

# **Preservation of Digital Motion Pictures in Museums**

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**Abstract**

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Since the turn of the 20<sup>th</sup> century, motion pictures have been a vital piece of cultural heritage. Over the last 30 years, digital formats have become increasingly popular for the production and storage of motion pictures. Digital technologies have been effective for production of motion pictures but have caused many problems for those charged with their preservation. This has become abundantly prevalent in museums that have traditionally had a collection of film and analog tape and are now moving towards digital collections. The purpose of this research was to understand what is being done in museums when it comes to the long-term preservation of digital motion picture collections and what challenges museum collections professionals are facing. This qualitative descriptive study used semi-structured interviews with museum professionals involved with preserving digital motion pictures. Collections staff from six museums in the Pacific Northwest region, that had a collection of film, analog tape and digital motion pictures were interviewed. Results show that despite differences in collection size and scope, museums are struggling to keep up with digital preservation standards. A lack of resources and constantly shifting technology were cited by most museum professionals as prevalent reasons that museums are falling behind in this area. Museum professionals did have some ways to combat these problems, including using the expertise of local resources as well as trying to obtain funding to help with a lack of resources. However, museums cannot control new

technology, and until something changes, most museums will continue to struggle to preserve digital motion pictures for some time to come.

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# Contents

Chapter 1: Introduction .....	<b>Error! Bookmark not defined.</b>
Chapter 2: Literature Review .....	12
I. Cultural heritage worth Preserving .....	<b>Error! Bookmark not defined.</b>
II. Preservation of Film .....	16
III. Transitioning from film to digital technologies .....	18
IV. Issues with preservation of digital motion pictures .....	21
V. Digital technology and preservation strategies .....	<b>Error! Bookmark not defined.</b>
VI. What is being done in the field today .....	31
Chapter 3: Methods .....	33
Research Purpose .....	<b>Error! Bookmark not defined.</b>
Research Design .....	<b>Error! Bookmark not defined.</b>
Subject Recruitment .....	<b>Error! Bookmark not defined.</b>
Data Collection .....	34
Data Analysis .....	35
Study Limitations .....	36
Chapter 4: Analysis .....	37
Description of Sample .....	37
Findings .....	40
Chapter 5: Conclusions .....	54
Next Steps .....	56
References .....	59
Appendix I: Subject Recruitment .....	62
Appendix II: Interview Guide .....	63

## Chapter 1: Introduction

History has been my favorite subject since elementary school. I have always been interested in learning about the past, whether it was about America, Ancient Rome, or sports. It has continued to be a passion of mine, partially fueling my decision to attend graduate school and attempt a career in the museum field. One piece of history that I have become increasingly passionate about over the past five years has been the history of motion pictures. In my spare time, I try to watch as many classic movies as I can, in order to better understand the overall history of motion pictures. Every time my brother and I get together, we share our thoughts about the latest movies, some of our favorite movies from the past, the Oscars and how all of this impacts the history of motion pictures. If we have the time, we usually watch a few of our favorites. This passion for motion pictures would not be feasible if not for the preservation of all the films of the past. Now, with the advent of digital technologies, the preservation of motion pictures in collecting institutions is changing. With this new technology, motion pictures are being produced in new formats. These new formats are changing the landscape of how motion pictures are being shared and preserved by institutions such as archives, libraries and museums. In order to be able to enjoy these motion pictures for the next generation, it is important for them to be preserved in these new formats for the long-term.

Since their introduction at the turn of the 20<sup>th</sup> century, motion pictures have evolved significantly. Sound and dialogue were introduced in 1927 with *The Jazz Singer* (Kushins, 2016). Color became popular in the 1930's with motion pictures like *Gone with the Wind* and *The Wizard of Oz* (McKittrick, 2019). A new, safer type of celluloid film was popularized in the

1950's and has been the dominant format for motion picture production until recently (McGreevey & Yeck, 2006).

Over the last half century, the preservation methods of film have become standard, allowing film to be preserved for upwards of 100 years (Maltz, 2014). Since the turn of the 21st century, digital technologies have become increasingly popular in the production of motion pictures. This new technology allows studios to cut costs and streamline the editing and postproduction process (Maltz, 2014). The question with this digital takeover is, how do institutions preserve this form of media for the long-term?

Preservation of digital motion pictures is much more difficult than film. A study done by the Academy of Motion Picture Arts and Sciences shows that preserving a digital motion pictures costs about ten times as much as film (The Digital Dilemma, 2007). It is also much more time consuming for staff to preserve digital motion pictures. Digital formats are changing rapidly and if digital formats are not updated every few years to keep up with new technologies, they will be rendered useless. Previous studies show that without constant transferring to newer formats and attention from collections specialists and archivists, digital motion pictures will become unusable after two years. This is quite the change from the more than 100 years that film can survive in the right conditions. Shifts in technology and preservation techniques have had a major impact on institutions that are in the process of transitioning from a film collection to integrating more digital motion pictures. Collecting institutions must adjust from the passive preservation of film to the much more involved long-term preservation of digital motion pictures.

This is a pressing concern for many collecting institutions. Many archives and libraries have large collections of film and video to care for. With motion pictures becoming more and more digital, these institutions are beginning to add digital motion pictures to their collection.

These are also beginning to come into collections at museums. For museums that have a collection of film, long-term preservation has been fairly easy and efficient for the last 50 years. Film can take a good amount of “benign neglect” (Maltz, 2014). Museum and archive staff can let films sit for an extended amount of time without having to do any preservation work with them. With the advent of digital technologies, museum’s collections have become increasingly digital, including their motion picture collections. This is problematic for the long-term preservation of motion picture collections at museums.

The literature focuses on what archives and libraries digital motion picture collections. These institutions are beginning to collect digital motion pictures and have some of their film collection digitized. While archives and libraries are experiencing these problems, there have been studies on their collections. Their problems have been brought to light with research looking at this new phenomenon. This knowledge gap puts museums at a disadvantage when it comes to the preservation of digital motion picture collections. Not much has been discovered about how museums are dealing with the problems that archives and libraries are experiencing with their digital motion picture collections.

Therefore, the purpose of this study is to understand digital preservation practices of museums that are transitioning their collection from film to digital motion pictures and how they are addressing the issue of long-term digital preservation. This study will be framed by the following research questions:

1. What strategies do these institutions use to preserve digital motion pictures long-term?
2. What are common challenges that museums face with the long-term care and preservation of digital motion pictures?

3. To what extent do current digital preservation practices meet the needs of different museums with varying sizes of digital motion picture collections?

There are some common terms that should be defined for the overall scope of this study. For the purpose of this study, “motion pictures” or “movies” refers to any kind of moving image. This can include full length features, short subjects, news reels, home videos, corporate videos, educational videos and any other type of moving image. Film can be normally be classified as either the physical format or it can be a term for a movie. For this study, “film” will refer to celluloid film and the actual chemical and physical format. “Analog tape” refers to VHS, Betamax and other tape-based formats that record audio and video.

As digital motion pictures become more popular, museums must figure out how to preserve them for the long-term. This study will be significant to museums that have a collection of film and other analog tape that are in the process of transitioning to more of a digital collection. It will be important for these museums to be able to compare what they are doing in terms of preservation to other museums that have collections containing both film and digital motion pictures. Museums will then be able to take this new information and devise new and improved collections strategies based on the successes and failures of other institutions. With more knowledge about overall practices, museums can step up and help to create better standards for digital preservation in hopes that digital motion pictures will last far into the future.

## Glossary

With the exception of motion picture, movies and film, the sources of these terms are identified when they are introduced in the body of the paper.

**Analog tape** - Refers to VHS, Betamax and other tape-based formats that record audio and video.

**Bit rot** - The slow deterioration in the performance and integrity of data stored on storage media.

**Born digital** - Texts or recordings produced in digital form, rather than having been converted from print or analog equivalents.

**Compression** - Reduces the size of file formats by eliminating redundant and non-functional data from the original video file.

**Codec** - A device or program that compresses data to enable faster transmission and decompresses received data.

**Data migration** - The process of transferring data between data storage systems, data formats or computer systems.

**Digital recording** – Recordings on a dedicated physical platform such as DVD's and Blu Ray discs.

**Emulation** - The ability of a computer program in an electronic device to imitate another program or device.

**Film** – Refers to celluloid film and the actual chemical and physical format.

**Fixity** - Information used to verify whether an object has been altered in an undocumented or unauthorized way.

**Media Assets Management (MAM)** – Software that is used to organize, store and retrieve digital assets and manage digital collections. These include photos, music, videos and other digital assets.

**Metadata** - A set of data that describes and gives information about other data.

**Motion picture and Movie** - Refers to any kind of moving image. This can include full length features, short subjects, news reels, home videos, corporate videos, educational videos and any other type of moving image.

**Server** - A computer or computer program which manages access to a centralized resource or service in a network.

**Technological obsolescence** - When a technical product or service is no longer needed or wanted even though it could still be in working order. Technological obsolescence generally occurs when a new product has been created to replace an older version.

## Chapter 2: Literature Review

Motion pictures, in its many forms, have been an important form of entertainment, news and information sharing for the last century. For much of that time, motion pictures were produced on film. Today, however, digital technologies have progressed significantly and have become highly involved in the production of all kinds of motion pictures. This recent popularity and prevalence of digital motion pictures is beginning to affect the museum world. With such an increased rate of production of this new medium, preservation practices are becoming very important. Museums that have been involved in the collecting and preserving of film now must transition to a more digital world. Film, while fairly unstable, could be preserved for a very long time. So far, this has not been the case for digital motion pictures. The long-term preservation of digital motion pictures has presented quite a few challenges. This has proven difficult for museums who are in the process of transitioning from a film-based collection to a more digital collection of motion pictures.

The purpose of this study is to understand digital preservation practices of museums that are transitioning collections from film to digital motion pictures and how they are addressing the issue of long-term digital preservation. To understand how museums are trying to deal with this new phenomenon and the challenges that it brings, it is important to look at six different areas of the literature. The first section discusses the history of film preservation and how motion pictures became an important form of cultural heritage. Next is a section about the preservation of film. This is followed by a section focusing on the transition from film-based motion pictures to digital motion pictures. Next is a section describing the problems that digital motion pictures are causing for preservation, followed by the technical details of digital preservation. The

literature review concludes with a section about how other types of institutions are handling the digital preservation problem.

## **Cultural heritage worth preserving**

Motion pictures have been around since the turn of the 20<sup>th</sup> century. Early on in their existence, they were seen by many as a disposable medium. Large studios in Hollywood who produced large amounts of motion pictures did not begin to care about preserving their assets until the 1950's (McGreevey & Yeck, 1997). They did not see the possible value of preserving their films for the future. In some extreme cases, some filmmakers were known to destroy their own works so that nobody else could copy it (McGreevey & Yeck, 1997). Due to this way of thinking, only 50% of films survive from before 1950 and only about 20% from the silent era (Higgins, 2006).

During this early stage, motion pictures were made on very unstable materials. Nitrate film was used until the 1950's (McGreevey & Yeck, 1997). This factor added to the amount of motion pictures that were lost early on. The nitrate film was extremely unstable and would cause fires and degrade very quickly in studios and private collections (McGreevey & Yeck, 1997). In the 1950's, this problem was mostly resolved by integrating acetate film, or "safety film" into the production of motion pictures (McGreevey & Yeck, 1997). This drastically reduced uncontrollable loss of films due to fire or other rapid degradation. Around this same time, there was also a shift in the collective thinking of those involved in motion picture production.

Shifting ideologies about the importance of the preservation of motion pictures led to different institutions getting involved in the process. The public had a growing interest in viewing previously produced motion pictures. This demand sparked the idea that motion

pictures were an important medium and led to the first film archives being started (Wasson, 2005). In 1935 the Museum of Modern Art (MoMA) in New York became the first institution in North America dedicated to collecting and preserving film as an art form (Wasson, 2005). MoMA's goal was to save and exhibit motion pictures that were in danger of being lost forever (Wasson, 2005). This was an important step in the preservation of motion pictures. Forming the film library at MoMA was instrumental in altering the general view of motion pictures in the industry. People began to view motion pictures as important cultural items and essential to art and history (Wasson, 2005). At this time, motion pictures became integral pieces of our collective cultural heritage.

The Library of Congress also played a large role in the preservation movement. It was one of the national leaders in the movement for film preservation. The Library of Congress created the first film archive in the United States in 1941 (McGreevey & Yeck, 1997). Records of every copyrighted movie from 1893 are housed at the library (McGreevey & Yeck, 1997). The library believed it was important to collect, organize and make these motion pictures accessible. This had never been a pervasive thought before. In the 1950's and 60's, the library was formalizing preservation activities to help further the overall practice of film preservation (McGreevey & Yeck, 1997). These practices have boosted overall preservation results. Since then, it has become ingrained in the national consciousness that motion pictures are a crucial piece of cultural history and deserve to be preserved for as long as possible. It is not just an institution that is focused on keeping the best or most popular films. The library is more concerned with preserving all types of motion pictures that will help future students understand the complete history of motion pictures, not just the popular, big budget movies (McGreevey & Yeck, 1997).

In 1965, the National Foundation on the Arts and Humanities Act was passed. This act created the American Film Institute (AFI) (McGreevey & Yeck, 1997). AFI was created to coordinate regional preservation activities (McGreevey & Yeck, 1997). When it was founded, AFI's mission was to set up a list of motion pictures that the organization believed were in danger of being lost (McGreevey/Yeck, 1997). Today, AFI continues to be an important organization for motion picture preservation.

In the 1980's, the focus on motion picture preservation hit a high point. Preservation techniques became more robust, with climate-controlled vaults and highly technical methods and procedures (Frick, 2011). Home video blossomed into a large industry. Studios were realizing even more that their motion pictures were assets that could make them money in all new ways (McGreevey & Yeck, 1997). In the 1980's, the National Film Preservation Act was passed by Congress (McGreevey & Yeck, 1997). The act created a national film commission, a film preservation board and the national film registry (McGreevey & Yeck, 1997). Each year, the board selects twenty-five films to preserve in their original formats. The films that are selected are treated as national treasures and are recognized as some of the best and most important films that are worthy of these great preservation resources (McGreevey & Yeck, 1997).

All these organizations have been instrumental in pushing motion picture preservation into the forefront. Since the 1950's, higher preservation standards have increased the lifetime of films. Once motion pictures became threatened, public libraries and archives became much more interested in preserving this cultural heritage and making sure that private studios could not lose them forever (Frick, 2011). Motion pictures have become an integral part of our cultural heritage that are protected and preserved as long as possible.

This focus on the importance of motion picture preservation has continued into the digital age. Preservation has changed and officials still are struggling to push preservation forward into a new age. The Academy of Motion Picture Arts and Sciences (AMPAS), began to pay attention to digital technologies in 2003 (Maltz, 2014). At this time, they formed a Science and Technology Council to monitor technological developments in the film industry (Maltz, 2014). To continue this focus, in 2005, there was a digital motion picture archiving summit. This summit consisted of film archives, motion picture studios and the Library of Congress (Maltz, 2014). These organizations are all highly involved in the motion picture business and continue to advocate for the importance of motion picture preservation.

There have been many people who have been strong advocates for the increased importance of motion picture preservation. Acclaimed director Martin Scorsese is one of motion picture preservation's biggest supporters. Scorsese says that, "Besides being art, film is history, it's our heritage" (Thompson, 1991). In any form that they take, motion pictures are an important part of our culture and should be preserved as long as possible.

## **Preservation of Film**

There are four major types and sizes of film that are used. Each one is used for different types of motion picture but may be found in a cultural heritage repository. 35mm film is what most major movie studios have used to produce their motion pictures. It has been used since the beginning of motion pictures in the 1890's and is made with different kinds of film, including polyester, nitrate and acetate (Bromberg, Palin & Burke, 2005). The mostly likely types to be found in museum and archival collections are 16mm and 8mm. 16mm film was primarily used for education, news, documentaries and some home movies. It can be found on polyester or

acetate film but not nitrate. 8mm film was used mostly with home movies and is mostly without sound. It is on acetate film (Bromberg, Palin & Burke, 2005). Super 8mm film was developed in the 1960's to increase the quality of home movies at the time in the 1960's. Unlike 8mm, Super 8mm can have a soundtrack and can be found in collections on acetate and polyester film (Bromberg, Palin, & Burke, 2005).

There is also another format, 70mm, that has been used to make some feature films, beginning with *Oklahoma!* in 1955. This format has been used to shoot recent movies such as *The Hateful Eight* and *Dunkirk* (Knowles, 2017). Directors such as Christopher Nolan and Quentin Tarantino believe that this format is the best way to capture film, although it is not used very often anymore (Knowles, 2017). 70mm celluloid films do not show up in many museum collections, but it is still an important format for the history of the medium.

If kept in the best possible conditions, most celluloid film can last for 100 years or more (Maltz, 2014). Film can decay and be destroyed like any other archivable material, but in the right conditions, film can sit unchanged for many years without having to be constantly checked on and worked on. It can be a passive media once it is prepared for long-term preservation. So far, this has proven to be the opposite when it comes to long-term digital motion picture preservation.

Basic film preservation follows these few steps. First, it is important to collect all the surrounding information that is accompanying the film and put it all together in one place (Bromberg, Palin & Burke, 2005). The next step is to inspect the film. This allows the staff to determine what kind of film it is and the physical shape it is in and if there is any damage (Bromberg, Palin & Burke, 2005). Film is stored flat on shelves. It must be stored in a cool location with low amounts of humidity. Anything that is deteriorating can be frozen (Bromberg,

Palin & Burke, 2005). The final step that can be done is reformatting the film into digital formats or other formats that allow for better accessibility and preservation. This can include making copies for researchers to use as well as a master copy for further preservation work (Bromberg, Palin & Burke, 2005).

## **Transitioning from film to digital technologies**

For the last century, film has been the chosen medium that motion pictures have been produced on. After the first half of the century where nitrate film was used, it has been a fairly durable and enduring medium when cared for correctly. It has been a useful medium for those charged with preservation. Under the right circumstances, motion pictures on film can be preserved anywhere from 100-500 years (Maltz, 2014). Although film had been the standard for motion picture production and storage for so long, it began to shift toward digital technologies.

Beginning in the 1980's, digital technologies began to make their way into the production of motion pictures. Audio was the first part of production that began to use digital technologies (The Digital Dilemma, 2007). These technologies and practices progressed throughout the decade. Analog tape recording, mixing and effects techniques were replaced by Digital Audio Workstations (DAW) (The Digital Dilemma, 2007). This escalated when Dolby came out with the SR/D format for *Batman Returns* in 1992. Today it is known as Dolby Digital (The Digital Dilemma, 2007). After this breakthrough, even more digital audio services began sprouting up. Having a choice in which products to use on motion pictures is a great advantage for production studios (The Digital Dilemma, 2007).

The need for more advanced visual effects was also a catalyst of the transition to digital technologies. The movie *Jurassic Park* was a catalyst in the digital movement. It is thought of as the first motion picture that has realistic digital characters that are important to the picture

(The Digital Dilemma, 2007). Instead of using a stop motion animation technique for the dinosaurs, they decided to make them fully digital (The Digital Dilemma, 2007). This was a huge advancement in effects and led to digital technologies having a larger role in more motion picture productions. In the same vein, a few years later, Pixar's *Toy Story* was made entirely with computer animation (The Digital Dilemma, 2007). Pixar was the first to do this and since then, most animation has been done using some digital technologies (The Digital Dilemma, 2007). These pioneering works led to a boom of motion pictures that heavily relied on digital technologies.

These advancements in the 1980's and 90's created a need for new Digital Asset Management systems (DAM), a data management tool used to organize elements of a digital archive (The Digital Dilemma, 2007). DAMs require extra costs, but they are good for managing production and postproduction elements and have been used to create many motion pictures in the time since (The Digital Dilemma, 2007). With this new medium, there needed to be some way to store information that could be used at various points of production.

The last part of the process that digital technologies was used for was the mastering of the motion picture. This process creates a master copy that includes every part of the motion picture and is used for archival purposes (The Digital Dilemma, 2007). This involves the final tweaking of the motion picture, including adjusting color and nailing down any final visual stylings of the motion picture (The Digital Dilemma, 2007). Kodak developed the first system that could change pieces of film into digital bits. It was called the KODAK Cineon system and was introduced in 1992 (The Digital Dilemma, 2007). The Academy estimated that, at this time, half of the motion pictures being produced were using this process to create a master copy (The

Digital Dilemma, 2007). Piece by piece, digital technologies began to carve out a useful life in the production and postproduction process of making motion pictures.

There are many economic, environmental and practical benefits to creating a motion picture using digital technologies (Maltz, 2014). Digitally shot motion pictures allow people to shoot a lot of footage and play it back instantly (Maltz, 2014). This makes production much faster than film. It is also a beneficial tool for the editing process. It is much easier to edit and re-compose bits of footage on a computer than having to do this with film (Maltz, 2014). Even directors like Steven Spielberg are beginning to buy into the benefits of digital technologies for production purposes. Until *The Adventures of Tintin* in 2011, Spielberg and his editor would cut film (King, 2018). Since this motion picture, Spielberg has been producing and editing digitally (King, 2018). Digital technology also makes the production of motion pictures much cheaper. It helps cut a lot of costs that used to be incurred with the use of film (Maltz, 2014). Overall, there are plenty of benefits that make it a worthwhile endeavor for filmmakers to make use of the technology.

There are also a few benefits on the post-production side of digital motion pictures. Digital formats help provide access to these works for researchers and the public (Bastron, 2013). Access is important for libraries, archives and museums. It has been very beneficial to the people these institutions serve to be able to have access to more motion pictures than ever. It also creates less need for physical storage space (The Digital Dilemma, 2007). Unlike film, digital motion pictures do not inhabit a physical space, and when they do, it is in the form of a small disc (Blu-ray, DVD, etc.). Most of their storage concerns are on computers and servers, not on physical shelves, taking up space. This development would help save a lot of this precious space for other collections.

Over the past 30 years, digital technologies have been taking over the motion picture industry. At this point, most theaters do not even handle film. About 80% only use digital projectors to screen motion pictures (Maltz, 2014). Today, most things are digital. Analog technologies and formats, such as film and analog tape, have become overshadowed and are on the decline. Most believed that digital tech would be a “god send” for the motion picture industry (Bastron, 2013). When digital technologies were just coming along, archivists were worried about the deteriorating nature of celluloid films and were hoping for a new format in which to transfer their motion pictures to. This new medium has been beneficial for production and the immediate preservation and access of motion pictures; however, there are also some lingering issues to consider before digital motion pictures completely take over.

### **Issues with preservation of digital motion pictures**

Preservation of digital motion pictures and videos can be complicated. Based on the Smithsonian Archive standards of digital video preservation, this type of media will first come to a collecting institution in the form of a DVD, thumb drive or other type of digital media (Bradyh, 2017). The institution will then transfer files to archive servers and hold on to the original formats. These files will then be copied to ensure redundancy (Bradyh, 2017). After these initial steps, it depends on the institution. There is no proven way to preserve digital motion pictures that works for every institution. Unlike other digital files, such as text and pictures, there is no agreed upon format or strategy when it comes to digital videos in collecting institutions (Bradyh, 2017). Digital video is much more complex than these other formats and the needs of different collecting institutions also come in to play with long-term preservation (Bradyh, 2017). Film and digital motion picture preservation are similar on the surface, but when digging into it, the

process completely changes. Digital motion picture preservation cannot be ensured for the long-term at this time and comes nowhere close to what can be accomplished with celluloid film preservation.

There are a lot of benefits to shooting motion pictures in a digital format. However, the preservation of digital motion pictures is where problems occur. The preservation of film has been fairly straight forward over the last half century. Institutions that have film collections could put them in storage with the right conditions and they would last 100 years or longer (Maltz, 2014). So far in the short existence of digital motion pictures, long-term preservation has been much more elusive. This is an important challenge that institutions collecting digital motion pictures must overcome.

One of the biggest issues with the preservation of digital motion pictures is the cost. A study done by AMPAS in 2007 showed just how expensive digital motion pictures are to preserve. The study showed that the yearly cost of preserving an archival copy of a film master is \$1,059 and the cost for a 4k digital master is \$12,514 (The Digital Dilemma, 2007). The cost is this high due to the amount of storage required and the cost of that storage space (Maltz, 2014). This is difficult for most collecting institutions to afford. Production studios try to save every bit of information from the motion picture production because these institutions have the available funds to do so. Studios view digital motion pictures as assets that will continue to make money in the future. Museums and other institutions do not have this luxury. Museums most likely will not have the room in their budgets to save everything. This means that museums will have to pick and choose what information is most important for long-term preservation. Some information will inevitably be lost due to these factors. This does not even include the cost of maintenance, replacing equipment, new software and other future expenses (Maltz, 2014).

Museums that have different kinds of motion pictures (newsreels, artistic performances, etc.) may have slightly cheaper costs, however it is still incredibly expensive to preserve any kind of digital motion picture.

Digital motion pictures also differ from film in another way. Film is a fairly passive media. It can survive long periods of “benign neglect,” meaning that, in the right conditions, film can stay in the same state without people constantly checking it and working on it (Maltz, 2014). This is not the case for digital motion pictures. The technology that digital motion pictures are made with and stored on are only designed to last 3-5 years (The Digital Dilemma, 2007). Most computer hardware and software have the same lifespan. If a digital motion picture is left unchecked, it would likely be unusable after 18-24 months (The Digital Dilemma, 2007). This phenomenon is referred to as “*technological obsolescence*” (Maltz, 2014). It happens because technology is changing so rapidly that every few years, new technology comes along, which means that the old tech will eventually cease to be compatible with newer versions. A similar situation arises when people digitize their photographs from a photo album. Once the pictures are digitized on a computer, cellphone or other medium, they must be moved to newer versions on these technologies every few years. If not, they will eventually be lost to technological obsolescence.

The only realistic way so far to combat this problem is *data migration*. Data migration is having to move your data, in this case some part of a digital motion picture, from one piece of tech to a new one (Maltz, 2014). This can be effective, but it comes with its own problems. Institutions must have trained staff on hand, constantly checking the data to make sure none of it is lost or corrupted. *Bit rot* is another issue that affects digital motion pictures. It is the rotting or corrupting of bits of information that make up the digital motion picture (The Digital Dilemma,

2007). If even one small part of the file gets corrupted, the entire asset becomes unusable. It is important for staff to constantly be making sure that everything is running smoothly.

The hardware and storage systems used for preservation also pose problems. These problems are caused mainly by neglect, carelessness, overuse or inappropriate use (Houghton, 2016). Hard drives that have digital motion pictures on them can crash or malfunction. The software can become obsolete so that it cannot be used with the format of the digital assets. It is important that everything is plugged in and running normally, and that the electricity does not get shut off (Maltz, 2014). There are a lot more challenges that must be accounted for at all times than film preservation is faced with. Even storage devices such as DVD or Blu-ray discs can create problems. If film gets scratched or damaged, it can be fixed to a degree. If a DVD or Blu-ray disc gets scratched, it becomes unusable (Bastron, 2013).

A high-profile example of the issues of long-term preservation of digital motion pictures was seen when Pixar wanted to release the first *Toy Story* on DVD. Five years after its release, when the producers of the motion picture were ready to release it on DVD, they realized that 20% of the original files were corrupted (Alimurung, 2012). They had to put together that lost footage through other, lesser quality copies. Another example occurred when *Toy Story 2* was being completed. At one point, an employee accidentally hit a delete button that began deleting elements of the motion picture. They lost entire scenes of the movie. They were only saved because someone had taken the only other copy of the motion picture home with them to do some work (Alimurung, 2012). All their work on the motion picture was almost destroyed in seconds by one mistake. If it can happen to a large studio such as Pixar, it can almost certainly happen to a small museum collection that is just transitioning to a digital collection.

At this stage, there are many issues facing the long-term preservation of digital motion pictures. All these issues contribute to the fact that digital preservation cannot come anywhere close to the standard set by celluloid film preservation. Digital motion pictures need to be able to survive on their own, without constant data migration, for as long as film can before it can be considered a viable alternative.

There is work being done to close this gap and improve the viability of digital motion picture preservation. Introducing format standards for every part of the motion picture preservation process would go a long way to streamlining digital preservation (Maltz, 2014). Right now, there are up to a dozen different digital image formats that can be used. This causes problems for preservation because archivists need to be ready and able to handle each kind of format. All these formats lead to reduced efficiency, increased costs and a lesser quality product (Maltz, 2014). If a standard image file was set in place, it would drastically improve the efficiency of digital preservation. It would not solve all the problems; however, it would be a nice start.

Another helpful solution would be the use of better *metadata*. This is all the information that describes and gives information about the data that is being preserved, in this case, digital motion pictures (Houghton, 2016). If the metadata that accompanies a digital motion picture is not good, then it will be easily lost. Digital motion picture files would become unusable because it would not be known what exactly was in their files (Houghton, 2016). However, if there were better practices with metadata, then it would become less of a burden on digital archivists who must piece it together.

## **Digital technology and preservation strategies**

These advancements in technology led to the digital revolution in the motion picture industry. This created the need to create ways to manage and store this information, which meant that archives, libraries, museums, studios and any other organizations that wanted to preserve these works needed to figure out a way to do so (Bastron, 2013). To do this, they had to first understand the new technology and then create software programs and institutional policies in order keep up with changing technologies. This section will focus on digital technologies that are used today and how institutions use them in order to preserve motion pictures.

First, it is important to understand the terminology and technology that is associated with digital motion pictures. There are three types of audiovisual recordings. The first are analog recordings, which consists of film, videotape, Betamax, etc., (Wright, 2012). A second category is digital recordings that are on a dedicated physical platform (DVDs, Blu-ray discs). The third type are digital recordings that are stored in digital files and do not have the same type of physical medium. These are stored on computers, hard drives, and servers (Wright, 2012). Digital storage methods are becoming more popular since the 1990's, although most motion pictures are still stored on analog recordings. About 85% of professional motion picture collections are stored on an analog medium (Wright, 2012). There are three ways to preserve analog recordings. One is to conserve the original. Another is to make copies of the original and the final method is to move it onto a new medium (Wright, 2012). Collections are in the process of adding more to their digital collections, including the transfer of film onto digital mediums for storage (Wright, 2012). This can help give the film more access to the public. By transferring to a new medium, it ensures that the celluloid film will not be lost, even when it physically deteriorates.

Once film has been transferred to a digital platform, it is treated the same way as motion pictures that are “born digital” (created with only digital technologies). At this point, institutions are faced with the task of ensuring the long-term access and preservation of motion pictures. Wright describes preservation of motion pictures as, “the totality of the steps necessary to ensure the permanent accessibility forever of an audiovisual document with maximum integrity” (Wright, 2012, pg.8). Meeting this standard has been easier with past formats. Celluloid film can be stored for a long time in the right conditions without having to check in or do anything to it. Digital motion pictures are a little trickier when it comes to preservation. There has yet to be an extremely successful plan to be able to preserve digital motion pictures to the same standard as film. These are some guidelines for institutions to shoot for when beginning the preservation stage of digital collections.

There are different levels of digital preservation. In order to ensure that their materials are safe long-term, museums and other institutions must understand these levels. These can be applied to their broader digital collections and narrowly to specific collections. In this case, it will be applied to their collection of digital videos. Below is a chart produced by the National Digital Stewardship Alliance (NDSA) that outlines the different levels of digital preservation.

**Table 1, NDSA Levels of Preservation**

<b>NDSA Levels of Digital Preservation</b>	<b>Level 1 (Protect your data)</b>	<b>Level 2 (Know your data)</b>	<b>Level 3 (Monitor your data)</b>	<b>Level 4 (Repair your data)</b>
Storage and Geographic Location	<ul style="list-style-type: none"> <li>- Two complete copies that are not collocated</li> <li>- For data on heterogeneous media (optical discs, hard drives, etc.) get the content off the medium and into your storage system</li> </ul>	<ul style="list-style-type: none"> <li>- At least three complete copies - At least one copy in a different geographic location</li> <li>- Document your storage system(s) and storage media and what you need to use them</li> </ul>	<ul style="list-style-type: none"> <li>- At least one copy in a geographic location with a different disaster threat</li> <li>- Obsolescence monitoring process for your storage system(s) and media</li> </ul>	<ul style="list-style-type: none"> <li>- At least three copies in geographic locations with different disaster threats</li> <li>- Have a comprehensive plan in place that will keep files and metadata on currently accessible media or systems</li> </ul>
File Fixity and Data Integrity	<ul style="list-style-type: none"> <li>- Check file fixity on ingest if it has been provided with the content</li> <li>- Create fixity info if it wasn't provided with the content</li> </ul>	<ul style="list-style-type: none"> <li>- Check fixity on all ingests</li> <li>- Use write-blockers when working with original media</li> <li>- Virus-check high risk content</li> </ul>	<ul style="list-style-type: none"> <li>- Check fixity of content at fixed intervals</li> <li>- Maintain logs of fixity info; supply audit on demand</li> <li>- Ability to detect corrupt data</li> <li>- Virus-check all content</li> </ul>	<ul style="list-style-type: none"> <li>- Check fixity of all content in response to specific events or activities</li> <li>- Ability to replace/repair corrupted data</li> <li>- Ensure no one person has write access to all copies</li> </ul>

Information Security	<ul style="list-style-type: none"> <li>- Identify who has read, write, move and delete authorization to individual files</li> <li>- Restrict who has those authorizations to individual files</li> </ul>	<ul style="list-style-type: none"> <li>-Document access restrictions for content</li> </ul>	<ul style="list-style-type: none"> <li>- Maintain logs of who performed what actions on files, including deletions and preservation actions</li> </ul>	<ul style="list-style-type: none"> <li>- Perform audit of logs</li> </ul>
Metadata	<ul style="list-style-type: none"> <li>- Inventory of content and its storage location - Ensure backup and non-collocation of inventory</li> </ul>	<ul style="list-style-type: none"> <li>-Store administrative metadata</li> <li>- Store transformative metadata and log events</li> </ul>	<ul style="list-style-type: none"> <li>- Store standard technical and descriptive metadata</li> </ul>	<ul style="list-style-type: none"> <li>- Store standard preservation metadata</li> </ul>
File Formats	<ul style="list-style-type: none"> <li>- When you can give input into the creation of digital files encourage use of a limited set of known open formats and codecs</li> </ul>	<ul style="list-style-type: none"> <li>- Inventory of file formats in use</li> </ul>	<ul style="list-style-type: none"> <li>- Monitor file format obsolescence issues</li> </ul>	<ul style="list-style-type: none"> <li>- Perform format migrations, emulation and similar activities as needed</li> </ul>

(Phillips, M., Bailey, J., Goethals, A., Owens, T., 2013)

These levels and other priorities are expanded upon further. In their book, *Digital Preservation for Libraries, Archives and Museums*, Edward Corrado and Heather Moulaison (2017) set out a few guidelines to handling digital collections. They set up three major categories; management, technology and content (Corrado & Moulaison, 2017). These are the basis for digital preservation in any institution.

The first category is management. A well-managed institution is essential for success in digital preservation. There needs to be a structure to the institution so that nothing falls between the cracks. It is very important that the institution has specific digital collections policies,

resources to handle preservation and a staff that has experience in preservation (Corrado & Moulaison, 2017). An institution that deals with digital collections must make sure that it has the room in its budget for this. Digital collections can be expensive to preserve, so these institutions must make sure that they can afford this cost. A staff with technical skills is important to oversee the preservation to ensure everything is done to the highest standards possible.

The second essential factor in digital preservation is technology. It is important for institutions to have the correct kind of hardware and software to be able to implement their plans. It will depend on the size of the collection and the resources available. There are different kinds of servers and software that would be used for different sizes of collections (Corrado & Moulaison, 2017). Most digital preservation is done using open source systems. This means that anyone can change and modify the software to fit their needs because it is a public software (Corrado & Moulaison, 2017). Motion picture files are very large and contain many bits of data. In order to afford to store this enormous amount of data, compression of the files is necessary (Wright, 2012).

Metadata is all the information that surrounds the actual piece of media being preserved (Houghton, 2016). This information is important to the digital preservation process. In order to keep things lasting as long as possible, institutions need to have excellent supplementary information. Metadata tells what the file contains, and any other important information about it. Without this, there would be no way to know what each file is and what kinds of care it might need (Houghton, 2016). All of this helps to streamline the process and make sure that everything is running smoothly.

The third category related to digital preservation is content. Without digital content, museums and other institutions would have nothing to preserve. Institutions need to understand what it takes to preserve digital motion pictures before they acquire them (Corrado & Moulaison, 2017).

Museums and other collecting institutions that are starting to transition from film to a digital motion picture collection must be able to handle what comes with it. Organizations like these need to have a good preservation plan in place, the best technology, and a trained staff in order to keep collections safe and intact well into the future.

### **What is being done in the field today**

Private studio archives are at the cutting edge of digital motion picture preservation. What these organizations are doing would be the ideal model at this time for museums. Large studios and private archives have much more money and more resources to deal with large scale digital preservation (The Digital Dilemma, 2007). These organizations can afford the best technology whenever something new comes out and have the resources to maintain all parts of digital motion pictures. This includes multiple copies of each motion picture. This strategy ensures that if one copy on one system is corrupted, lost or damaged, the institution has more copies that are in different physical places and on different systems that can then be used. To the studios, motion pictures are money making assets and studios will do whatever is necessary to ensure these assets are preserved for future endeavors. This is slightly different for museums, which view them as assets, but their preservation is more about access than capital gains. Most museums may not have the resources to implement this kind of level of digital preservation. Depending on the mission of each individual museum, they have to spread their focus across a

number of collections. Museum collections staff are usually not focused entirely on its digital assets.

The Academy of Motion Picture Arts and Sciences is at the frontlines of the digital preservation movement. Known for being behind the Oscars, this organization serves a unique purpose between the motion picture studios and museums. AMPAS has produced multiple studies in the last decade, along with digital summits with other organizations in order to try and figure out the future of digital motion picture preservation (Maltz, 2014). AMPAS has numerous ongoing archiving projects and in 2019, they will be opening their own museum. This will allow them to focus even more on the issues of preservation, and especially those that involve digital motion pictures.

The literature highlights how large institutions like big studio archives or libraries are handling this transition. There is a gap in the literature when it comes to what is going on in museums in terms of digital preservation of motion pictures. Not much is known about how museums are handling this phenomenon. It is not known if other museums are facing these challenges that come with large scale digital preservation. If they are facing these same challenges, it is also not widely known how they may be dealing with the issues and what strategies may work best for different types and sizes of museums. This is the gap in the literature that this study is looking to fill.

## **Chapter 3: Methods**

### **Research Purpose**

The purpose of this study is to understand digital preservation practices of museums that are transitioning their collection from film to digital motion pictures and how they are addressing the issue of long-term digital preservation. This study will be framed by the following research questions:

1. What strategies do these museums use to preserve digital motion pictures long-term?
2. What are common challenges that museums face with the long-term care and preservation of digital motion pictures?
3. To what extent do current digital preservation practices meet the needs of different museums with varying sizes of digital motion picture collections?

### **Research Design**

To understand how museums' motion picture collections are transitioning from film to digital formats, it is important to obtain data from museums with differing sizes of collections. A qualitative descriptive methodology will allow for rich data to be collected and analyzed from a diverse sample of museums. This type of research design utilizes interviews, observations and document analysis as a means of collecting data (Creswell, 2014). Interviews will be conducted with museum professionals at each site. These museum professionals are directly involved in the preservation of digital motion pictures housed at their museums.

## **Subject Recruitment**

Sites for this research study were selected based on the size and makeup of their motion picture collections, both film and digital. It was important that each of these museums were in some form of transition from a collection based in film and analog tape to digital motion pictures. The second criteria used for selection was the size of the museum's collection. A cross section of museum types were considered, representing those with small, medium and large motion picture collections. Having sites with varying sizes of collections is important to see if and how the size of the museum and its collection has any bearing on digital preservation methods. Also, geographic location was used as a criterion for subject recruitment. Each museum that was contacted was located in the Seattle area, Pacific Northwest Region and California. At first, the goal was to get participants from the Seattle area. To expand the scope of the study, museums along the west coast were contacted for inclusion.

Each site was recruited by email after identifying it as a site with a motion picture collection that fits the scope of this study (see appendix). Any staff member working with these specific collections was eligible to participate in this study. The participants are all involved in the collection management at their respective museums.

## **Data Collection**

For this research study, data was primarily collected using semi-structured interviews. These interviews took place in person or over the phone with museum professionals at each participating museum. They included staff who are directly involved in the digital preservation process for their museum's collection of digital motion pictures. Semi-structured interviews

allowed for participants to go into greater detail about the condition of their motion picture collection. It also allowed the researcher to ask and follow-up and clarifying questions.

The interview questions were created to answer the three main research questions posed by the study (see appendix). The first section asked each participant about their background and role at their respective institutions. The second section is geared toward preservation strategies and explores how each institution goes about preserving their collection and who is involved. After this, the participants were asked about the challenges that their institution might individually face in regard to their digital motion picture collection. The goal of this section was to see if museums were facing any challenges during this process and to identify what they might be. The final section focused on identifying if the preservation tools that they are equipped with are adequate. Along with this, the participants were also asked if there is something that they currently are unable to do in this realm that they would like to employ. It asks if how the size of their collection may change the effectiveness of their preservation strategies.

## **Data Analysis**

Each interview was audio recorded and individually transcribed. Responses by the museum professionals were analyzed and coded using emergent coding strategies. Each individual subjects' response was analyzed and categorized based on themes that became present during the interview. Each institution's responses were analyzed and coded based on the larger themes of the study that were represented by the three research questions. Similar institutions were grouped together to see if there were any trends or similarities between them.

## **Study Limitations**

The study relied on a range of museums that are in some stage of a transition from a film and analog tape motion picture collection to a digital collection. To get a clear idea of what is happening in museums regarding digital motion picture preservation, the study needed to include different types of museums with different sizes of collections. While several museums in the Pacific Northwest and California area were contacted to see if they had a compatible collection and were asked if they would be interested in participating in the study, only six museums were included in the study because of their combination of location, size and makeup of their motion picture collection.

The sample size of this study included just enough museums of different sizes and collections to compare cases and derive meaningful results. However, a sample of six museums limits the ability for this study to be more broadly generalizable. It provides a first step in understanding what is happening with digital preservation of motion pictures in museums and will benefit from further exploration. More participants would allow for trends to emerge and for these trends to be applied to a wider range of museum collections.

## Chapter 4: Analysis

### Description of Sample

The participants for this study came from six museums in the Pacific Northwest region. Five of them are located in the Seattle area, while one is located in Portland. Each museum professional that was interviewed is involved in the collection of digital motion pictures, film and analog tape for their respective museums. From the six museums chosen for this study, seven staff members were interviewed. They had a range of job titles, but all served in roles that were responsible for collections management, including digital and analog motion picture collections. This number of participants allowed for a cross section of data between different kinds of institutions that have various sizes of collections. This sample represents all kinds of museums, with various sized institutions and collections. It includes a small history museum, larger aviation and history museums, a new computer museum and one art museum. Each of their collections also offered various sizes of film and digital motion pictures. The participating museums, interviewees and job titles are described in the table below.

**Table 2, Research Study Interview Participants**

<b>Museum</b>	<b>Participant Name</b>	<b>Participant Job Title</b>
Living Computers Museum, Seattle, WA	Dorian Bowen	Media Archivist
Museum of Flight, Seattle, WA	Nicole Davis Ali Lane	Supervisory Archivist Digital Assets Coordinator
Museum of History and Industry, Seattle, WA	Anna Elam	Library Collections Manager
Museum of Pop Culture, Seattle, WA	Kevin Harvey	Video Producer/Editor

Portland Art Museum, Portland, OR	Samantha Springer	Objects and Media Conservator
Renton History Museum, Renton, WA	Sarah Samson	Curator of Collections and Exhibitions

It is important to first look at the makeup of the motion picture collections housed by each participating museum to provide context for how participants responded and thus the results of this study. Each participating museum had a different collection. This includes the types of motion pictures in each collection, the amount of film and the amount of digital motion pictures housed in the collection of each museum. The amount of film and digital motion pictures and videos of each collection are slightly variable. The following table groups museums into different tiers based on the overall size of their motion picture collection.

**Table 3, Museum collection size**

<b>Museum</b>	<b>Size of motion picture collection</b>	<b>Percentage of collection that is digital</b>
<b>Tier One:</b> Portland Art Museum	100 or less film and digital video	90%
Renton History Museum	131 film and digital video	59%
<b>Tier 2:</b> Living Computers Museum	300 tape and digital video	30% or less
Museum of Flight	300-500 films and digital video.	20% or less
Museum of History and Industry	300-500 film and digital video	20% or less
<b>Tier 3:</b> Museum of Pop Culture	500 plus film, Betamax tape, digital video	20%

This table illustrates that the museums with the smallest motion picture collections have the highest percentage of digital collections, whereas the museums with larger collections have a smaller percentage of digital collections. There are several possible reasons for this outcome such as, the size and scope of their collections. Also, the effort it would take to digitize and maintain their collection is a factor. Museums including the Living Computers Museum and the Museum of Flight indicated that they were in the early stages of digitizing their film collection and are just beginning to gather born digital motion pictures.

All but one museum interviewed had film and digital motion pictures in their collection. The Living Computers Museum does not have any film in their collection, but they have many other types of outdated analog tape media that is similar to the film in the other collections. Their collection includes magnetic tapes, discs of varying sizes and other vanishing media formats. Even though they do not have film, this collection is still incredibly valuable to analyze and see how they approach digital preservation.

Digital motion picture formats used by each museum in this study to store and preserve digital videos were either not known or not acquired. However, it would be likely that these museums would have videos in common formats that other institutions regularly use. Popular formats that could be used in museums include MPEG-4, QuickTime MOV, Microsoft AVI (Falcao, 2012). It is not known how many of each type are housed in collections at these museums, however they are prevalent in other institutions that have similar collections.

There are certain advantages and disadvantages that come along with each format. MPEG-4 offers quality picture quality and it does not take up a large amount of data. This could be beneficial for storage and archival purposes. However, the software that is used to run these files are not as sophisticated as others, so it may not be as beneficial to archiving and storage as it

theoretically could be (Soffar, 2017). The MOV and AVI formats flexible and are highly compatible (Soffar, 2017). They offer great quality of video and are very durable formats (Soffar, 2017). They are very large files that take up quite a bit of room. MOV files cannot be used as much outside of a QuickTime application. (Soffar, 2017). These popular formats could be beneficial to the long-term preservation of digital videos in museums; however, they do come with a fair number of issues.

## **Findings**

The purpose of this study is to understand digital preservation practices of museums that are transitioning their collection from film to digital motion pictures and how they are addressing the issue of long-term digital preservation. The results of this study will be analyzed in this chapter and will be organized by the three research questions: (1) What strategies do these museums use to preserve digital motion pictures long-term? (2) What are common challenges that museums face with the long-term care and preservation of digital motion pictures? (3) To what extent do current digital preservation practices meet the needs of different museums with varying sizes of digital motion picture collections?

### **Research Question 1: What strategies do these museums use to preserve digital motion pictures long-term?**

The first research question explores the preservation strategies that museums use when it comes to the digital preservation of their motion picture collections. This sets out to see if museums are generally using accepted strategies that large studios and archives are employing regularly or if they employ other preservation measures. Interview participants were asked about

the specific strategies they used with their collections and if they thought this process might change with more of a focus on digital motion pictures. Participants were also asked about what kinds of resources are available for this endeavor. This includes how much staff the museum has to work on preservation and if they have any technical training with digital media.

### **Digital Preservation Process**

The overall digital preservation process for each museum participant contains similar steps. First, museums have to intake the digital asset. This includes getting a portion of film collections digitized, acquiring a born digital motion picture or creating digital videos in-house. The next step is to create certain metadata surrounding the digital asset. This includes creating a catalog record and entering any relevant information into the database. After this is complete, the assets are then put on a hard drive or on a dedicated collections server, whichever systems the specific museum employs. At this point, museums use slightly different methods. Larger museums, such as the Museum of Pop Culture (MoPOP), the Museum of Flight and the Museum of History and Industry (MOHAI), migrate or plan to migrate digital files to newer platforms every few years, while the smaller museums, like the Renton History Museum, is comfortable leaving them in their current formats. MOHAI plans to do fixity checks and run checksums to ensure that this data remains what they think it is. This lets the staff know if any of the data in each motion picture file is corrupted or is becoming unusable. At the end, museum's collections of digital motion pictures are kept for long periods of time on hard drives and servers for as long as possible and migrated whenever needed.

## **Storage Resources**

The staff at the Renton History Museum and MOHAI said that they stored their digital motion picture collections on a hard drive. The Library Collections Manager at MOHAI says that they plan on migrating the digital motion picture data on the hard drives every three to four years. In the meantime, the museum plans to come up with a more sustainable long-term preservation plan for its digital collections, including software to allow them to check the fidelity of these files, ensuring that everything is what it should be.

The Museum of Flight, Living Computers Museum, Portland Art Museum and MoPOP all have dedicated server space for their digital motion picture collections. All of these servers are backed up regularly and some of these museums have multiple copies of everything in their collections. MoPOP has a very large collection of digital motion pictures. The Video Producer and Editor at the museum gets one copy that is put in storage and another copy is given to the other collections staff at the museum. The digital motion pictures at the MoPOP are stored on LTO6 tapes, which are another form of digital media storage. MoPOP's LTO6 drive holds 2.5 terabytes of information, which encompasses a small portion of their collection. At the Living Computers Museum, the Media Archivist says that the parent company of the museum, Vulcan, backs up the servers. The Living Computers Museum has a lot of redundancy with storage and it has many copies of the contents of its digital motion picture collection. The museum also has a media asset management system, which allows for more streamlined and efficient management of its digital collection. The museum is still figuring out how best to implement this piece of technology, but once it does, the media asset management system will be a helpful tool for the long-term preservation of digital motion picture collections.

## **Staff & Training**

Staff and training are also an important factor in implementing any preservation strategies. Two of the smaller museums in the study have only one staff member that is concerned with the care of these collections, while four of the museums with larger collections have a few more people involved. The Curator of Collections and Exhibitions at the Renton History Museum is the only staff member that is involved with digital collections. About the motion picture collection housed at the museum, they said, “If it’s going to happen, it’s going to be me.” They also shared that she has not had any specific training when it comes to digital collections, outside of attending workshops and general collection practice knowledge.

The museums in tiers two and three tended to have one or two staff members that deal with preservation of digital motion pictures. MoPOP had interns working with the motion picture collection at various times in the past, but nothing long-lasting. Half of the museums in the study have staff members who have specific training or background in handling digital media collections including the Museum of Flight, MoPOP and the Living Computers Museum. Digital Assets Coordinator, Video Producer/Editor and Media Archivist are the job titles of those who have had previous experience or training to handle these types of collections. The Library Collections Manager at MOHAI said that the museum has one archivist who has had training with MIPOPS (Moving Image Preservation of Puget Sound). This organization is a non-profit organization in the Seattle area that helps other collecting organizations convert their old video formats to digital. This training has been brought back to the MOHAI collection to help with their preservation activities.

The staff at the Renton History Museum and the Portland Art Museum who work with the digital motion picture collections do not have any formal training when it comes to the

preservation of digital motion pictures. Their training comes from attending various workshops about digital preservation and other such activities. These staff members are responsible for all the collections housed by the museums, not just the digital collections. Museums do not always have the time or staff to dedicate to the upkeep and preservation of digital motion picture collections.

### **Collections Policy**

None of the museums participating in this study have a dedicated collections policy that specifically pertains to digital motion pictures. The collections staff interviewed mentioned that these collections mostly fell under their general collections policy, but they had no policy at the time that is geared toward digital collections. The Supervisory Archivist at the Museum of Flight said that their digital motion picture collection was just beginning to expand. They mentioned that if the museum receives a grant, they will begin to develop a digital collections plan that deals with digital motion pictures. A plan like this would go far in helping the museum figure out how to handle and process its growing collection.

All of the other participants in this study said similar things regarding their museums lack of digital motion picture collections. The Video Producer and Editor at MoPOP mentioned that he had a few basic procedures used for digital preservation, however, the museum did not have anything formal. The Curator of Collections and Exhibitions at the Renton History Museum said that the museum has a digital reproduction policy, which is used if a member of the public would like to obtain something in the digital collection but does not address how to take care of the digital collection. Participants from the Museum of Flight, MOHAI and the Living Computers

Museum specifically expressed a desire to develop a collections policy for their digital holdings, especially for digital motion pictures.

One of the interviewees at the Renton History Museum expressed that the collections of digital motion pictures at this museum is not at top priority at this time. This is because other collections that the museum oversees take on a higher priority. The other participants at other museums did not come to this conclusion specifically; however, other collections are larger, take up more time and resources and may be of more importance and priority to the museums in this study. Digital motion picture collections are a newer phenomenon that are just a small portion of the overall collection housed by a museum.

## **Research Question 2: What are common challenges that museums face with the long-term care and preservation of digital motion pictures?**

All of the museums interviewed shared a litany of challenges that they face concerning the long-term preservation of their digital motion picture collections. The most common challenges that were discussed by the participants are storage issues, time, and staff concerns. Of these, issues revolving around storage space, storage methods and other storage related things were brought up by almost all participants.

### **Storage related issues**

Digital videos and motion picture files are much larger than digital images or text files. This is because digital motion picture files are made up of more bits of data than other digital files. This makes storage for digital motion picture collections more difficult and cumbersome.

Four of the six participants mentioned experiencing challenges with storage. Not surprisingly, these four museums comprise Tiers Two and Three (see table 3). They have the largest collections of digital motion pictures that need to be stored well and cared for. Storage takes two forms, physical and virtual. Both areas of storage are constantly affected by new technologies and preservation actions. The issue here can be difficult to nail down. Museums cannot possibly predict new technologies that will be developed in the future. Constantly changing technology is the root of the storage issue that museums are facing. Technological shifts affect data migration. Museums that have digital motion picture collections must decide if they are going to migrate them to new technology or not. This decision affects the digital storage plans of a museum. Museums have to either adapt to new technologies and preservation methods or manage issues that arise with maintaining the status quo.

All of the participating museums have just recently begun to explore digital motion picture collections housed in each collection. Museums that have a new digital collection are faced with new challenges when it comes to preservation and storage. These museums have to be aware of storage problems and are always looking for new solutions. At one point, the Museum of Flight ran out of space to process its digital image collection and this caused the museum to halt all digitization efforts until it could find a solution. Similar issues could arise with their digital videos if storage solutions are not discovered. MoPOP has 2.5 terabytes of storage on each LTO6 tape. The Video Producer and Editor at the museum says that one terabyte is taken up by about five interviews. Half of a tape of storage taken up by just a few interviews is not sustainable for a museum with a large collection like that of MoPOP. This also means that MoPOP and the other tier two museums are not able to always keep digital motion pictures in the best resolution or quality.

Every time MoPOP acquires new production equipment, the size of the files gets larger. This is unsustainable for the museums large and growing collection. The museums that have larger collections, like MoPOP, are not able to keep digital videos in the best resolutions possible. Also, these museums are unable to save everything associated with digital motion pictures. With limited storage, the staff must pick and choose what to save.

### **Technological Obsolescence**

Storage challenges also lead to challenges with technological obsolescence and having to constantly migrate collections to newer formats to keep up with new technologies. Data migration happens when a new format or technology comes out and the older version will not be supported any longer. In order to still be able to read the data, staff then needs to transfer the digital motion picture data to the newer technology, otherwise it will not be able to be read in the future. Having backups of their collections are sometimes a problem for these museums. The Living Computers Museums said that they do not know the extent of their digital collections. This makes creating backups and storing their collections difficult.

Museums that have the largest digital motion picture collections, like MoPOP, expressly had issues with technological obsolescence and having to migrate their large sums of data. The staff at MOHAI currently houses the museum's collection on a series of hard drives. The staff plans to migrate the data on these hard drives every few years to make sure that it is still usable and on a usable form of technology. MoPOP used to back up its digital motion picture data to LTO3 tapes, however, the company that manufactured these tapes can no longer support this technology. It has become an outdated storage format for digital data. The museum still has some of their collection on this type of media and are unsure if they will ever be able to get that

information back. The collections staff must keep an old computer around just to be able to play some of these older videos. When speaking about these issues, their Video Producer and Editor said, “It is a constant dance into the future, and we are always behind with new technology coming out. Everything is always changing.” Museums with a large amount of digital motion pictures in their collection are being affected greatly by new technologies coming along and older technologies becoming obsolete.

### **Human Resource Challenges**

Staff resources and time concerns were mentioned as some of the larger problems for the museums with smaller collections, including the Renton History Museum, Portland Art Museum and MOHAI. These museums only have a small staff working with their collections. Often it is only one or two people, with possibly an intern or volunteer. Collections professionals in museums are tasked with overseeing other kinds of collections and not just digital motion pictures. For a museum like the Renton History Museum or Portland Art Museum, collections staff have a responsibility to oversee the entirety of museum collections. These staff members cannot focus their entire attention on the motion picture collections of their respective museum.

Interviews indicated that staff members also had different levels of training when it comes to digital motion picture collections. Some of the staff members at MoPOP, the Museum of Flight and the Living Computers Museum had some sort of formal training or background with digital or motion picture collections. The Museum of Flight has a Digital Assets Coordinator who is responsible solely for the digital collections of the museum. They mentioned having specialized skills, training and coursework specifically focusing on the management of digital or motion picture collections. The Media Archivist at the Living Computers Museum

also had a background in film preservation and is focused on the preservation of analog tape and digital motion picture collections. The other participants have staff with less specialized training, if any at all. A staff member at MOHAI has done training with MIPOPS and has taken this training back to the museum. Even with some training with local experts, the Library Collections Manager expressed that MOHAI, “currently does not have the expertise to handle this stuff,” referring to digital collections and digital motion pictures.

The Curator of Collections and Exhibitions at the Renton History Museum mentioned having no formal training with digital collections, except for attending local digital preservation workshops. They said that having general collections knowledge helps to at least identify collections and understand that they must be preserved. They also said, regarding the museum's film collection, “Hey, this is film, this will deteriorate, I should get it digitized.” These kinds of informal training and general collection knowledge can be beneficial for some museums; however, it is very labor intensive for the staff to spend a good deal of their time doing this training. The museums with smaller motion picture collections seemed to have a hard time with staffing issues when it comes to working with these specialized collections.

To combat staffing issues, participating staff members indicated that they have had interns and volunteers working on their digitization projects in the past. It has proven to be problematic because these people do not always have the right kind of training required to handle these collections. A few participants, including MoPOP, indicated that they have had interns in the past, but the work they did was not up to standards. Collection staff at the Renton History Museum also mentioned that their projects had been so long ago, that they would have to spend a good deal of time getting back into the project to set it up for an intern to get started. This

requires a lot of time and effort that a small museum, like the Renton History Museum, does not have.

Time issues go hand in hand with staffing deficiencies. Since collections staff at museums have many different collections to care for, they cannot always devote as much time as they would like to other collections, including digital motion pictures. One of the museums with the smallest collections, the Renton History Museum, said that its biggest problem is time. The Curator of Collections and Exhibition oversees all their collections, and the motion picture collection is one small piece of this. This collection is not a top priority for this museum, and it is difficult to find time to do any work with it. The curator does not have the time to devote the day to day preservation of the motion picture collection at the museum. They said that the museum has not been able to do any work with the collection since it was digitized and put on a hard drive. Time issues are related to staffing problems, so the smaller participants who did not have much staff to work on these collections, also do not have enough time to make digital collections a high priority.

### **Overcoming Challenges**

Participants were also asked how they currently are working to overcome any of these challenges that they face. Museums professionals are tasked with coming up with solutions to the current shortcomings in the field today. Participants are employing some strategies to mitigate the challenges that they face. The Library Collections Manager of MOHAI said that they currently work with MIPOPS. The museum is currently, “leaning on experts,” when it comes to the preservation of its digital collections. This partnership helps the museum digitize

what film it has and has helped train staff so that they can bring skills and knowledge back to the museum, which helps the museum make up for its lack of resources in other areas.

Participants also expressed an interest in looking for new funding opportunities and looking for any partners that would be willing to help them with any projects. The Museum of Flight has been working on a grant that would allow it to get a better handle on its digital motion picture collection. This would be a solution to possibly helping it bring in more staff to help with the museums growing digital collection. Similarly, The Curator of Collections and Exhibitions of the Renton History Museum wrote a grant so the museum could digitize its collection of film. This created the bulk of the museums digital motion picture collection, and ensured the museum had resources to manage this newfound collection. Funding opportunities can also help bring in equipment to help with the preservation of these collections. Other participants, like MOHAI, are also always looking for funding opportunities or partnerships that would help with the management of its digital motion picture collections.

Others, like MoPOP, are trying to keep up with technological changes to ensure that the museum can stay on top of the preservation of its collections. Every so often, the museum must make a large purchase and fit it into the budget, in order to keep up with preservation needs. This does not help overcome all or the challenges faced by the museum, but it helps the museum keep its collections moving into the future. The Video Producer and Editor at MoPOP said that, “Everything keeps getting bigger, nothing is resolving or evening out.” Museums are trying to be proactive about the limitations of digital motion pictures so that they do not compound any issues.

**Research Question 3: To what extent do current digital preservation practices meet the needs of different museums with varying sizes of digital motion picture collections?**

The third research question wraps everything together. It was meant to see if current digital preservation practices that are being used by each museum is sufficient enough for their needs. The museum professionals were asked if they thought they were able to do enough to ensure long-term preservation. Also, participants came up with ideas for what they would like for their museums to be able to do but were not currently able to under the circumstances.

All the participants responded that they were not able to do everything necessary to ensure long-term preservation of digital motion pictures at their respective museums. The lack of all the necessary resources is what leads to the challenges that are listed above. Large studios and archives that specialize in these collections have many of these resources and are still not able to comply with everything that digital preservation requires. These museums are focused on many other areas and collections and cannot devote all of their resources to digital motion picture collections. Interviews indicated that motion picture collections are not the highest priority of museums, however they are still tasked with looking after these collections.

When asked what they would like to be able to do that their museums are unable to at this time, each participant responded with similar answers. They all indicated that they would like to have more staff training or funding to be able to carry out certain preservation actions. Participants, including the Living Computers Museum and Museum of Flight, mentioned that they do not know what their whole collections are comprised of. These museums would really like to be able go through and inventory everything in the museum's collections. This would

give them more information and would allow each museum to be better equipped to deal with the challenges that come up during preservation.

Another answer that came up was being able to organize and share collections with the public. MoPOP said that the museum would really like to have a Media Asset Management (MAM) system. With this piece of technology, the museum would be able to better organize their digital collections. Once this is taken care of, the museum would be better equipped to share its collection with researchers and public inquiries. The Video Producer and Editor for the museum imagined that it could help the museum itself, by being able to better promote exhibits with the understanding and use of its extensive collection of motion pictures. He also believed that MoPOP would then be able to aid the public. People may be looking for videos, interviews and motion pictures that are in the museum's collection. Currently, not many people beyond the collections staff at the museum have access to or know what is even in the museums vast motion picture collection.

None of the participants had any definitive ways to overcome the glaring issues that are steeped in the digital preservation process. Their suggestions on how to overcome these challenges are only temporary fixes. Eventually, if digital motion pictures are going to be a sustainable venture for museum collections, there will need to be some more permanent advancements to how these collections are preserved.

## Chapter 5: Conclusions

Since the 1950's, collecting institutions have had a vested interest in the preservation of motion pictures. They have become an important piece of our cultural heritage. Now that a large amount of motion pictures are being produced using digital technologies, collecting institutions, including libraries, archives and museums, have to adapt. So far, they have been struggling to keep up with the changes. Since not much was known about how museums specifically are handling this issue, this research study set out to ask museum professionals who are actively working with digital motion picture collections how they are managing new technologies and how they are overcoming any challenges that may come about.

These findings show that museums are struggling to catch up with the digital world when it comes to motion picture collections and their long-term preservation. Motion picture collections, especially newly formed digital motion picture collections, are not a top priority for a lot of museums. Most museums in this study are new to preserving digital motion pictures and are still trying to find their way. Unlike other collecting institutions, museums typically focus their efforts on preserving objects, artifacts, and archivable documents. As such, none of the museums interviewed have collections policies that govern their digital motion picture collections specifically. Each museum has a general collections policy that is also applied to motion picture collections. When combined with the challenges of obtaining the necessary resources to be able to effectively preserve digital motion picture collections, museums are often unable to provide the best care possible. Until digital motion pictures become a significant portion of a museum's collection, they will not receive the large amount of care necessary to preserve them for the long-term.

Even if museums do prioritize motion picture collections, problems still arise. Museums are not large archives or libraries, and fundamentally do not have the structure or best practices to preserve digital motion picture collections to the highest standards. This is because museums often lack the necessary resources. Whether it is money, staff, equipment or expertise, museums usually do not have everything needed to engage in the highest levels of digital preservation.

Analog media formats such as film and tape can last a much longer than digital media at this time. Museums are able to preserve these formats for the long-term. Collections staff do not have to spend much time on the preservation of these materials. With digital motion pictures, they must put in a lot of time and effort that they cannot afford. This results in digital motion picture collections not receiving the best possible care that they need to survive for future generations.

The findings of the study also show that the size of the institution and its collection influenced the challenges that experienced. Interviewees working for museums that had smaller motion picture collections can be more agile in managing digital collections, but struggle with basic resource issues. This is an area that smaller museums in general, like the Renton History Museum, struggle with regarding all collections, not just their digital motion picture collections. Smaller museums do not have time, staff or training available to properly care for digital motion picture collections for the long-term. These museums have less assets to keep track of, but also fewer resources to ensure that everything is always taken care of.

Larger museums that benefit from greater resource availability are plagued with issues often beyond their control. The issues that these museum face with constantly shifting technology and storage issues are not dictated by museums, but by the technology industry. Museums can only react to what is being done in this industry. Until there is a technological

breakthrough that makes preserving digital files easier or simplifies the transition from one format to another, museums will always be playing catchup. MoPOP is a great example of a museum that is struggling with this. The museum is constantly having to update their formats. Technology used to produce and preserve digital motion pictures is changing faster than museums, even ones with a large amount of resources, can keep up with. If this continues, museums will always be behind, at the detriment of the motion picture collections. There are many benefits to having digital motion picture collections, however if preservation practices and technologies are not improved, it may not be practical for museums to preserve these collections.

## **Next Steps**

To be successful, digital preservation cannot be a one-time make-shift effort. Preservation activities must be sustained because of the many shortcomings that come with long-term preservation of digital motion pictures. Technology is constantly changing, and new formats of digital motion pictures are being created. Since technology is ever evolving, preservation efforts must remain constant in order to keep their collections viable.

As museums formulate reasonable strategies to manage digital motion picture collections, there are steps that must be taken to maximize the preservation of digital motion picture collections. The first and most important step for museums to consider is the development and implementation of a digital collections policy and digital preservation plan. This plan should include all the digital collections of the museum, but it should also include a section about digital motion picture collections. A few of the museum professionals interviewed mentioned that they are interested in developing some type of plan in the near future.

One section of this plan should touch upon how the museum intends to collect digital assets. It should lay out if the museum is going to collect digital assets from other sources, or mostly acquire collections as a result of digitizing its own collections. Since museums are not best equipped at this time to preserve digital motion pictures, it may be in museums best interests not to collect outside digital assets. These collections may be best served if they are given to a large library or archive that specializes in digital motion picture preservation. However, a plan can include ways for a museum to digitize its own collections, or create digital motion pictures, which the museum will then preserve.

These policies also should lay out a preservation plan that is best suited for the individual museum. Not all museums are capable of the same degree of digital preservation. Digital collections policies and preservation plans should be consistent with the size of the collection and the resources that the museums are able to put towards digital collections. If possible, a museum should try to keep at least three copies of each digital motion picture in the collection. These copies should also be kept on different hard drives and stored in different areas. Museums with collections of any size should also make sure the digital collections are checked every few months to make sure everything is as it should be. It is imperative that digital motion pictures are migrated to new formats and technologies every few years to make sure that the data is still usable into the future. Until a more effective preservation strategy is found, these are the most effective ways for museums to ensure the long-term preservation of digital motion picture collections.

Museums may also want to make collections of digital motion pictures more accessible to the public. This may bring more attention to these collections that people may not otherwise have known. Some of the museums in this study, including MoPOP, see access to these

collections as an important next step. Focusing on access could increase the importance of digital motion picture collections in museums and, therefore, make these collections a higher priority in their respective museums. Once digital motion picture collections become more of a priority, museums will likely be able to devote more resources to preserve collections.

Museums, like the ones in this study, can make certain efforts to help preserve these collections in the short term. Museums can lean on outside resources and companies, like MIPOPS, for help when collections staff does not have the expertise required for the preservation of motion pictures. Also, museums can keep looking for new funding opportunities to help keep up with preservation costs or provide more staffing resources. Every so often, a museum may have to make room in their budget to obtain new equipment. This will allow the collections staff to keep up with the rapidly changing technology as best as they can.

While these strategies and recommendations may not completely fix the issues that museums face with the preservation of digital motion picture collections, they could help to alleviate the current burden. By developing specific digital collections policies and plans, geared toward the management of all digital collections, museums will be better organized and have a better idea of how to handle and preserve digital motion picture collections. It may sound like a hopeless situation for many museums, but by developing preservation policies and the structures to support them, organizations like the ones in this study can do their best to ensure the long-term preservation of digital motion picture collections.

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## **Appendix I: Subject Recruitment**

### **Email Recruitment Example**

Dear,

My name is John Ford and I am in the Museology Graduate Program at the University of Washington. I am contacting you regarding my thesis research to see if you and your institution would be interested in being a part of my study.

I am conducting a qualitative descriptive study of museums in the United States who have a collection of digital motion pictures/videos in digital and film formats. These media may include motion pictures, news reels, and any other kind of video format. Specifically, I am interested in understanding how these media are being preserved in museums.

I believe that due to the museum's collection, your institution would be an excellent candidate for my study.

For this study, I would need to speak to one or more staff members who are involved with the preservation process of the (digital) motion picture/video collection housed at the museum. The interview would be done in person if possible or by phone/skype and would take 30-45 minutes.

If you have any questions about my study, I would be happy to answer them before you decide about participation.

Thank you for your consideration. I look forward to hearing from you soon.

John Ford  
Email: ford0353@uw.edu  
Phone: 612-750-2676

### **Interview Confirmation Email**

Dear (insert name)

Thank you for agreeing to be part of my research. This email is to confirm that our interview will take place on [day and time] and will be conducted [in-person, via telephone, or Skype]. The interview will be recorded and will take approximately 30-45 minutes. Please feel free to contact me if you have any questions about my study before the interview. Thank you again for your time and being a part of my study.

John Ford  
Email: ford0353@uw.edu  
Phone: 612-750-2676

## **Appendix II: Interview Guide**

### **Interview Guide**

#### **Consent Script**

Thank you for agreeing to speak with me today. Before we begin, let me restate that I am working on a research study for my master's thesis at the University of Washington and would like you to participate in the study. The purpose of this study is to understand digital preservation practices of museums that are transitioning their collection from film to digital video and how they are addressing the issue of long-term digital preservation.

This interview will take about 30-45 minutes and be recorded for research purposes only. You and your institution will be identified in my published report and anything you say may be quoted or paraphrased. You may request to review your quotations prior to the final submission of my thesis. You may request to review your quotations prior to the final submission of my thesis. Your participation is voluntary and refusal to participate will involve no penalty or loss of benefits. If you have any questions or concerns in the future, you may contact me or my advisor.

Do you agree? Do you have any questions before we get started?

#### **Background/Context for Discussion**

First let's start with some background questions:

What is your job title? How long have you been in this position?

How are you involved in preservation of the motion picture collection?

So, let's talk about the collection...

Can you describe the motion picture collection housed by the museum?

- What is the nature of the collection (what kind of motion pictures/video do you have)? Where does the collection come from?
- How much of the collection is film and how much is digital?

How has this changed during your tenure at the museum?

- Is the digital motion picture/video portion growing? In what ways?

#### **Preservation Strategies**

Now I would like to get some information about how the museum handles preservation

Can you describe the digital preservation process?

- What are the steps?
- Who is involved?

- How much staff is there working on the preservation of this collection?
- What are their qualifications? Do you provide training or are they hired with these skills?

What kind of storage systems and software do you use?

Does the museum have the resources to adequately preserve this collection?

Does the museum have a collections policy devoted to this collection?

- If so, can you share it with me? Is preservation of this media a priority?

How do you expect this process would evolve as your collection changes?

### **Challenges**

I would like to talk about the challenges that may arise during this process.

Can you describe any challenges that you face concerning the long-term preservation of the museum's collection of digital videos?

How do you overcome these challenges?

What factors impact your ability to effectively conduct long-term preservation?

- Is there anything you would like to be able to do that you are unable to at this time?

Are there any other challenges that the digital motion picture collection face?

### **Meeting the needs of different sized collections**

To what extent do you think your process would change if your collection were different; larger, smaller, older, etc.?

What advice or lessons learned would you convey to colleagues who are planning to undertake long-term digital preservation?

Is there anything else about your collection or institution that you would like to share?

Thank you for your time and for participating in my study.