, with no physical backup drive, and he usually doesn't bother to rename the raw camera files that he transfers to his computer, though he does keep a folder organization system by video or by the location where he filmed each clip. (He uses B-roll from various cities he's been to across multiple videos.) “I often have some sort of reference table that I make [for the videos] that has the description or date or location,” he said, referring to a spreadsheet he makes for the raw footage.⁴⁴ This makes some sense if you've watched any of Delahanty's work, which features a mix of native iPhone footage (both B-roll of the locations he's been to and vlog-style shots of him talking to the camera), images, graphs, and screen recordings from Google Earth Studio that he'll often use in place of on-location video clips for cities he can't get to. It's an organizational system built around editing and being able to access a local database of video elements for multiple concurrent projects, and not so much around long-term storage. But when you're producing a new 15-minute video each week by yourself, it's no wonder that this workflow may seem like the most practical way to go about it.

⁴⁴ Interview with Ray Delahanty, April 13, 2023.

On the other end of the YouTuber spectrum is a Canadian film essayist named Maia, who produces longform videos under the username Broey Deschanel. Her videos usually range from around 24 minutes to an hour, and she releases new videos once a month to her 319,000 subscribers. Despite having a channel dedicated to analyzing film and television, Maia has received no formal education in archiving and preserving digital video, even though she expressed a clear understanding in why archiving is important and what she could be doing better. “I think because this is such a new profession, unless you’re coming from an editing background—which a lot of people do, in my niche—you don’t really have the tools or the foresight to do this,” she told me. Maia only began to take preserving her videos more seriously after one of her older projects got taken down off of YouTube for featuring clips from the 1995 film *Kids*, which YouTube incorrectly identified as child pornography. Despite her efforts to dispute the takedown claim from YouTube, the platform has yet to reinstate her video. “I don’t have it anymore, and I can’t download it off the internet because the video has been restricted,” she says. “So now I’m running into an issue.”⁴⁵

Unlike Delahanty, Maia has a team of collaborators who assist in filming and producing her videos, but she is still the primary editor and overseer of her digital files. In her current workflow, she saves her completed videos onto a hard drive, but will almost always delete the raw footage used in videos—both clips she filmed herself and clips from media she’s analyzing—in order to free up storage space. “I’m basically working on one project at a time, and the only thing I’ll save on my computer is the stuff for one project.”⁴⁶ Again, to me, neither of these examples convey a carelessness towards archiving or an unwillingness to learn how to initiate better practices. It’s just that YouTubers are almost always acting as a one-man

⁴⁵ Interview with Maia (Broey Deschanel), April 19, 2023.

⁴⁶ Interview with Maia.

production or, at best, the head creator and producer of a small team, tasked with doing a plethora of tasks that would typically be assigned out to multiple people on a traditional film crew. Without any existing knowledge of professional archival practices, it's unreasonable to expect them to integrate those practices into their workflow on their own.

There are a variety of resources out there geared towards helping people organize their digital video content. Heather Ryan's *No-Nonsense Guide to Born-Digital Content* is, as the title suggests, a very straightforward and accessible guide for anyone with a digital collection that they want to preserve. However, this book can be hard to come by—the cheapest used copy that I was able to find on Amazon was \$74. Then there's the *Digital Preservation Handbook*, created by Digital Preservation Coalition, who helped popularize the 3-2-1 rule—the idea that for everything in your collection you have 3 copies, 2 on different media storage formats, and at least 1 kept in a separate location. In a similar vein is the work of Ashley Blewer, who published a separate guide for the DPC,⁴⁷ and who has built out an excellent online portal for learning all aspects of digital preservation.⁴⁸ While very comprehensive, these sorts of guides are largely geared towards professional archivists and system administrators who already have some sense of where their gaps in knowledge lie, not so much individual artists or filmmakers who may be coming to the archiving field completely fresh and who are simply trying to preserve their own personal collections.

Witness, a nonprofit dedicated to training and supporting those who use video to document human rights violations, has a widely circulated *Activist's Guide to Archiving Video*, which is available as an online database as well as a PDF.⁴⁹ While this guide has some useful

⁴⁷ Ashley Blewer, "Pragmatic Audiovisual Preservation" (Digital Preservation Coalition, October 2020), <https://www.dpconline.org/docs/technology-watch-reports/2381-pragmatic-audiovisual-preservation-member-preview/file>.

⁴⁸ "Training," Ashley Blewer, <https://training.ashleyblewer.com/>.

⁴⁹ "Activists' Guide to Archiving Video," Witness, accessed April 30, 2023, <https://archiving.witness.org/archive-guide/>.

tools that can be applicable to independent filmmakers, it is also geared towards a very specific use case that may not be relevant to non-documentarians. And then there's AMIA's Preservation for Filmmakers program, for which Rachael Stoeltje is one of the leads.⁵⁰ The online hub for the project includes several written resources, like the Sundance Institute's "How to Save Your Film and Tape" and "Check Your Film Before You Wreck Your Film"; a one-page comic called "What We Mean by Restoration"; Tribeca's guide to archiving film; Digital Preservation Coalition's explanation of the 3-2-1 strategy; and an Indiewire article on the importance of filmmakers preserving their work. There is also a list of past webinars on digital preservation that are available on demand, though you are required to email AMIA in order to gain access to them. As of March 2023, the project has also conducted in-person seminars at the South By Southwest film festival and the Sojourner Truth Festival of the Arts at the University of Chicago.

But film festivals and other industry events cannot be where filmmakers are introduced to archiving for the first time. They, or at least someone involved in their production, should be thinking about preservation in the back of their mind during every stage of the production process. Unfortunately, the common mindset on film sets is that the post-production team and its resources will take care of all archival duties. "Filmmakers seem to not have thought about this as a question at all," Stoeltje told me. "And independent and smaller ones are really not thinking about it." While it is certainly possible to transcode AVI, QuickTime, or MP4 files into lossless compressed video formats,⁵¹ but ideally this would not be done at all, as errors in the transcoding process can lead to corrupted files that can't be played back.⁵² The ideal future-proofing best practice would be for production crews to take these steps from the beginning and to shoot in the

⁵⁰ "Preservation for Filmmakers," AMIA, accessed April 30, 2023, <https://amianet.org/resources/preservation-for-filmmakers/>.

⁵¹ Reto Kromer, "On the Bright Side of Data Migrations," *LASA Journal*, no. 49 (December 2018).

⁵² Morel, "A Guide to Approaching Audiovisual Digitization."

highest resolution format available to them, and then create lossless video masters alongside their distribution copies.

3. Digital production and an overabundance of data

The rise of digital filmmaking meant that directors were no longer working with a finite amount of film stock for each production. Coupled with the relative ease in shooting digital compared to film, this has led to an exponential increase in the amount of footage produced for each production. When it comes to digital data, independent filmmakers aren't reaching anywhere close to the benchmarks set by Marvel and other large-scale productions, but they are on average working with more raw footage than they would have been prior to digital technology.

This has two major consequences on preservation. One is that the more data produced for a production, the more unwieldy and costly its storage will be. Raw files are in danger of being lost if not properly organized, and while overall digital storage costs have consistently decreased over the past two decades, uncompressed raw footage can still be a financial burden on individual filmmakers. In 2007, *The Digital Dilemma* estimated that the annual cost of preserving an 8.3-terabyte digital master is about \$12,000—more than 10 times what it costs to preserve a traditional film master. Delahanty stated that for each video he releases on YouTube, he keeps just one master file in MPEG-4 1080p, for both preservation and distribution, due to his limited storage space and budget. “I could do 4k, but it's gonna use up a lot,” he said. “I already have problems running out of hard drive space—it's a constant battle.” In extreme cases, filmmakers and videographers may not bother to keep raw footage or even masters in the long

term once the final product has been distributed, preferring to free up hard drive space for more projects.⁵³

This feeds into the second issue: the perception that digital files are easily disposable. Unlike film post-production, where multiple film elements such as original camera negatives, A&B rolls, duplicate negatives, and release prints may all be preserved, independent filmmakers and creators may only be incentivized to keep one master copy of their work, plus perhaps the work file they used in their non-linear editing software. For internet creators, saving raw footage may only seem necessary if they can reuse a clip in future projects. Otherwise, there's little reason to keep around multiple edits or versions of a video, as all it's really doing in the short term is taking up valuable storage space on a hard drive. This isn't necessarily a bad thing, since it's impractical for filmmakers to save every bit of data that they produce, but it does mean they're less likely to keep around high-quality, preservation-level content because of spatial issues, and if they do, they may not be doing so in the most efficient way possible (e.g. storing multiple identical copies of the same videos in the same hard drive, which just takes up extra space).

On a broader scale, the sheer amount of digital video content available in the world means it's become increasingly difficult for archivists to pick and choose what is most valuable for preservation. The Internet Archive is perhaps the best-known organization dedicated to asking this very question, but in terms of archiving video, they are largely limited to either the public domain or donations. Even if you limit the search to narrative independent films released on streaming, picking and choosing what to archive is a daunting task—and chances are, the platforms providing the distribution are not going to pick up the slack.

⁵³ Sam Beckman, "Should You Keep RAW Footage?," YouTube video, April 13, 2018, <https://www.youtube.com/watch?v=ELNZ1eAti7E>.

4. Lack of assigned responsibility

Perhaps because archival practices are not a standard component of university film degrees, or even more informal production training, many independent film productions only have a vague idea of who will be in charge of archiving and maintaining its digital assets. Is the filmmaker/the director? Is it the producer? The film editor? Is it something the production shouldn't be concerned about until a distributor buys the film, and then they can be the ones to take care of the archiving? But then what happens to the original production elements?

In some cases that responsibility, at least in the short term, may fall onto digital imaging technicians, or DITs, an often overlooked position on film sets. Not all production crews have a DIT, but when they do, the DIT oversees data management of all film assets during production and into post-production. They secure and back up dailies as they're being filmed, organize a project's audiovisual assets onto cards and drives, and overall follow a strict workflow for compiling digital footage that hopefully was mapped out prior to production. They then help to transcode raw footage into manageable files for editing, requiring them to have a strong familiarity with different codecs and recording formats. At times, DITs may even edit together dailies for the director and producers to look at, and perform basic color correction on raw footage before it enters the editing bay.⁵⁴ Logically, this would put the DIT in the best position as the person in charge of overseeing the long-term preservation of a film's assets, especially since they'll be making initial decisions about codecs and proxies that can determine a file's integrity and longevity for years to come. But the DIT's role ends as soon as the film enters post-production, at which point the editor becomes the de facto archivist for all the film elements.

⁵⁴ Jourdan Aldredge, "Digital Imaging Technicians: The Unsung Heroes of Film Sets," *The Beat* (blog), April 2, 2018, <https://www.premiumbeat.com/blog/what-is-digital-imaging-technician/>.

As a freelance editor, Osborn has had this happen to them many times, including for higher-budget productions where those involved should have known better. “A music video that I edited, an extremely high profile video, had gotten into a festival eight or nine months after it had been released,” they recalled to me. “The day before, I was asked to create a DCP of it, because I was the only one who had the source master file of the film that would suffice a DCP for the actual whole exhibition. And I was like, why am *I* doing this? Why doesn’t the record label already have this, because we all got the links from the post house that did the color? Why don’t the producers do it? Because they should have downloaded it, but nobody downloaded it, so I’m the only one who had it.” As a result of incidents like this, along with their own commitment to preserving overlooked works like music videos, Osborn still keeps backup drives for the majority of the projects that they’ve worked on, on the off-chance that they once again end up being the sole person with good copies of the film.

5. The fragility of OTT (over-the-top) digital distribution platforms

These days, the vast majority of digital film and video works are distributed in some form through over-the-top (OTT) digital distribution platforms, whether that be online video platforms such as YouTube or Vimeo; video-based social media platforms like Instagram and TikTok; or streaming services such as Netflix, Hulu, Peacock, HBO Max, Disney+, or AppleTV+. OTT platforms are defined as giving consumers à la carte access to content over the internet, in opposition to traditional broadcast, cable, or satellite TV.⁵⁵

Filmmakers and non-filmmakers alike often mistakenly refer to YouTube, Vimeo, and other online video hosting sites as “archives.” These platforms, as well as social-based platforms

⁵⁵ “What Is OTT?,” Endavo, <https://www.endavomedia.com/what-is-ott/>.

like Instagram and TikTok, bear some similarities to what Abigail de Kosnik refers to as “rogue archives” in her 2016 book *Rogue Archives: Digital Cultural Memory and Media Fandoms*. These spaces, as de Kosnik defines them, provide “constant (24/7) availability; zero barriers to entry for all who can connect to the Internet; content that can be streamed or downloaded in full, with no required payment, and no regard for copyright restrictions (some rogue archivists digitize only what is already in the public domain); and content that has never been, and would likely never be, contained in a traditional memory institution.”⁵⁶

It’s true that social media has allowed for expanded access to everything from new indie film releases to rare archival material, and that video platforms have served as the basis for important cataloging projects, such as Maya Cade’s Black Film Archive.⁵⁷ Many social platforms provide ways for users to download and save their content elsewhere. But YouTube itself is not an archive any more than the projection booth at your local AMC is an archive—it is a digital distribution platform, first and foremost. And if the only available copy of a film in existence is a file that resides on YouTube’s servers, it only takes one decision from Google to remove that work from existence. The most common reason for this is that video is flagged for copyright infringement by YouTube’s AI software that automatically detects copyrighted material, known as Content ID. The glaring issue with this is that the algorithm cannot detect whether the use of a copyrighted material in a work is authorized or unauthorized, or if the use of the material could be considered fair use under United States copyright law. Additionally, there have been many cases of corporations and individuals abusing YouTube’s DMCA takedown request system in order to remove unflattering portrayals. For instance, in 2020, electric vehicle manufacturer Nikola issued copyright takedowns of videos revealing that their promotional ad for a

⁵⁶ Abigail De Kosnik, *Rogue Archives: Digital Cultural Memory and Media Users* (Cambridge, MA: The MIT Press, n.d.).

⁵⁷ Maya Cade, Black Film Archive, <https://blackfilmarchive.com/>.

“self-driving” truck was staged by rolling the truck down a hill.⁵⁸ As a response to this, amateur archivists have explored options for generating automated downloads of videos on platforms like TikTok using web crawler technology, but TikTok itself has actually blocked capture feeds, making it difficult to amass an offline archive of these videos.⁵⁹

Moreover, as any content creator who has tried to make a living off of YouTube knows all too well, the platform is not as democratic as its initial promise made it out to be, with major broadcasting corporations striking deals with the platform to prioritize their content in searches and recommendations over that of independent creators. Robert Gehl actually predicted this outcome back in 2009 with the paper “YouTube_As_Archive: Who Will Curate This Digital *Wunderkammer*?” In it, Gehl writes, “While YouTube promises to democratize media, its lack of a centralized ‘curator’ actually sets the stage for large media corporations to step into the curatorial role and decide how each object in YouTube’s archives will be presented to users.”⁶⁰

The fragility of online video platforms has now carried over to the other dominant form of OTT media distribution: the streamers for major studios. Since HBO Max’s buyout with Discovery, original shows have disappeared suddenly off the platform,⁶¹ and showrunners being uncertain as to how to access their work or what rights they’ll have over sharing or distributing it in the future.⁶² With no home media options for these titles, piracy has become the de facto but

⁵⁸ Jon Brodtkin, “Nikola Issues Copyright Takedowns against Critics Who Use Rolling-Truck Clip,” *ArsTechnica*, October 2, 2020, <https://arstechnica.com/tech-policy/2020/10/nikola-tries-to-silence-critics-with-copyright-takedowns-of-youtube-videos/>.

⁵⁹ Karl Blumenthal, “Archiving Tiktok,” Archive-It, April 25, 2023, <https://support.archive-it.org/hc/en-us/articles/4410475150868-Archiving-TikTok>.

⁶⁰ Robert Gehl, “YouTube_As_Archive: Who Will Curate This Digital Wunderkammer?” (George Mason University, 2009), https://collections.lib.utah.edu/dl_files/54/11/54116a81b4e562697f4ce4d50daffad382dd3d0f.pdf.

⁶¹ Eric Deggans, “Popular Titles Are Vanishing from HBO Max after Merger,” *NPR*, December 17, 2022, <https://www.npr.org/2022/12/17/1143901911/popular-titles-are-vanishing-from-hbo-max-after-merger>.

⁶² Kathryn VanArendonk, “TV Has Always Disappeared. This Feels Different.,” *Vulture* (blog), December 14, 2022, <https://www.vulture.com/article/hbo-max-warner-cancelations-disappearing-tv-streaming-future.html>.

highly imperfect solution to preserving these works outside of their corporate owners.⁶³ Though piracy can guarantee extended access to these works for public consumption, torrents are not a substitute for true preservation masters.⁶⁴

6. Lack of financial and institutional support

The issue of distributors gatekeeping or outright losing film titles predates digital cinema. In 2022, the nonprofit Missing Movies was established to help filmmakers, distributors, and archivists to locate missing film materials or even entire movies that have gone missing, have ownership rights up for litigation thanks to either licensed content or to distributor mergers, bankruptcy, and/or dissolution. Many of the films identified by Missing Movies include commercially-released projects that, while considered independent films, were recognizable titles from recognizable directors: Elaine May's *The Heartbreak Kid* (1972), Mary Harron's *I Shot Andy Warhol* (1996), Charles Burnett's *Annihilation of Fish* (1999), and more. Among the reasons listed on the Missing Movies website as to why films commonly go missing, one of them is labeled as "distributor indifference." "The film has an identifiable distributor who may or may not have all of the materials and the rights to exploit the film but chooses not to," it reads. "The reasons may have to do with the film's content (deemed inappropriate or 'not commercial') or, in most cases, there's an unwillingness to spend the tens of thousands of dollars necessary to upgrade the film to current technological standards (i.e. a 2K or 4K digital conversion) for use in cinemas, streaming, disc or television)."⁶⁵ Sometimes, merger contracts may leave certain titles

⁶³ Swapnil Dhruv Bose, "Why Piracy Is the Most Effective Form of Film Preservation," *Far Out*, February 5, 2022, <https://faroutmagazine.co.uk/piracy-effective-film-preservation/>.

⁶⁴ John D. Martin III, "Piracy, Public Access, and Preservation: An Exploration of Sustainable Accessibility in a Public Torrent Index," *Proceedings of the Association for Information Science and Technology* 53, no. 1 (December 27, 2016), <https://asistdl.onlinelibrary.wiley.com/doi/full/10.1002/pr2.2016.14505301123>.

⁶⁵ Missing Movies, <https://missingmovies.org/>.

in a state of legal limbo, such as when Sony purchased Columbia's home movies division but did not acquire the rights to redistribute the films. In other cases, the films may have been released entirely independently with no distributor at all, in which case the film elements "may be in the possession of the filmmaker, at a lab, or have gone missing."⁶⁶ And for many of these films, especially those made on shoestring budgets, the underlying rights to the story, music, or other copyrighted material used in the project may not have the proper clearance for redistribution.

Even if a studio's archival practices appear thorough and foolproof, they are a business at the end of the day, and not beholden to the wishes of the individual filmmaker. The reality is that, as a result of incidences like the Universal fire, many studios now place their archival holdings with third-party, off-site storage companies such as Iron Mountain, offloading the responsibility and long-term maintenance complications onto someone else. Iron Mountain employs many skilled professional archivists, but because their entire business model is based on volume, the quantity of assets digitized is prioritized over the quality of that digitization; it's likely that the rise of AI automation will exacerbate this issue, unless proper quality-assurance checkpoints are installed within their workflow. Additionally, the process of requesting and retrieving a single asset within a large-scale storage facility with many different clients can take weeks, if not months—if they can even find that asset at all. This is why it's crucial that filmmakers preserve and maintain their own master copies of their films in their possession.

Of course, this is easier said than done, because the other side of institutional support is funding, and there are currently few grant programs specifically geared towards born-digital creators. Many preservation grants that do exist for filmmakers, such as NFPF grants, are geared towards works that are shot and preserved on film. While Preservation for Filmmakers has received support from the National Film Preservation Board, many independent filmmakers and

⁶⁶ Ibid.

the archivists who want to support them are unable to receive large-scale funding for preservation work. In the *Digital Dilemma* survey, one filmmaker wished for a “[public] place – a library or other institution – where we can have our works archived. It should be free and sponsored by a major cultural institution.”⁶⁷ Other filmmakers expressed similar wishes for a collective approach, and for there to be archives with the “finances, storage space and staff” to store independent works.⁶⁸

While well-meaning, this represents a common misconception of how “major cultural institutions” receive funding for archival projects—not to mention the amount of money required for such a task. The vast majority of funds for specialized collections—such as the work of independent filmmakers—comes from grants, which require arduous application processes that do not guarantee funding. Additionally, funding from grants is finite, and may not fully cover the costs of a long-term preservation project. And while major studio archives may have the storage space, staff, and environmental control required to house these films, they have little financial incentive to store anything in their archive beyond their own assets.

In the case of web-based distribution, online platforms have enticed creators to their platform through the promise of funding. In 2022, TikTok established a “creator fund” that would guarantee \$200 million that would be distributed annually to creators on their platform based in the U.S. But, as longtime YouTube personality and internet creator advocate Hank Green pointed out shortly after the announcement, that number will remain static no matter how much annual revenue TikTok makes as a company, or how many creators join the fund. Plus, TikTok’s ad structure does a disservice to creators hoping to receive ad revenue; unlike YouTube, which runs ads immediately preceding each video, TikTok runs ads in between videos as users

⁶⁷ Shefter and Maltz, “The Digital Dilemma 2,” p. 17.

⁶⁸ Ibid.

are scrolling their feeds. This means there's no way for TikTok creators to receive direct revenue through ads, which is a major source of income for YouTube creators.⁶⁹ That being said, even YouTube's Partner Program for creators who monetize their work on the platform is not ideal. In the past few years, the platform has run into legal trouble from creators who believe their content has been unfairly demonetized, sometimes in a discriminatory manner, as in the 2019 case where LGBTQ creators sued the company for demonetizing their videos that contained queer-related, but not sexually explicit, content.⁷⁰ And even if that content had been explicit or profane, therein lies the inherent issue with YouTube for filmmakers, creators and artists: The platform's ability to act as a viable host for innovative or transgressive art will always be shackled by its need to appeal to advertisers.

In a 2017 survey conducted by Luca Antoniazzi at the University of Leeds, individual filmmakers were asked about their thoughts on preserving their digital data on photochemical film. Unsurprisingly, the majority of interviewees considered the process to be too costly. A more likely but still far-off solution would be for filmmakers to be able to preserve their films on both digital hard drives at LTO technology. "A transition from a completely analogue to a completely digital preservation strategy is not foreseeable," Antoniazzi notes. "Hybrid solutions (digital/analogue and tape/disks) seem to be the most viable, flexible and affordable options."⁷¹ The good news is that LTO technology, as with all digital and digital-adjacent storage, is now more affordable than ever. Factoring in the cost of LTO-9 devices, the price for storing 1 PB of

⁶⁹ Hank Green, "So...TikTok Sucks," YouTube video, January 20, 2022, <https://www.youtube.com/watch?v=jAZapFzpP64>.

⁷⁰ EJ Dickson, "Inside LGBTQ Vloggers' Class-Action 'Censorship' Suit Against YouTube," *Rolling Stone*, November 14, 2019, <https://www.rollingstone.com/culture/culture-features/lgbtq-youtube-lawsuit-censorship-877919/>.

⁷¹ Luca Antoniazzi, "The Sustainability of Film Heritage: Cultural Policy, Digitalisation and Value" (University of Leeds, 2017), https://etheses.whiterose.ac.uk/16918/1/Antoniazzi_L_Media%26Communication_PhD_2017.pdf, p. 173.

data is just under \$15,000 as of February 2022,⁷² which is significantly cheaper than the cost to store that much data on hard drives. To put that in a more manageable scale for most independent filmmakers, a single LTO-9 tape, which can hold up to 18 TB of uncompressed data and 45 TB of compressed data, costs around \$140,⁷³ while a single Seagate IronWolf HDD drive that holds 20 TB costs \$328.⁷⁴ Still, the vast majority of creators will be stuck archiving their work on external hard drives, not only for convenience but because it's all that they can hope to afford.

7. Conclusions

It's increasingly clear that digital filmmakers are working with widely differing gaps of strengths and weaknesses, with no consistent protocol as to how to archive digital material in a way that best matches their chosen profession. Filmmakers will need to sort assets by project, while internet content creators may need a more complex system of organizing video and audio that cross-references their other work. Artists may fall somewhere in between, depending on the substance and serialization of their work. What is clear is that a little extra funding in the budget does not directly translate to a comprehensive preservation strategy, which is how freelance editors like Osborn end up archiving the work of record labels. This is not the fault of any one person, whether a YouTuber working completely solo or a producer for an independent production studio, but rather a systemic negligence towards archiving digital film within these parallel industries. This is what allows even skilled and organized people to overlook principles that archivists take for granted.

⁷² Desire Athow, "First Ever LTO-9 Tape Drive Review Shows Lots of Promise - but Also Worrying Weaknesses," *TechRadar*, February 4, 2022, <https://www.techradar.com/news/first-ever-lto-9-tape-drive-review-shows-lots-of-promise-but-also-worrying-weaknesses>.

⁷³ <https://www.amazon.com/HPE-LTO-9-45TB-Data-Cartridge/dp/B09GBGDMJN>.

⁷⁴ <https://www.amazon.com/Seagate-IronWolf-20TB-Internal-Drive/dp/B09MKK1YCK>.

III. Recommendations

The following section will outline some potential preservation strategies for independent filmmakers and content creators using born-digital assets. The recommendations here are designed to be broad and applicable to a wide range of content. By the same token, filmmakers and creatives may want to adjust or tinker with these suggestions in order to fit their specific preservation needs, resources or budget. I will also include some recommendations for how archivists can approach filmmakers and content creators about these issues, both through individual outreach as well as more systemic changes that can be put in place.

1. Short-term/ongoing recommendations

The most important short-term recommendation that filmmakers can apply to their works is file organization. It's critical to come up with a file naming standard that is uniform across every file in a collection. As an example, each file name can start with the name of the project—the film title, or an abbreviation of it—followed by the context for the file. If it's raw footage, the file name may indicate the date it was shot, which take it is, and/or which camera it was shot on. If it's a work file or a rendered file that's not the master cut, the name can refer to which cut of the film it represents, and what its purpose is—"rough cut," "release cut," "festival trailer," etc. This will make sorting through and recovering film elements much easier for both the filmmaker and any future parties—archivists, distributors, etc.—who may later gain possession of the collection. For similar reasons, it's best to group all the files for different projects into designated folders for each project. In the case of YouTubers or other creators who make serialized content and refer back to previous footage, grouping certain raw video files

together by content, rather than by project, may be more practical—it all depends on which organizational style fits which need best.

The next step filmmakers should take is backing up their data, which ideally they would do with both physical storage—such as an external hard drive, separate from their local storage such as the laptop or desktop that they edit on—as well as some form of cloud storage system. Hard drives should correspond to the operating system of the filmmaker’s main drive. Additionally, it's best to be future-thinking and buy extra storage space depending on how much content is expected to be produced in the next few years. As an extra safeguard, identical copies may be stored on two separate hard drives in two separate locations—just remember that, if the hard drives are the same model and were bought at the same time, it is very likely that they'll fail at the same time.

As for cloud storage options, Amazon Web Services and Google Cloud Storage are popular, with Google being slightly more intuitive for freelancers. However, cloud storage should not be the sole method used for backing up data, both because of its status as a relatively new technology with myriad security risks, and because it would be very unwise to trust Google or Amazon to be the sole guardians of one’s personal data. Contracts with any of these services should be read carefully, and an exit strategy should be put in place by individuals, production teams, or institutions using cloud storage in case data is compromised.

If you're actively producing digital content, space is always going to be an ongoing concern, especially when paying for backup services like the cloud. What should be kept, and what should creators get rid of over time to free up storage space? When considering what to keep and what to discard, it's important, first and foremost, for filmmakers and creators to always save the final cuts, or “masters,” of their work, both in compressed and uncompressed versions.

Uncompressed versions ensure a high-quality preservation master from which additional copies can be made, if needed, while compressed files can be more easily transferred and shared for distribution and access.

The second most important elements to keep are raw camera files, followed by at least one work file, ideally the most recent version that served as the basis for the film master. Raw camera files typically take up the most storage space, and thus it may be necessary to seriously consider which files to keep and which to remove. Project files, however, tend to be small, as they don't actually contain AV content files but rather "summon" them from elsewhere on the drive using file paths. This makes them worth saving in order to make quick revisions to a project whenever necessary.

Saving metadata for a collection can be daunting if filmmakers don't have much experience working with XML documents or open-source software such as Mediaconch, but keeping a spreadsheet of all files, with their names, dates, and relevant metadata fields, can be helpful for quickly assessing the collection at any time. Filmmakers may want to include both descriptive metadata (title, length of the video, cast and crew members who participated in it) and technical metadata (file type, format/codec, bit rate, resolution, etc.).

2. Long-term preservation

For long-term preservation, hard drives will last two to five years before they need to be replaced. Though SSDs are generally more reliable than HDDs, they are more expensive and still prone to malfunctioning and failure through their power supplies, especially if the user is

frequently accessing data from the drive.⁷⁵ Drives should be kept in storage that is safe from temperature fluctuations, dust, or electrical surges that can disturb their functionality.

In archives, it's common practice to run fixity checks on digital files in order to maintain their integrity and keep tabs on any potential file corruption. However, running checksums can be complicated for the average person who has limited experience running scripts using Terminal or other command line interfaces on their computer. It's also difficult to give a good recommendation on how often to run checksums on files as a matter of habit; institutional policies for libraries and archives range from running checksums on their whole collection once a month (which would be incredibly costly, time-consuming, and have a negative environmental impact) to once a year or less. Filmmakers may not want to run checksums unless they absolutely have to, such as when transferring files between drives, where a potential corruption could take place. However, checksums are useful against data corruption in the long run, and are the only sure way to know whether or not the file is damaged. At the very least, if not running checksums, filmmakers should look through any files being copied or transferred between drives and check that each transferred file is both 1) able to be played back and 2) has an identical file sizes to the original.

Finally, filmmakers should be prepared for not everything to go smoothly, and to allow for some flexibility. Just as in film production, they should expect things to go wrong, to not panic as a result. They should also be prepared for files in their digital storage that they didn't think were that important to suddenly become crucial a couple years down the line, or vice versa.

⁷⁵ "How Long Do Hard Drives Last? Lifespan And Signs Of Failure," ProSoft Engineering, September 15, 2020, <https://www.prosofteng.com/blog/how-long-do-hard-drives-last>.

3. Recommendations for archivists

Lastly, I wanted to propose what we as archivists can take away from all this, and what some possible solutions are for leveling the playing field when it comes to digital preservation. There's an urgent need for archivists to provide better outreach to digital media industries, so that independent filmmakers don't see archiving as a niche industry or someone else's responsibility, but rather an integral part of digital filmmaking.

The first step would be to advocate for and establish more grant funding for born-digital and web-based works. Filmmakers and creators who work with digital video and/or share their content online should not have to rely exclusively on for-profit distribution platforms to provide them with funding, and while crowd-funding websites such as Patreon and Kickstarter help to fill in the gaps, it might be worth setting up nonprofit funds for the explicit purpose of preserving digital works, much in the same way that NFPF grants preserve works on film. Additionally, archivists should campaign for existing grant programs geared towards film production to explicitly fund long-term preservation efforts for their recipients. This would fit into the mission statements for programs such as the Media Arts grant from the National Endowment for the Arts, which aims to “advance or sustain the creative work or careers of people whose opportunities to engage within the field of media arts are limited by factors such as geography, race or ethnicity, economics, or disability.”⁷⁶ As I have outlined, preservation helps filmmakers to keep autonomy over their work, thereby contributing to a robust independent filmmaking ecosystem. NEA has taken a step in the right direction through their Independent Film & Media Arts Field-Building

⁷⁶ “Grants for Arts Projects: Media Arts,” National Endowment for the Arts, <https://www.arts.gov/grants/grants-for-arts-projects/media-arts>.

Initiative, a collaboration with Bay Area Video Coalition (BAVC), but has yet to narrow in on supporting programs geared towards preservation.⁷⁷

Another solution would be to encourage digital filmmakers to employ community cloud infrastructures that would support each other in archiving their work. A community cloud is defined as “a cloud infrastructure in which multiple organizations share resources and services based on common operational and regulatory requirements.”⁷⁸ While not explicitly designed for community archiving, community cloud has the potential to be used as such, as it represents both economic and practical benefits to workers and creatives using digital video. With more people than ever working remotely as a result of the Covid-19 pandemic, community cloud allows organizations in multiple physical locations to have access to the same assets. But it also can be used to pool cloud computing resources together while still having extra security compared to a public cloud system.⁷⁹ So far, community cloud structures have primarily been used within the government, healthcare, and education sector as a means of sharing resources across multiple facilities. For filmmaker collectives or small production companies, it may be possible to introduce a hybrid system in which sensitive data may be stored on a local, private cloud server, while finished projects and access copies sit on a public cloud that each participant contributes a small portion of funds to.⁸⁰ This would also allow relevant vendors, such as post-production houses or film archivists, to access certain files with permission from the administrator without gaining public access to the entire cloud environment. As with all cloud computing initiatives, any storage on the cloud should be done with an agreed-upon exit strategy in mind. There also

⁷⁷ “Field Briefing: Independent Film and Media” (Sundance Institute, National Endowment for the Arts, November 2022), <https://www.arts.gov/sites/default/files/IMAG-Field-Briefing-KMR2.pdf>.

⁷⁸ Ramya Mohanakrishnan, “What Is Community Cloud? Definition, Architecture, Examples, and Best Practices,” *Spiceworks* (blog), August 5, 2021, <https://www.spiceworks.com/tech/cloud/articles/what-is-community-cloud/>.

⁷⁹ Alex Hunter, “Overview and Benefits of a Community Cloud Model,” *Parallels* (blog), November 9, 2020, <https://www.parallels.com/blogs/ras/community-cloud/>.

⁸⁰ SMPTE Staff, “Cloud Technology for TV and Filmmakers,” *SMPTE* (blog), May 18, 2020, <https://www.smpete.org/blog/cloud-technology-tv-and-filmmakers>.

must be assurance that participating filmmakers and creators will hold autonomy over their own work within the cloud system. Overall, while utilizing cloud technology for community archiving is still uncharted territory, its potential for independent filmmakers should be explored.

Finally, archivists should be pushing for university programs centered on film production or cinema studies to expand archival practices in their curriculum. Digital preservation concepts should be introduced early on, connecting them back to the history of film preservation as a whole and the vital role that archives have played in film education and even the art of cinema itself. At MIAP, Dan Strieble's Curating Moving Images course—which is open to all Cinema Studies students—is one example of a course that showcases filmmakers who incorporate archival material into their work in interesting ways, and that makes students aware of orphan films and other vulnerable audiovisual works that were never properly archived. In more production-focused courses, students should be expected to draft long-term preservation plans for their films alongside call sheets, location release forms, and other important paperwork. Class projects could center on setting up a RAID system and researching the best file formats for preservation copies of works, as well as learning how to use archival softwares such as MediaInfo and perform checksums. This will give filmmakers a better understanding of archival practices and a foundation for integrating those practices into their own professional work.

IV. Conclusion

It would be impossible to give each filmmaker a graduate-level understanding of digital archiving and the tools to implement each best practice, but with a stronger emphasis on outreach, archivists can lay the groundwork for normalizing good preservation practice in the digital video profession. I refer back to the National Digital Stewardship Alliance's Levels of Digital Preservation,⁸¹⁸² which allows institutions to assess the degree to which they've implemented digital archiving standards. Realistically, an institution or individual may not get to Level 4 in all categories, but it can help give benchmarks as to what they're capable of and what more they could be doing. When speaking with independent filmmakers, archivists should approach digital archiving recommendations in the same way, meeting the person halfway and tailoring recommendations to their needs with a clear understanding of the specific work that they do with digital video.

As the world of digital filmmaking and online video content continues to blur, this type of outreach will only become more necessary, as high-volume production and instantaneous access to audiovisual entertainment will continue to be prioritized over long-term preservation. Even amateur videographers—that is, all of us—should be thinking about how much content we are producing, what we are saving, and how we hope to access our videos in the future. Depending on who you ask, digital video can represent important records, creative expression, or simply a placeholder for memories. We cannot afford to lose more than we already have.

⁸¹ <https://ndsa.org/publications/levels-of-digital-preservation/>

⁸² "Levels of Digital Preservation," National Digital Stewardship Alliance, <https://ndsa.org/publications/levels-of-digital-preservation/>.

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