

City, University of London

*Examining Analogue Film's Viability as A Preservation Method
for Film Archives*

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Abstract

The purpose of this project is to examine film stock's viability as a method of preservation for film archives in the current climate of later-stage practice transition. It seeks to identify the impact of the film stock production decrease upon archival practice and assess and compare analogue and digital practice. It also seeks to determine the viability of a film stock production increase, and in turn film stock's viability, and propose potential future uses for film stock outside the archival sector.

The methods used include conceptual and historical analyses of literature in the field, and a selective critical literature review of 4 film stock producers' and 33 European and American film archives' websites, supported by a film archive curator interview.

The analyses of literature support that there is viable infrastructure and practice supporting film stock as a preservation method in film archives when compared to digital preservation. However, the selective critical literature review shows that due to the production decrease and corresponding costs, film stock is not a viable active preservation method. The research shows that film archives are currently in transition to digital practice without defined terminology, affordable digital infrastructure or practice, or an equivalent digital preservation method to rival film stock's abilities, creating a risk of information loss. The research shows a need for either a longer transition period between film stock and digital media, which is unviable, or the development of archive-specific digital preservation technology.

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Definitions

Film stock – Widely used, industrially produced film stocks, used to create films, including cellulose nitrate, cellulose acetate, and polyester safety stock. This includes various standard stock formats. For this research, this definition includes commercial, experimental, and amateur/home films. This definition does not include photographic, custom chemical mixes, or homemade film stocks.

Preservation – The processes involved in maintaining a document for future access, including acquisition, processing, treatment, and storage. Defined by Wallmüller (2007) as ‘the totality of activities that guarantee the survival and the permanent accessibility of our moving image heritage’. (p.79) This definition includes restoration.

Restoration – As defined by Busche, (2006) an aspect of preservation, involving the removal of damage due to use or interference from a film to preserve the original content. (p.3) Also used in literature to refer to the reconstruction of lost or severely damaged films from multiple different versions. This process can be either analogue or digital.

Digital preservation – The preservation of material in a digital format for future access, and all processes involved therein. Includes both born-digital films, and analogue format films that have been digitised for preservation. Defined by Conway (2007, in Matusiak and Johnston, 2014) as the policy and technology that support preservation of digitised or born-digital film. (p.249)

Digitisation – the transfer of analogue format films to a digital format, for the purposes of restoration, or accessibility. Considered distinct from digital preservation, as the original analogue format continues to be preserved and the digital copy is employed for restoration or access purposes.

1. Introduction

1.1 Background and Context for Research

Film stock as a medium has existed for a century as a way to capture life in motion. Although it has developed since its inception, it has remained recognisable from one iteration to the next and the preservation practices within film archives have reflected this. However, unlike older standardised formats such as books the digital revolution of the film industry has led to digital technology replacing film stock for shooting purposes, a move 'not so much about aesthetics as economics, driven largely by market forces and the interests of global manufacturing corporations, not necessarily by the needs of the industry itself'. (Crofts, 2008, p.8) This shift has led to a decline in film stock production, which could have consequences for film archives.

This project is being undertaken because film stock functioned as a major preservation method for film archives with film stock holdings, and the drop in film stock production due to industry digitisation could potentially result in large amounts of information loss. Possible factors in this potential information loss include a loss of knowledge concerning analogue preservation practices due to lack of exposure, which could result in film stock holdings and the information they contain becoming inaccessible. The drop in film stock production could also result in information loss at the point of acquisition and processing due to potential lack of conformity in the chemical makeup of film stock as access to standardised stock decreases, causing preservation issues related to correct treatment and storage. The position of digital preservation having 'crucial issues in terms of format standardization, longevity, and back compatibility' (Crofts, 2008, p.10) also has the potential to result in information loss due to its more active preservation requirements in comparison to film stock's passive preservation practices.

1.2 Aims, Objectives, and Research Question

The overall aim of this dissertation is to determine the viability of film stock as a preservation method for film archives, when compared to current digital preservation

practices in the sector. To achieve this, the research is structured around several objectives in order to best address the research question:

1. To identify how the lessening of analogue film stock production due to industry digitisation has impacted analogue film preservation practices in film archives.
2. To assess analogue film as a medium for preservation in film archives in comparison to current digital preservation practices.
3. To evaluate the viability of increasing analogue film production by critically analysing the potential benefits and costs to film archives and analogue film stock producers.
4. To propose potential uses for analogue film as a preservation medium outside the film sector.

1.3 Research Methodology

To achieve the research objectives, several methods of desk research have been employed, alongside email interviews which will support the desk research findings. These have been outlined in detail in chapter 3. Historical analysis of analogue preservation practices provides an overview of analogue preservation practice development within the film sector, and a comparison with the development of digital preservation practices supports objective 1 and achieves objective 2. A conceptual analysis of the definitions of preservation, digital preservation, and access and the academic debate surrounding these terms supports the comparative assessment of analogue and digital preservation practices, supporting objective 2. A selective critical literature review of film archive and film stock producer websites achieves objectives 1 and 3, via a critical analysis. A background literature review serves to provide context for these analyses and supports the achievement of all research objectives.

Primary sources from newspapers and journals are employed for the historical analysis, with some secondary sources being employed for support, sourced largely from *The Moving Image: The Journal of the Association of Moving Image Archivists*. (2001-2019) A majority of the sources for the conceptual analysis are drawn from secondary source literature, examining the academic debates around definitions and theories of preservation. Key texts such as Fossati (2018), Brown (2013), and *The Moving Image: The Journal of the Association of Moving Image Archivists* (2001-2019) are used to explore contemporary discussion, as well as debate around the time of the

digital shift in the industry. For both the conceptual and historical analyses, resources have been primarily sourced from the City, University of London library catalogue.

For the selective critical literature review and subsequent critical analysis, sources have primarily been drawn from the websites of film archives, and the websites of film stock producers. The archives were selected in accordance with the criteria outlined in section 1.4, and websites were identified based on an initial online search, which was then refined using the FIAF membership list. (FIAF, 2021) The film stock producers were selected based on an initial online search, and identification of whether they produced film stock via their websites.

In order to support the critical analysis, and support objectives 1, 2, and 3, primary data has been collected via an email interview with an archive curator. This has been achieved by approaching UK film archives and conducting a standardised interview via email, which can be seen in the appendices, and was structured to support the objectives of this research. As the interview data is in support of a critical analysis, it cannot be considered a representative sample. It is also important to note that all research methods have been impacted by the COVID-19 pandemic which may have impacted the response rate for the interviews, and that the sample based on the criteria outlined in section 1.4 in the UK is small, which may also have had an impact on the response rate.

This research holds value as it contributes to the academic debate surrounding film preservation by providing an analysis of the current viability of film stock as a method for preservation within film archives. It also explores the potential viability of increasing film stock production to serve archives, and of encouraging longer transitional periods between mediums to allow for stabilisation and minimising loss of information. The background literature review serves as an examination of technological obsolescence, the current state of analogue and digital preservation practices, and the impact of rapid technological changes within one section of an industry that has consequences for the operations of another section.

1.4 Research Scope

The research for this dissertation involves an examination of film archives, film stock producers, and the history and debate surrounding film preservation practices, to

determine the viability of film stock as a preservation method for film archives. However, as this is a broad field with many different parties involved the scope of this research was restricted to examining film archives in Europe and America, active at the time of research. Within this group, only archives with 25,000 or more items and a variety of common film stocks in their collections were included, in order to examine the preservation requirements for different stock types. Although initially research was intended to be limited to archives holding exclusively or majority film stock, this proved to be impractical as many archives hold other collections that outnumber film stock collections in items held, therefore, the scope of research was expanded. Archives dealing exclusively with ancillary material, TV, or photographic collections were excluded from research. Large scale national archives were also not included in the research scope, as the scope of their collections was deemed too wide for there to be a specific focus on film stock preservation.

Film labs, though an important aspect of film stock processing and preservation, were not included in the research scope as they aid in the preservation of film stock but are not in themselves archival institutions. Museums with film archives or film departments were also excluded from the scope of the research. While Fossati (2018) argues that the traditional delineation between film archives and museums and cinemateques is that the latter two often focus on active exhibition of films, (p.31) the reason that archives within museums have not been included in the scope of this research is that the preservation focus is on maintenance of an original item, and so migration of any kind, be it analogue or digital, is less relevant. However, cinemateques have been included in the research scope, as they preserve film stock in a similar way to archives and also preserve playback technology, an important aspect of avoiding format and medium obsolescence that is addressed in section 2.3. Libraries with film archives that meet the criteria have also been included in the research scope as a clear delineation can be made between the processes of the library institution, where the makeup of the collection is in transition, and the archive within it, where the makeup of the collection is more static. It is important to note that the delineation of archives, and museums and cinemateques is growing less relevant as digital technology allows for more collection access options, (Fossati, 2018, p.32) providing archives with the ability to exhibit their collections just as museums and

cinematheques do. However, while the lines between different institutions within this sector may be blurring, a delineation has been made here for the purposes of maintaining a feasible research scope for this project.

1.5 Research Limitations

This research is limited by what is feasible for the timescale of a dissertation and is therefore unlikely to be comprehensive. It has also been limited by the impact of the COVID-19 pandemic, as the desk research elements have been restricted to what is available remotely and online and the interview element also had to be conducted remotely. The impact of this research is also limited by its nature as a Master's dissertation, and the limited exposure it may receive as a result.

1.6 Style

For the purpose of this research, an academic writing style has been chosen as appropriate, as the majority of the dissertation research is comprised of literary analysis in various forms. While theoretical debates surrounding the definition of preservation in the film sector, or a historical analysis of preservation practices could conceivably warrant a more narrative style, the research question of determining the viability of film stock as a preservation method for film archives is more suited to an analytical, academic style.

1.7 Originality

To the best knowledge possible, this research is original. Any literature or findings not the author's own have been referenced and credited appropriately.

2. Background Literature Review

2.1 Introduction

Film is both a comparatively young medium, and an incredibly faceted one academically, with many specific lenses and frameworks available for this subject area alone. As a result, there is a broad scope of literature concerning film stock and the film industry's digitisation, and not all of it can be covered conceivably here, however key texts in this area have been used. The sections chosen reflect the key trends within the body of literature that has been examined, and align with the research objectives to establish a background for the later research.

2.2 The Impact of Industry Digitisation

Antoniazzi (2020) defines industry digitisation as the widespread changes that occur when a sector or process digitises, and digital preservation as the preservation of a digital collection. (p.1658) While a shift in preservation practices due to the introduction of digital technology could fall under this definition of industry digitisation they will be treated separately here as the commercial film industry and film archives are two distinct areas within the same sector.

The emergence of digital technology in filming, distribution, and exhibition as an alternative to the analogue processes associated with film stock was predicted to have a significant impact on film archive operations (Cave, 2008, p.2) even before the digital shift, and this has broadly held true. Dombrowski (2012) argues that exhibitors were incentivised to adopt digital screening technology by the industry, due to the appeal of new technology and the flexibility of digital distribution (p.235) as a digital shift would result in studios saving money, and would standardise distribution formats. (p.236) The distribution format for digital films, the digital cinema package (DCP), was strictly standardised, as were the exhibition requirements, resulting in conversion costs of at least \$65,000 for each screen in a cinema, which was often funded under agreement that full conversion occur by 2012. (Dombrowski, 2012, p.236) While the digital shift has had an impact upon archive operations, with the sudden domination of

a new format, it can be argued that the standardisation of digital formats does hold some benefit for future archival practice. As the DCP format is so strictly regulated and standardised, processing and storage of digital films could be far simpler than the more varied analogue formats if a long-term preservation solution is developed. However, this does not solve the issue of preserving analogue holdings. It is also important to note that many smaller exhibitors chose to adopt non-compliant, flexible, cheaper digital exhibition options in order to screen films as digital was adopted by more filmmakers, while others adopted compliant digital exhibition technology in order to screen larger films. (Dombrowski, 2012, p.237)

This method of adoption suggests that smaller exhibitors, previously screening film stock, were forced to adopt digital technology in order to continue operating as the larger players in the industry abandoned shooting on film stock. This resulted in the gradual conversion of the commercial sector to digital exhibition, with many large studios growing reluctant to loan prints of films for exhibition to exhibitors who still employed analogue technology. (HaDuong, 2012, p.149) This reluctance on the part of studios may have been due to the cost of loaning a print versus the cost of loaning a DCP (HaDuong, 2012, p.150-151) and did have a direct impact on archives, which saw a significant increase in print loan requests, resulting in some archives restricting the provision of print loans. (p.151) This restriction is understandable, as increased use raises concerns around preservation due to wear and tear (HaDuong, 2012, p.152) which is exacerbated by the cost of film stock going up as production goes down due to lowered demand. (Dombrowski, 2012, p.238) However, as archives restrict the use of film stock by exhibitors to preserve it, there is a risk that fewer exhibitors will return to archives for loan prints, limiting public exposure to film stock and the revenue gained from print loans. If there is little awareness of a format, there is less concern about its obsolescence, and the potential loss of the information it holds.

The other key consideration for archives is the issue of caring for both analogue collections, and the growing intake of digital media (Cave, 2008, p.2) as preservation methods suited for analogue collections do not work for the variety of digital formats that have emerged. (Conrad, 2012, p.28) The speed of digital format development results in a shorter lifespan, forcing archives to acquire films as early as possible in order to preserve them (Cave, 2008, p.7) which results in increasing pressure upon the

archive as the size of the collection grows without the ability to leave some acquisitions for a later date. Turci (2006) explores how archives in Europe have adapted to the digital shift, finding that a combination of digital and analogue preservation practices were in use, with specific practices depending upon the needs and policies of the archive. (pp.112-124) However, it is also important to note that in some archives there was still a preference for analogue practice over digital due to staff inexperience, (Turci, 2006, p.114) which stands in direct contrast to Lameris and Flueckiger's (2019) later findings that students studying film had very little awareness of analogue practices due to the industry adoption of digital technology. (p.95) This shift in knowledge over the course of a single generation of archivists has the potential to put analogue collections at risk, due to a lack of incoming knowledge about analogue practice. This knowledge shift also poses a risk to future archivists, as the term "film" can no longer be applied only to the analogue and a distinction between analogue and digital processes must be made in order to avoid information loss about the practices and debate surrounding analogue film. (Streible, 2013, p.229) While such views may not have been so concerning if digital formats supported long-term preservation, and migration had been able to occur at an earlier point, this was and continues to not be the case, and so the risk to knowledge and information held on and about film stock is very real.

2.3 Format and Medium Obsolescence

There is an argument that 'fast-paced planned obsolescence is still incompatible with trustworthy preservation structure within film heritage' (Antoniuzzi, 2020, p.1667) which is difficult to argue against as analogue practice involves passive preservation through controlled storage. Digital items, meanwhile, require active preservation to ensure that mediums and formats do not become obsolete, and information inaccessible. (Thurlow, 2020, p.79) While such a shift from passive to active preservation would not be insurmountable, the key issue in the case of film archives is, as Cave (2008) argues, that film stock has been declared obsolete before digital formats have stabilised to be suitable for long-term preservation. (p.3) This is a broader technological issue, with many digital devices having lifespans of less than five years in order to encourage higher rates of consumption, and due to consumer

demand for lower costs (Leverett, 2019, p.96) a cycle which occurred in the digitisation of the film industry as outlined previously by Dombrowski. (2012) This cycle is unsustainable for archives based on cost and scale alone.

While issues such as formatting changes and confusion surrounding stakeholders (Conrad, 2012, p.31) already existed, they have been exacerbated by the digital shift, and although 'the risk of investing in something that will soon become obsolete is considerable' (Fossati, 2018, p.70) for everyone involved in the industry, the cost for archives is an ongoing one as they are faced with having to adopt new technology while also maintaining old technology and formats for as long as possible in order to maintain preservation. There is a suggestion that archives will not be forced into mass digitisation so long as the formats and technology remains available (Antoniazzi, 2020, p.1668) but this again relies on the maintenance of technology and knowledge within the institutions, which many archives may not have the capabilities to do. However, it is also important to recognise that film as a medium is not flawless; it is difficult to access and transport, and easy to damage, (Walsh, 2008, p.38) and if stored incorrectly is at high risk of deterioration. Established analogue practice could also potentially be viewed as an issue, as digital preservation standards are held up to those of analogue preservation standards, and so digital technology is viewed as too unstable (Conrad, 2012, p.28) for preservation.

Another key issue for archives is the obsolescence of industry sectors related to the processing of film stock (Elwes, 2013, p.59) which forces film stock into obsolescence as a preservation method unless archives are able to establish internal processing. Fossati (2018) argues that the point where film stock is no longer produced will herald analogue obsolescence, and digital must be adopted for long-term preservation. (pp.88-89) While it is unknown now when this point will be reached, it can be argued that the current cycle of rapid obsolescence does not encourage the idea that digital technology will be optimised for long-term preservation. Another issue in this regard is that of legal ownership and copyright, as digital items often occupy a grey area, and copyright law within the UK requires that unpublished items hold a tangible form in order to be recognised. (Harbinja, 2019, pp.6-8) While this may be less of an issue for commercial, or published films held in archives, digital films that

go unpublished may not hold clear copyright and could limit preservation efforts as a result.

Relating to the issue of technology maintenance, Crofts (2008) raises the question of knowledge transfer in relation to maintaining obsolete technology (p.14) which is important to consider, particularly as technical knowledge prior to the digital shift was centred around analogue practices, with limited knowledge of digital (Fossati, 2018, p.88) and yet as previously discussed the next generation of archivists have little exposure to analogue practices. There is an effort in archives to preserve knowledge surrounding analogue practices for history if not practice (Bonatti and Legelius, 2019, p.150) however it can be argued that this knowledge gap represents a wider cut-off point for film stock as a primary preservation method for film archives, as it now exists outside the standard commercial format.

A possible future of film stock could be seen in how archives find it difficult to process and preserve analogue experimental films, as they are created outside the commercial standards of production and practice, and present difficulties in not only preserving the film but the context surrounding it, as in many cases the presentation of the film is as important as the film itself. (Groschke et al., 2012, pp.128-135) In this case, a lack of standardisation runs a higher risk of suffering from information loss due to the variables present, and with the increase of digital technology it could be argued that this is a risk for film stock and many digital formats as the rapid obsolescence cycle affects both sides. However, there is also an argument to be made that the knowledge surrounding analogue practices is not disappearing but transforming. Given that film archives have traditionally adapted technology to suit the needs of the archive, (Fossati, 2018, pp.107-108) and even use obsolete technology from other areas of the field to restore films (Paletz, 2006, pp.7-8) the concept that analogue practices will persist in some form is not an impossibility. However, as a preservation method, it is difficult to deny that film stock is heading for obsolescence in the face of the digital shift.

2.4 The Current Position of Film Stock Production

As previously outlined, the digital shift has resulted in the obsolescence and closure of film stock processing services, however alongside this the production and manufacture

of film stock has also seen a significant decrease. (Fossati, 2018, p.43) Lenk (2014) argues that this decrease is due to the dominance of the DCP, and raises the question of whether film stock can still be valued in this new environment. (p.101) It can be argued that as a medium outside the new standards for the industry, film stock will lose its value as it continues to be used less frequently; however, in the case of film stock, complete devaluation in favour of digital technology may not be currently possible. As Lenk (2014) outlines, many archives do not have the funding or manpower to completely digitise their collections, and the FIAF preservation guidelines emphasise medium to medium transfer, keeping films on film stock for as long as is feasible. (p.103) It would appear, given these factors, that archives cannot afford for film stock to become obsolete because of the information risk to analogue collections that cannot feasibly be digitised or digitally preserved on a short timescale. However, while there were views that film stock could still rival digital technology in development and capabilities (Crofts, 2008, p.8) before the digital shift, two years after the shift Lenk (2014) shows concern that analogue collections may be viewed as obsolete and burdens by archives. (p.102)

The phasing out of film stock production was noted before the digital shift, as Cave (2008) raises that the largest manufacturer of film stocks, Eastman Kodak, has already begun reducing film stock production (p.2) and Crofts (2008) notes Eastman Kodak's increasing investment in digital technology. (pp.4-5) This suggests that film stock was already viewed as obsolete in some capacity in comparison to the emerging digital technology, or at the very least less profitable. However, it is important to note that in 2015, in the wake of protests by creators within the industry, Eastman Kodak agreed to ensure that filmmakers who choose to can continue to use analogue film (Fossati, 2018, p.44) which does suggest that film stock is still valued, and so has the potential to be viable in some form as a preservation method for archives so long as production continues. While this may be arguable, it is not possible to ignore the fact that film stock production is not based solely upon the needs of film archives, and is instead driven by industry demand. In such an environment, it is likely that it will not be profitable for companies to continue to produce film stock after a certain point, which has a significant impact upon archival practice, as film stock is no longer a viable preservation method. (Crofts, 2008, p.24) However, Crofts (2008) also points out that

there is a danger in focusing entirely on film stock as a preservation method at the cost of digital technology, as there will come a point where digital will have to be the new long-term preservation method. (p.25) Focusing on film stock in this case could result in a lack of communication surrounding how to make digital technology viable for long-term preservation, which could result in a greater risk of information loss if the technology adopted is still part of the rapid obsolescence cycle.

Archives are arguably in the middle of shifting from an entirely analogue practice to a digital one, given that large parts of their collections are frequently still analogue in nature. This can be seen in the practice of FIAF archives, many of which maintain their analogue collections either because there was limited incentive to digitise until recently, or as backups to support digital access copies. (Lenk, 2014, p.102) There is also the risk with the decrease in film stock production that analogue collection items in poor condition may not be restored or digitised due to a lack of demand for the item (Lenk, 2014, p.105) and due to the fact that, as previously addressed, it is costly to digitise films and is becoming costly to transfer films to new stock with the production decline. While prioritising the preservation of “valuable” items is not new in film archives there is a serious risk of information loss due to inaccessibility, inability to migrate content, or film stock degradation. While analogue preservation may have been viewed as more long-lasting than digital preservation (Crofts, 2008, p.12) the industry and archives are now reaching a point where choosing analogue preservation is becoming increasingly difficult due to production decline, and digital preservation is becoming the only option.

2.5 The Current State of Digital Preservation

There are many reasons to adopt digital preservation, including internal and external long-term information access, legal requirements, cost savings, and as part of a broader digital shift (Brown, 2013, pp.20-24) and it was recognised that while establishing a new digital system would be difficult, digitising films would be simple once infrastructure was established. (Walsh, 2008, p.39) However, industry digitisation specifications have been tailored to contemporary distribution instead of archival films which could cause exhibition issues if these specifications are adopted as standards

(Fossati, 2018, p.80) as this form of digital preservation does not accurately preserve older films due to format differences.

Thurlow (2020) argues that a culture shift must occur to integrate digital preservation (p.80) which has caused difficulties as it is hard to find professionals with knowledge of analogue and digital practices (Bonatti and Legelius, 2019, p.146) to breach the transition. However, despite this many archives have now integrated digital technology as part of their workflow (Fossati, 2018, pp.84-85) and digital preservation is increasingly addressed in academia. (Brown, 2013, pp.80-81) This shift may be reflective of the fact that digital technology has been broadly integrated into life and so a new generation of professionals is more comfortable with the technology. As Brown (2013) argues, preservation preserves the key properties of an item, and broad agreement about what those key properties are aids in standard creation (p.198) which can only occur if the technology underpinning the preservation is understood. This is also key because data migration occurs more frequently in digital preservation, and so there is a greater risk of information alteration or loss if the technology is not properly considered. (Brown, 2013, pp.209-212) A good way to guard against information loss in digital preservation is to maintain multiple copies (Brown, 2013, p.220) and ensure fast detection of integrity failures (p.223) both of which are arguably both easier in digital preservation due to the ability to digitise these processes alongside the digitisation of collection items.

Archives employing digital preservation use storage technology such as LTO tapes and formats that are at the least risk of information loss (Bonatti and Legelius, 2019, p.144) however while such hardware is widely used, it is not ideally suited to archival preservation due to frequent migration and increasing costs. (Antoniuzzi, 2020, p.1664-1665) Despite this fact there is a common external view that preserving analogue copies in an increasingly digital field is a financial drain (Cherchi Usai, 2009, p.11) a view which, if supported internally, could result in an increased risk of information loss due to destruction of analogue copies. However, another element of digital preservation to consider is the decentralisation of creation, as Gracy (2007) argues that with the rise of online content creation, moving image preservation may be the responsibility of individuals rather than institutions which could alter the standing of the archive in society (pp.184-197) and also poses the issue of how

archives will preserve the digital content that is now being produced. Many concerns surrounding digital preservation are about authenticity and medium stability (Matusiak and Johnston, 2014, p.248) which has resulted in analogue collections being preserved even after digitisation for various reasons (pp.259-260) a fact which could be seen as undermining the perception of digital preservation within archives. Archives have also had limited input in digital standards (Crofts, 2008, p.15) resulting in many suggesting a need for collaboration within the field to create standards suitable for long-term digital preservation. (Crofts, 2008, pp.19-20, Antoniazzi, 2020, p.1659, Keller et al., 2019, pp.51-54)

As previously discussed, digital technology is being adopted in archives, and Fossati (2018) observes that it has been adopted widely in editing and restoration work (p.56) which may be a factor in the acceptance of digital preservation within archives. However, digital preservation and high-quality digitisation for access is still a difficult and expensive process (Fossati, 2018, p.130, Cherchi Usai, 2009, pp.10-11, Gracy, 2012, p.423) that could be seen as a major restriction in the adoption of digital preservation for analogue collections where analogue practice is well-established. Despite such barriers digital technology is becoming the dominant format, and as Bonatti and Legelius (2019) address, widely used digital systems are less likely to become obsolete and so data can still be retrieved, where film stock is becoming less prevalent (pp.177-178) and therefore less reliable. Digital technology also presents the possibility of emulating older formats (Brown, 2013, pp.212-213) and the development of CGI potentially being employed in recreating damaged areas during film restoration (Fossati, 2018, p.60) which would not have been possible in analogue restoration without an undamaged version of the film.

While there are many issues with long-term digital preservation such as rapid obsolescence, information or data loss, and damage or deterioration of carriers for a variety of reasons (Fossati, 2018, pp.89-94, Brown, 2013, pp.200-206) another emerging issue is that of copyright, as copyright uncertainty can restrict archival efforts to digitise their collections (Fossati, 2018, p.132) and current copyright law is unclear surrounding digital works and the migration necessary to ensure their preservation (Brown, 2013, p.207) so as a result many archives will not digitise full versions of items, or will not digitise at all. (Gracy, 2012, pp.446-447) Another barrier

to large scale digital preservation is cost, as the processes and equipment involved are expensive (Fossati, 2018, pp.136-137, Bonatti and Legelius, 2019, p.148) and while there is some argument that maintenance of a digital archive is less costly than the initial investment (Bonatti and Legelius, 2019, p.146) this does not recognise the issue of the large analogue holdings of film archives that would require digital preservation, which would be costly to undertake.

2.6 Analogue vs. Digital: The Academic Debate

A key text in the academic debate surrounding analogue and digital film preservation practices is Fossati (2018) who states that archival practice is in a transitional stage as new digital formats emerge, and the sector is forced to question its position in society (p.23) while also recognising the fact that there is still hybridisation of practice within archives. (p.22) Digital was adopted by some filmmakers for cost or aesthetic reasons, (Fossati, 2018, p.72) however the main drive towards digital adoption was predicted to come from the commercial sector, which being outside the influence of archives would force archives to adopt reactionary strategies (p.82) as addressed in section 2.2. With many archives set up to handle passive preservation (Conrad, 2012, p.29) and professionals being unclear about the practices of digital preservation and the future of film stock (p.31) before the digital shift, it can be argued that reactionary strategies were the only way forward for archives until digital practice standards emerged. While there is evidence of groups such as the AMIA addressing the issues surrounding the digital transition by working with the community (Fossati, 2011, p.157) it can be argued that these efforts would be limited, purely based on the fact that for most of film's history, active preservation in archives has been via analogue migration (Walsh, 2008, p.38) with a large part of practice being passive preservation management which contrasts with the far more active preservation practices needed for digital preservation. However, the culture shift required is not the only important element of the academic debate, as Knowles (2016) addresses the increase in DIY film labs and film stock production as commercial film stock production decreases (p.147) which could place any future intakes of film stock in the same position of experimental films of the past, as addressed in section 2.3.

It is also important to recognise that despite the efforts of organisations to address issues associated with the digital shift, many institutions in the sector had no reference to digital preservation, or digital preservation standards, in film preservation guides before the shift occurred (Conrad, 2012, p.32) which may have contributed to the reluctance surrounding digital adoption in archives. As previously addressed in sections 2.3 and 2.5, rapid obsolescence is a major issue in digital preservation development and while migration is a potential solution, it is also very time, resource, and cost intensive. (Conrad, 2012, pp.33-34) However, with the current position of film stock these factors can be seen as less influential, as digital adoption increasingly becomes an inevitability. This early delay in addressing digital preservation may well have exacerbated future issues, as digital preservation will grow more complex with format variation and there is recognition that archives may not survive if they do not successfully address and embrace digital preservation. (Conrad, 2012, pp.37-38)

Due to the hybridisation of preservation practices, there are some areas such as restoration where an entirely digital workflow is adopted, and standards developed as a result, as outlined by Fossati (2018, pp.100-103) which arguably show that development of digital standards is occurring and being employed within archives where relevant, however, these are still only aspects of the preservation process. While the recent academic debate centres around the adoption of digital technology, there is some recognition that analogue preservation is limited in its information retention capabilities and that digital technology is showing those limitations, despite its own issues. (Walsh, 2008, p.38) However, it is still recognised that digital preservation is expensive, forcing archives to prioritise either storage space or content quality, and that rapid obsolescence results in a lack of recognised format standards, (Conrad, 2012, pp.34-35) which if ongoing poses a real risk of large quantities of information loss due to a lack of standards, or an inability to follow best practices for preservation.

Several key standards outlined for digital preservation are tied to the idea that to be viable, digital preservation should meet or surpass the capabilities of analogue preservation, (Conrad, 2012, p.32) however in areas such as resolution film stock is far less definable than digital. (Fossati, 2018, p.69) As a result, it could be argued that meeting analogue standards in these areas consistently would be difficult as it would

be hard to identify discrete amounts of analogue information and determine both correct quality levels for a digital counterpart, as well as evaluate any possible information loss occurring during the transition. However, Walsh (2008) considers the possibility that, with the rise of digitisation, analogue collections could be destroyed at the point where it is no longer sustainable to maintain the medium (p.40) a concern which could now be seen as valid given that, as Loertscher et al. (2016) found, the gap between digital and analogue aesthetics and quality has now closed (p.468) suggesting that there may be no commercial need for film stock. There is a recognition in the academic debate that there is an inevitable point where film stock will no longer be viable and alternate preservation formats must be found, regardless of whether digital will be suitable as a replacement (Fossati, 2018, p.89) however this is accompanied by the idea that analogue media will not disappear entirely, and that there may be a place for film stock, (p.27) even as digital becomes the new preservation method.

2.7 Summary and Key Issues

The background literature in this area positions film stock as a primary method of archival preservation, but one that is dying out in the face of commercial sector digitisation. While digital preservation is seen by many as an unavoidable necessity due to the influx of digital filmmaking, it is recognised that digital technology is not yet suited for long-term preservation, and may in fact be detrimental due to rapid obsolescence. As a result of these factors, the field is moving further into the transitory phase between analogue and digital, where both forms practice are undertaken in film archives, and because of this there has been debate surrounding standards and policy for digital preservation.

The research outlined and undertaken in the next few sections can be justified as examinations of archival practice within the literature have been restricted to a few select archives, and a broader scale examination of archival practice to determine the viability of film stock as a preservation medium specifically has not, to the researcher's knowledge, recently occurred.

3. Research Methods

3.1 Introduction

As the relationship between the research objectives and research methods has been outlined in section 1.3, this chapter will not re-outline them, but will address how each method relates to the research objectives in more detail. These subsections will identify and justify the methods used, address how they have been employed in detail, relate them to the research objectives, and cover any limitations or issues encountered in the process. Sections 3.2 through 3.2.5 will address that a key requirement for a dissertation is that research strategies must be defined and justified, (Biggam, 2017, p.177) and why this is the case, and briefly address more widely applicable limitations to the research and the dissertation. Section 3.3 will address ethical considerations that have been undertaken.

3.2 Justification of Methodology

Biggam (2017) states that for research to be considered valid, it must be conducted using recognised research, data collection, and data analysis techniques that are appropriate for the research being undertaken. (p.178) In order to ensure the validity and reliability of the research methodology being used for this dissertation, this section will address the various research methods employed. This section will also work with the appendices to provide 'clear and unambiguous information' (Biggam, 2017, p.153) allowing for research reliability and transparency.

As the empirical work for a dissertation is likely to be limited in some form, (Biggam, 2017, pp.199-200) it is also important to address research limitations here, to further support the validity and reliability of the work undertaken. As the research largely consists of various forms of desk research it is also important to address the broader limitation that it is not possible to examine all sources relevant to the research topic, and that instead the research consists of examining all available and relevant sources. (Pickard, 2013, p.174) This would be true given the normal time constraints of the dissertation process, however source access has been further restricted by the

impact of the COVID-19 pandemic, which has resulted in research largely based on sources that are online and available remotely. This is important to address here, as all aspects of the dissertation process have been impacted by this limitation, but this is still particularly true of the desk research and empirical work.

3.2.1 Background Literature Review

The background literature review is a key element of the research process, as it 'locates the research within the context of the published knowledge that already exists about the area that is being investigated' (Denscombe, 2017, pp.170-171) and in the case of this research not only provides research context, but also developed the various desk research methods. The background literature review was primarily sourced from the City, University of London library catalogue. Given the importance of defining terms and boundaries for a literature review (Biggam, 2017, pp.122-123) it was decided that literature should be restricted to the mid-2000s onwards, as this would cover the shift from analogue to digital practice while also addressing the most recent debates in the field. While the initial search was non-categorical, later searches employed variations on key terms "film stock" and "film preservation" within the discipline of film specifically. These terms were deemed suitable as they related to the research question of the viability of film stock as a preservation method for archives. Biggam (2017) also argues that information gained from any source should be relevant to the research, credible, and recent. (p.123) These criteria were met by the employment of key search terms and date boundaries, and use of the City University of London library catalogue. While this may not be a guarantee of credibility, sources were further examined to ensure that they came from trusted authors or journals in the field.

In line with Biggam's (2017) advice to define the literature review and research around the research objectives, (p.106) the background literature review was divided into five relevant sections, that also reflected themes in the literature. Sections 2.2 and 2.3 relate to objective 1 by providing a background for the digitisation of the film industry and exploring format and medium obsolescence respectively. Sections 2.4 and 2.5 relate to objectives 2 and 3 by providing background to the current state of film stock production and digital preservation methods respectively, supporting the desk

research. Section 2.6 provides the academic background of the digital vs. analogue debate in the field, supporting all objectives. Research was restricted to literature available online and remotely accessible, due to the COVID-19 pandemic, undoubtedly limiting the reach of the background literature review. However, the resources available were suitable, such as key texts like Fossati. (2018)

3.2.2 Conceptual Analysis

Conceptual analysis, as a form of analysis that identifies concepts by defining the boundaries of its classification within an area (Furner, 2004, p.233) is suitable as a research method to explore the definitions of preservation, digital preservation, and access in film archiving, primarily due to the academic debate surrounding the terms, which was discovered in the background literature review. Although initially the analysis was to be limited to definitions of preservation and access as seen in the research proposal in section 8.2, this was expanded with the exploration of the literature. The debate of content/carrier in the field was important to discuss, as it would define the viability of film stock as a preservation method by establishing whether the content or carrier was more important to preserve. As a result, key texts from the background literature review were incorporated into the conceptual analysis in order to better define concepts and explore the impact of the debate upon practice. A large section of the literature was sourced from the City, University of London library catalogue, specifically *The Moving Image: The Journal of the Association of Moving Image Archivists*, (2001-2019) and Fossati. (2018)

By examining concepts such as preservation, digital preservation, and access, the conceptual analysis relates to objectives 1 and 2 by analysing whether analogue and digital practices can be compared, examining how academic debates can impact practice and define the viability of film stock as a result, and exploring what a film can be defined as. Source access was limited due to the COVID-19 pandemic and the conceptual analysis draws largely on the academic debates within the field. While these may have an impact on the preservation practices of archives their ultimate level of effect is difficult to gauge as each archive will have different preservation approaches and policies. It may have been ideal to approach each archive for details

on this, and build the conceptual analysis upon this groundwork, however this would not have been practical within the time constraints of a dissertation.

3.2.3 Historical Analysis

Historical research, focusing on documentary analysis of the distant or recent past (Biggam, 2017, p.163) is a suitable research method for exploring and comparing the development of analogue and digital practice, as it focuses on primary source analysis, which provides more support for empirical work than analysis of secondary sources if undertaken correctly. As Pickard (2013) argues, establishing a chronology or scope is key to historical research, with a broader scope resulting in a less in-depth analysis. (pp.169-170) For this project the chronology for analogue practice was established as running from the early 1920s to the early 2000s, with the chronology for digital practice running from the early 2000s to the present. This broad approach was deemed best suited to support the critical literature review, providing a timeline of practice developments alongside the theoretical debate in the conceptual analysis.

Without an understanding of how film and digital preservation techniques developed and compare, the other analyses would operate outside the field's history and the research would have limited grounding. Sources were drawn from the City, University of London library catalogue, using the key term "film preservation" and setting date limits by decade moving forward through the chronology. Primary sources were largely drawn from well-known newspapers such as *The New York Times*, (1851-2021) or from professional journals referenced frequently in secondary sources, being assessed for credibility as required by documentary research (Denscombe, 2017, pp.249-250) with secondary sources being largely drawn from *The Moving Image: The Journal of the Association of Moving Image Archivists*. (2001-2019) In providing a comparison of the development of digital and analogue practices, the historical analysis directly relates to objective 2 and supports objective 1 by analysing the development of digital practice, and by extension the impact of lowering film stock production upon archive practices. As a research method, historical research is inherently fragmentary, (Biggam, 2017, p.163) so no complete picture can be drawn of the development of film preservation practice. It is also difficult to achieve full information saturation (Pickard, 2013, p.173) in historical research. The timeframe also

necessitated that the analysis was less in depth than if a more specific timeframe had been selected. With the restrictions of COVID-19, all sources had to be accessible online and remotely, resulting in limited analytical possibilities.

3.2.4 Literature Review

A critical literature review requires describing the key themes or issues of the literature, providing an overview, and then evaluating the themes or issues in the literature to come to a conclusion. (Denscombe, 2017, p.374) This method is suitable to research the current preservation activities of film archives, as any research would have to be done remotely due to COVID-19 restrictions and the wide geographic locations of the archives. As worldwide film archives are a significant research population, a decision was made to limit the research to archives in Europe and America that met a collection threshold of 25,000 items. A suitable sampling frame, as defined by Denscombe (2017, p.35) was the FIAF membership list, (FIAF, 2021) and the key issues selected were the archive's infrastructure and support for digital and analogue preservation practice. The archive's websites were analysed according to this structure, and evaluations made on the current position of European and American film archive preservation practices, and whether film stock would be a viable preservation method. Denscombe (2017) advises that with online sources, particular care should be placed in determining the authority and trustworthiness of the source, (p.252) which was partially achieved via the sites being accessed through the FIAF membership list, however care was still given to determine the reliability of the sites. The same method was adopted to select the websites of film stock producers, with the key issue to determine whether they produced film stock; however, as this research population was significantly smaller it was determined that no wider sampling frame was necessary. In analysing the current preservation practices of archives, and the current production of film stock, the literature review directly relates to objective 3 by determining the viability of film stock as a preservation method for film archives. The literature review as a research method is limited by what literature, in the form of websites, is available from the archives themselves. While direct interviews with the archives may have been more suitable, this was not feasible due to the number of archives and the project's time constraints. There was also the issue that, in some

cases, the websites had no English language version, so to include them in the research it was necessary to use Bing Translator, (Bing, 2021) which may have had an unknown impact on the validity of the literature.

3.2.5 Interviews

To support the literature review, it was decided that interviews with film archive curators would be employed to gain in-depth qualitative data about the current state of preservation practices. Interviews were deemed an appropriate approach because they are a good method to employ when seeking to gain opinions, explore complex issues, or gain an expert perspective. (Denscombe, 2017, p.203) A structured, open-ended interview format was chosen to gain qualitative data about preservation practices and support the literature analysis, as in this format the participants are given the same questions, but allowed to respond how they choose (Pickard, 2013, p.199) allowing for a greater level of data variation to support the literature review. The interviews were conducted via email, due to COVID-19 restrictions. All documents involved can be found in appendices 8.3 through 8.7. Five archives in the UK fit the research criteria outlined in section 1.3 and were selected as a sample, as it was decided that they would be more likely to respond within the timescale of the project and the archives spanned the collection size range, allowing for variations in responses. This selection was made in part due to the limitations of dissertation research, and the resulting sample could be classified as either a convenience sample, or a cluster sample as defined by Pickard. (2013, p.63) Emails for the archives were found via their websites, and the archives were approached with a standard email that can be seen in appendix 8.7. Of the five archives approached, two responded and one participated, giving an overall response rate of 20%. It was recognised in the research proposal that there could have been no responses due to COVID-19, however as there was a response, the data was included in the research. While it is important to recognise that it is not appropriate to generalise from a small-scale sample, (Pickard, 2013, p.59) these interviews were intended to support the literature review, not be generalised.

The interview questions, which can be seen in appendix 8.3 were structured according to the research objectives, and analysed according to the inbuilt themes;

questions 1 and 2 were intended to establish basic information about the collection, questions 3 and 4 concerned the current state of preservation practices in the archive, questions 5 and 6 concerned the impact of film stock production decreases on preservation practices, and questions 7 through 10 concerned the potential impact of an increase in film stock production upon archive preservation practices. The analysis of these themes was placed in relation to the literature review, as relation of empirical findings to literature analysis allows for more meaningful analysis. (Biggam, 2017, p.199) The questions in the interview are structured around the research objectives, and so relate to them directly, with questions 3 and 4 relating to objective 1, questions 5 and 6 relating to objectives 1 and 2, and questions 7 through 10 relating to objective 3.

The interviews were restricted by COVID-19 and had to be conducted remotely, and the pandemic may have influenced the response rate, which was low. While in-person interviews, or interviews with the entire research population used for the research may have been more suitable approaches, these were not possible due to project time constraints and COVID-19 restrictions. It may have been suitable to conduct a questionnaire instead of interviews, however this may not have guaranteed a good response rate and would have sacrificed the level of qualitative data obtainable from email interviews.

3.3 Ethical Considerations

All empirical data for the desk research has been obtained from publicly available sources, and all sources and literature have been fully referenced. Interview subjects have been asked to give informed consent to participate, have been informed of the purpose of the project, how their data will be used, that they may choose to withdraw at any time, and their data has been held and backed up in secure locations, under encryption. All data included in the project and appendices has been anonymised before inclusion, and all personal identifying data has been removed. A full outline of ethical considerations for this project can be seen in appendices 8.2, 8.5, and 8.6.

4. Findings

4.1 Conceptual Analysis

Fossati (2018) argues that with the digital shift, there has been a shift in the nature of what film is (p.21) and while conceptual debates in the field exist, given that film is arguably an inherently transitory medium, (Fossati, 2011, p.155) it could be argued that the digital shift exacerbates them. These debates will be examined here with the aim to explore definitions of preservation, digital preservation, and access. The digital shift arguably introduced a change in understanding of what defines film, reflected in the use of “moving image” as an umbrella term for the formats encompassed in the field (Streible, 2013, p.230) and the fact that, even after the digital shift, distinction between analogue and digital was fluid, a detriment to theoretical understanding as it did not allow for accurate and clear division. (p.228) This has arguably not improved, as there are competing definitions around what defines a digital asset (Harbinja, 2019, p.5) and much like “film”, “digital” is used to refer to a broad spectrum of characteristics within archival practice (Crofts, 2008, pp.22-23) resulting in unclear conceptual definitions which impact other definitions within practice.

The conceptual debate also exists for analogue practice definitions of “restoration” and “originality” in relation to preservation, with the expanded abilities of digital technology exacerbating the debate, (Fossati, 2018, pp.97-98) and while it is recognised that the digital shift is the move from one major artefact to another (p.203) it is still important to have broadly recognised conceptual definitions during the transition for the sake of current and future theorists in the field. However, due to characteristics such as consistent reproducible quality (Bonatti and Legelius, 2019, p.146) and the ability to mimic analogue characteristics (Loertscher et al., 2016, p.459) discrete definitions from analogue practice appear more difficult to cleanly apply to emerging digital practice. This also applies within digital practice, as distinctions between “digitisation” and “digital preservation” vary, or are more often used interchangeably (Cherchi Usai, 2009, pp.10-11) potentially creating a dangerous view that the two are the same, and risking information loss if items are not actually preserved but simply digitised for access. It is important to note that film has historically had various theoretical frameworks applied to it, and this is unlikely to

change with the digital shift (Fossati, 2011, p.158) as Fossati (2018) observes that various theoretical frameworks in the field may be altered by digital technology, but are not invalidated by it. (pp.167-176) Fossati's (2018) conclusion is that debate in the field is largely between viewing film as a conceptual or material artefact, as the latter recognises a difference between analogue and digital while the former does not (p.325) and this debate has a significant impact upon the definitions being examined here.

The materiality of digital is debated, as though it does not have a carrier, it does still exist in some form (Streible, 2013, p.231) and this form is arguably more vulnerable due to the lack of a carrier which would ensure preservation security. (Conrad, 2012, p.34) This is important, as for restoration and preservation, the "original" carrier is viewed as the best source to draw from (Fossati, 2018, p.207) an element that is absent in digital preservation, which arguably influences restoration practices, as the distinction between restoration and alteration has traditionally been drawn by an understanding of analogue carriers. (pp.284-285) However, Busche (2006) observes that film restoration has no professional code (p.2) and its ethics are drawn from fine art restoration, which is debatably applicable to the field, particularly as restoration in film frequently occurs on copies instead of original artefacts (p.6) resulting in debate around what is acceptable restoration and what is information removal. (p.18) This debate has been exacerbated by the introduction of digital restoration technology, which can be automatic, but has proven to require human intervention to maintain authenticity. (Fossati, 2018, pp.112-116) While there is an understanding of terminology in restoration (Wallmüller, 2007, pp.79-80) the lack of a professional code introduces variation based on personal understanding, particularly as it is often unclear how elements present in a film should be categorised, (p.82) and this uncertainty ties restoration and preservation practice to the materiality of film.

The content/carrier debate is longstanding in the field and is argued as being purely theoretical as true carrier and content preservation via migration is impractical. (Lameris, 2017, p.92) However, it can be questioned as Cave (2008) argues that the rise of carrier-less digital content threatens traditional archival practice, (pp.4-5) with digital carriers that do exist being less prioritised because they can be identically copied. (Bonatti and Legelius, 2019, p.147, Brown, 2013, p.199) However, the choice to

maintain, migrate, or emulate the artefact still applies, particularly as maintenance is the archival ideal, but again impractical. (Brown, 2013, pp.208-209) There is also an argument that film is a historical resource (Bonatti and Legelius, 2019, p.150) supporting preservation of carrier and content. While digital is seen as altering the debate regarding access, it also poses new problems (Matusiak and Johnston, 2014, p.242) and arguably further clouds the related debate around originality. Busche (2006) argues that there is no clear concept of originality in film preservation, which causes increasing issues as digital dominates (p.10) because different aspects of film can be used to define originality; (p.14) they also argue that the content/carrier debate has little bearing when it comes to restoration, because restoration occurs on copies of an artefact, and in analogue practice the content is inseparable from the carrier (p.17) which can be seen to render both debates useless as each analogue item is unique and inseparable. However, digital restoration and reconstruction causes debate in the field with some viewing it as a bridge between practices, and others viewing it as erasing elements of the artefact, removing contextual elements in combining multiple film versions and placing the restoration as the new original, (Bonnard, 2016, p.140-141) arguably placing the older artefacts at risk if the digital restoration becomes prioritised.

The debate surrounding film originality has an impact on preservation, as Fossati (2018) argues that the archival extremes are preservation above all else, rendering the artefact inaccessible, or access above all else, rendering the artefact increasingly damaged and eventually lost, with many archives trying to find a middle ground, (p.208) however digital film alters this balance. This is not aided by the fact that both “preservation” and “restoration” are debated in terms of their definitions in analogue practice, (Busche, 2006, pp.3-4) and that there is a view of digital access being the same as digital preservation, (Crofts, 2008, p.21) which could run the risk of information loss if a distinction is not made clear to those outside the archival sphere. While the aim of preservation can be defined, (Brown, 2013, pp.193-194) what it can be defined as conceptually is less clear, due to the debates discussed above, which has the potential to impact practice and future preservation efforts due to uncertainty.

4.2 Historical Analysis

The first few decades of film preservation history show evidence of research into preservation by newly established archives and an emphasis on vault storage (*The Observer*, 1921, p.7, *The Times*, 1940, p.4, The United Press, 1940, p.27) with archival efforts supported or started by political support from governments that viewed film as an educational medium. (*The New York Times*; E7, 1924, p.7, Kent, 1926, pp.30-33, *The Manchester Guardian*, 1932a, p.10, *The Manchester Guardian*, 1932b, p.8) Much of this preservation development was based upon the fact that film stock was often poorly stored and neglected by legislation, leading to calls for more adequate preservation efforts, (*Special to the New York Times*, 1923, p.12, Nugent; X3, 1936, p.3) particularly as it emerged that nitrate stock was both combustible and produced noxious gases if stored improperly, a fact which drove the creation of early preservation storage standards. (Johnson, 1939, pp.79-92, Arbaugh, 1939, pp.106-114) This development was also driven by large-scale film fires, and several deaths due to fume inhalation, caused by improper storage conditions. (McIlvaine, 1926, pp.96-99, *The New York Times*, 1929, p.56) Early preservation standards were arguably influenced by manufacturing and distribution practices and film fire disasters, with many early archive staff having limited knowledge of film stock care, resulting in variation that was dangerous to preservation efforts. (Gracy, 2013a, pp.368-389, Grimm, 2001, pp.21-38) However, there is evidence that before this legislation there was recognition that correct storage could preserve film stock, with studios and production companies contributing to the effort (*The New York Times*; X5, 1926, p.5, Johnston; SM7, 1926, p.7) and archives beginning to select films for preservation with the understanding that not all existing films could be preserved. (*The Observer*, 1935, p.3, *The New York Times*; N3, 1938, p.3) FIAF was also formed, encouraging inter-archival loans and sharing of knowledge. (*The Manchester Guardian*, 1938, p.12) There was also debate at this time about film stock's viability as a medium for document preservation, but due to the new nature of the medium it was unclear how stable it would be. (Kuhlman, 1935, pp.189-214)

Wartime restrictions impacted the entire industry and were supported by government orders, with film stock being reallocated to major studios, resulting in protests from within the industry. (Nugent; SM14, 1942, p.14, *The New York Times*, 1942c, p.26, *The New York Times*, 1942d, p.26) The impact of restrictions was also felt

in the post-war years, with the British film industry in a dangerous position due to lower market value and higher production taxes (Nettleton, 1947, p.32, Robinson, 1948, p.4, *The New York Times*, 1952, p.31) and cuts to film stock use in Hollywood. (Brady, 1951, p.42) However, despite these industry restrictions, archives such as the BFI saw storage and acquisition growth, and the development of acquisition and cataloguing practice (*The Times*, 1942, p.6, Chibnall, 1955, pp.79-80, Lindgren, 1956, p.4) and preservation plans involving migration of nitrate stock to triacetate stock emerged. (*The New York Times*, 1955, p.19) Film also developed as an advertising and educational medium, resulting in new preservation techniques to avoid damage and lengthen film stock lifespans, (*The New York Times; F6*, 1951, p.6, Mallon, 1947, p.23) and increasing appreciation for film and film preservation efforts, resulting in high-profile donations. (*The New York Times*, 1945, p.23, *The Times*, 1958, p.9) However, while archives were showing an interest in acquiring film for preservation they did not always have the correct storage facilities (Hall, 2013, pp.185-186, Spehr, 2013, p.153) and the awareness of nitrate stock dangers led to a culture of destruction after triacetate copies were made, and the eventual banning of unregulated nitrate stock. (Spehr, 2013, p.154, Habib, 2006, p.120) Medium stability and long-term preservation were also not top priorities for manufacturers or filmmakers, (Heckman, 2015, pp.52-54) which placed more pressure on archives to undertake preservation work. However, there were still developments in archival practice, particularly as it became more appreciated that films were deteriorating due to neglect, lack of storage, disagreements over preservation responsibility, and decentralised preservation efforts. (Nason; X5, 1955, p.5, Nason; X13, 1956, p.13) Film was also understood as an increasingly costly and fragile medium to try and preserve, which was argued as necessitating some form of training for new archivists (Griffith, 1956, pp.4-8, Elton, 1955, pp.208-219, Baumhofer, 1956, p.236) particularly as nitrate was so dangerous and many aspects of preservation such as cataloguing were still unstandardised. (Caswell, 1958, pp.412-413, Grenfell, 1959, pp.81-82)

Across the sixties and early seventies there was an increasing appreciation of film as an area of academic study, and by extension film preservation as an enabler of that study. (Kula, 1962, pp.83-93, Gent, 1970, p.42, *History News*, 1971, p.262, Wagner and Rose, 1974, pp.71-73) During this time, existing archives expanded acquisition

boundaries (Cleveland, 1980, p.44) and new archives were established, (O'Connor, 1965, pp.83-90, Shepard, 1974, p.31) with the new American Film Institute being created to centralise and support preservation efforts of existing archives, and undertake wider scale preservation efforts. (Canby, 1967, p.51, Crowther; D1, 1967, p.1, Shepard, 1971, pp.59-65, Karr, 1977, p.50) There was also a call for archivists to have input into new technology to shape it for archival use, and the emergence and beginning of digital records use within archives. (Smith, 1974, pp.6-7) As the understanding of the scale of film deterioration and preservation risks increased, increasing research was undertaken and preservation practices shifted to restrictive use of unique items. (Decker, 1962, pp.357-359, Noble, 1980, pp.23-28, Calhoun, 1967, pp.517-525, Bowser, 1962, pp.35-36) While archives increased publicity surrounding film preservation with showcase festivals, there was internal debate and pressure surrounding whether nitrate stock was suitable to continue preserving (Deschin; D37, 1969, p.37, Adler; D1, 1969, p.1, Canby, 1977, p.91) as it became recognised that a failure to plan future preservation would result in another great loss. (Wagner, 1969, p.126) By this point in preservation practice it was understood that stability, processing, and storage were key to long-term preservation and as such nitrate stock was unsuitable for records use, with acetate stock also suffering from emerging preservation issues. (Eaton, 1970, pp.85-86, Karr, 1980, p.356)

By the beginning of the eighties there was a better understanding of the broad scale of early film lost, and the factors behind it such as the commercial nature of film causing it to be devalued and neglected, and the high cost of nitrate transfers. (Smith, 1981, pp.423-434, Klawans, 1988, pp.142-143) As a result, there was an archival push to not only source funds for nitrate migration and preserve at risk films, but also to try and preserve emerging formats so that such a loss did not reoccur. (*The New York Times*, 1982, p.18, *MOMA*, 1983, p.3, *Afterimage*, 1999, p.2, Barker, 1982, p.8, Lindsey; C26, 1985, p.26) There was also a shift towards accessibility, as film was growing as an area of academic study and collections were viewed as inaccessible. (Kuyper, 1994, p.102, Abbott et al., 1995, pp.325-335) Alongside recognition that preservation should not be restricted to what was considered classic cinema in order to serve future generations, (*MOMA*, 1988, p.4) archives also developed standards of documenting preservation practices, and began to see the emergence of vinegar syndrome in

acetate stock, creating a new preservation issue (Klawans, 1995, pp.25-26) alongside a shift in public perception of silent era cinema that resulted in films that were commercially valuable becoming niche, restricting interest in their preservation. (Canby; H23, 1984, p.23, Tibbetts, 1997, p.75) While some legislation recognised film preservation, other suggested legislation intended to protect copyright posed a risk to preservation efforts, (*The New York Times; C19*, 1988, p.19, Luce, 1991, pp.73-74) an issue as academia viewed original format films as essential to the field of study, with restoration becoming a focus of academia. (Tibbetts et al., 1995, p.90, Bertellini, 1995, p.277)

It is important to note here that much of the literature from the mid-2000's onwards has been discussed in chapter 2. There was a recognised shift in archival culture and academia towards using digital technology for access and intermediate work despite the high cost of developing digital infrastructure, and limited knowledge of digital technology within the field. (Mashon, 2007, pp.140-141, Den Kamp, 2011, p.133-135, Gracy, 2013b, pp.349-360) While digital was viewed as suitable for access it was an unstable preservation option, but the cost of film distribution drove digital adoption within the industry and resulted in a knowledge gap between the current and next generation of film archivists. (De Lusenet, 2003, pp.113-115, Wright, 2004, pp.71-75, Enticknap, 2004, p.132) As digital did not meet analogue standards, digital intermediate practices were employed but migration to analogue for preservation was still used. (Schnepp, 2005, pp.96-98, Belton, 2008, pp.58-63) While digital technology had fewer technical limits than analogue it also took longer to process and was more costly, restricting the number of restorations an archive could undertake. (Paletz, 2006, pp.14-15, p.19) It was recognised that digital perpetuated a false belief that preservation degradation was solved, and that the terminology used was not yet defined enough to be useful (Cherchi Usai, 2010, pp.252-253) however despite this, digitisation projects began to occur within film archives to identify lost films, improve exposure to a wider audience, and better preserve analogue originals. (Ingravalle, 2015, pp.83-90, Monizza, 2017, pp.129-132, Fletcher and Yumibe, 2013, pp.14-15) However, digital preservation occurred less frequently as it was difficult to find a film lab that could scan to an analogue standard. (Fossati, 2018, pp.281-282) While preservation methods earlier in the decade were entirely analogue and understood in

great detail, archives also had to handle preserving old formats while managing film intake in a variety of new formats (Gracy, 2003, pp.1-41, Aubert, 2003, pp.506-509) and with the digital shift in 2012, businesses offering film stock production and processing began to close or shift to digital technology, resulting in a higher cost to create new film prints and a dilemma for archives due to the instability of digital as a preservation medium which resulted in restrictions on print loans. (Eagan, 2012) However, in recent years an argument has emerged that a dichotomy between analogue and digital is not possible anymore, as digital technology has developed to a point where it can replicate analogue aesthetics, (Fossati, 2018, p.69) rendering film stock commercially unviable for the industry and leaving archives as one of the few sectors which still has a demand due to the maintenance of analogue collections and preservation practices.

4.3 Literature Review

The decrease in contemporary film stock production has already been explored, and while producers of film stock still exist, there are now very few of them, as can be seen in appendix 8.8. However, of those that do exist, some produce film stocks suitable for archival use, although only eight film stocks of this type are sold between the four companies. (Appendix 8.8) Although there are film stocks available that are compatible with digital processes (ORWO UK 2020c; Eastman Kodak, 2021g) several of the largest producers have seen a decline in film stock production and associated services, and a rise in digital technology in the last two decades. (Appendix 8.8) This decline has resulted in higher costs for all available film stocks, (ORWO UK, 2020d; 2020e; 2020f; Eastman Kodak, 2021i, pp.15-27) which would restrict the ability of archives to undertake analogue preservation, in turn limiting the commercial viability of selling film stock, particularly when the commercial sector of the industry has transitioned to digital. Both Eastman Kodak and Spectra Film & Video offer materials, cameras, and processing services for analogue stock, but these services can again have a higher price range depending upon requirements (Eastman Kodak, 2021j; 2021k; 2021l; Spectra Film & Video, no date b; no date c; no date d) which would limit archives with smaller budgets to fewer purchases. This makes film stock and its associated services a niche

product, of increasingly limited commercial viability as the digital rollout continues to develop across the film industry.

There are some common trends across film archives, regardless of collection size, including the use of LTO tapes for digital preservation storage, and the mandatory deposit requirement, noted in the table and references of appendices 8.9 and 8.10. However, as preservation practices vary by collection scale, the findings have been divided into collection size brackets of 100k+, 75k+, 50k+, and 25k+, as can be seen in appendix 8.9.

100k+

Archives will commonly employ both digital and analogue preservation practices for their collections, (appendix 8.9) with both preservation methods being recognised as costly and time consuming to undertake but arguably necessary, due to the scale of the collections and the fact that, alongside large analogue collections, these archives also have the storage capability to hold nitrate stock (appendix 8.10) which has been viewed historically as requiring migration due to risk factors. There is a drive to digitise, either for accessibility purposes, or for more long-term digital preservation (appendix 8.10) which can be seen as more achievable for archives of this scale, as there are large-scale digitisation projects or programmes at the BFI, (2017, p.28; p.30) Gosfilmofond and Arhiva Nationala de Filme and research into digital preservation frameworks to create preservation standards and infrastructure. (appendices 8.9 and 8.10) However, while archival policies recognise digital preservation as an important element of practice (appendix 8.10) analogue preservation practices still occur at several archives alongside digital preservation (appendices 8.9 and 8.10) which could indicate that film stock is still a viable medium for archives of this size.

75k+

While these archives hold slightly smaller collections many aspects are similar to the 100k+ archives, however some have more reliance on external preservation and digitisation services. (appendix 8.10) Films are more likely to be digitised for online access rather than preservation (appendix 8.9) as film stock is still viewed as a more reliable long-term preservation format. (appendix 8.10)

50k+

Many archives of this size hold largely analogue collections and engage in passive analogue preservation for long-term preservation, employing digital technology for restoration or access to collections. (appendices 8.9 and 8.10) However, some archives of this size are able to take a more active approach to digital preservation, such as the recent digital preservation policies and exclusively digital mandatory deposit of the Swedish Film Institute, the large-scale digitisation projects and policy and infrastructure development at the EYE Filmmuseum, and the large-scale digitisation and digital preservation of film collections at Indiana University Libraries Moving Image Archive. (appendices 8.9 and 8.10) Acquisition of large collections or nitrate is often not possible due to a lack of correct storage facilities and where held is often prioritised for digitisation or transfer (appendix 8.10) due to its volatility, which depending on the pathway taken would require film stock to undertake. Another element to consider is the makeup of the collections themselves, as more archives hold large educational, amateur, experimental, or industrial collections (appendix 8.10) which could be viewed as less commercially valuable than preserving “classic” films, due to their more niche audiences.

25k+

Archives of this scale have a greater reliance on outside funding via grants or partnerships in order to undertake preservation projects (appendix 8.10) and some offer film-related services (Chicago Film Archives, no date c; Lichtspiel Cinematheque, no date b; Det Danske Filminstitut, no date b) which is also an aspect of some larger archives. There appears to be a lower level of digitisation than in some larger archives (appendix 8.10) which could be due to a number of factors, including a decrease in funding which inhibits preservation efforts and the high cost and instability of digital media although again, this does not apply to all cases. (appendices 8.9 and 8.10) Digital preservation priority is given to high-risk analogue items with a majority of the collection being passively stored for preservation and undergoing analogue practice. (appendices 8.9 and 8.10) However, there is still a drive towards developing digital preservation and digitisation standards and policies within these archives (appendix

8.10) which could suggest that while films stock may be viable to some extent at present, it may no longer be necessary in the future.

4.4 Interviews

As stated in section 3.2.5, although there was only one participant in the interviews, the data was included to support the literature review. All documents associated with the interview can be found in appendices 8.3 through 8.7. As questions 1 and 2 of the interview are concerned with establishing basic information and do not connect to any of the objectives thematically, they will not be explored here, but can be seen in the appendices. Question 11 provided an option to give additional thoughts about the interview topics, but as it was not answered and is not specifically connected to any of the objectives, it has not been included here but can be seen in the appendices.

Questions 3 and 4 were intended to establish the current state of preservation practices within the archive, supporting objective 1, to identify how the lessening of analogue film stock production due to industry digitisation has impacted analogue film preservation practices in film archives.

3. How frequently are analogue preservation practices and digital preservation practices employed for the archive's film stock holdings? Preservation practices in this case refer to the processes involved in maintaining film stock for future access.

Participant A states that for analogue preservation at the archive, 'all film is preserved on site in specialist temperature and humidity controlled vaults' but that 'nitrate is the exception which is held in specialist facilities', (Participant A) establishing that the archive has analogue infrastructure, but not specialised nitrate storage. Most of the response is concerned with digital preservation practices, with several large digitisation projects mentioned, however they state that due to 'the expense of digitization, ours is usually funding through projects and as such, happens with different frequency'. (Participant A) This, alongside the fact that they 'do not yet have a digital preservation infrastructure' (Participant A) at the archive positions digital preservation practices as being less well-established, but still a significant presence.

- 4. Do you have a preference for analogue preservation or digital preservation, and if so, why? Analogue preservation of a document and digital preservation of a document can be defined by whether the end result to be preserved is an analogue or digital document.**

Participant A shows a preference for analogue practice as 'it's far more straightforward and proven to last hundreds of years if stored properly' and recognises that 'there's also potential for information to get lost if it's not included in the digital asset' (Participant A) during digital preservation, which is less of a risk in analogue practice if the original item is being passively preserved.

Questions 5 and 6 were intended to establish the impact of film stock production decreases on preservation practices, further supporting objective 1, and objective 2, to assess analogue film as a medium for preservation in film archives in comparison to current digital preservation practices.

- 5. Has there been any impact upon the archive's preservation practices, knowledge of preservation practices, or upon the archive more generally, because of the digitisation of the film industry? Has there been any impact because of the drop in film stock production?**

Participant A states that archival practices 'have changed drastically over the past 5-10 years' and that 'and staff has had to train and learn about new digital technologies', (Participant A) a timeline and change which aligns with the major digital shift within the industry a decade ago. They also state that there has 'been an impact in the ease with which we can buy conservation materials' (Participant A) for analogue preservation, which aligns with the decrease in materials and services discussed in section 4.3.

- 6. What do you think the future of preservation practices for film stock holdings could be? Are there any notable benefits or risks associated with this?**

Responding to the question of future preservation practice, Participant A was of the opinion that 'basic preservation practice for film – stored in a cool, dry place – will remain the same as it's most effective', (Participant A) positioning analogue preservation practice as currently still viable. When considering more recent formats, Participant A cited format fragility and technological obsolescence as a reason why 'this will be the thing that changes where it may only be preserved in its digital format'

(Participant A), positioning digital preservation as being undertaken to preserve at-risk formats or items.

Questions 7, 8, 9, and 10 were intended to explore the potential impact of an increase in film stock production upon archive preservation practices, supporting objective 3, to evaluate the viability of increasing analogue film production by critically analysing the potential benefits and costs to film archives and analogue film stock producers.

7. Would an increase in film stock production have an impact on the archive's current preservation practices?

Participant A stated that an increase would 'make our conservation / preservation work easier' (Participant A) because analogue preservation materials are increasingly difficult to obtain as stated in their response to question 5, positioning a production increase as beneficial for archival practice.

8. Would an increase in film stock production have an impact on the future of preservation practices?

Although Participant A stated that a production increase would not the future of preservation practice, they did state that a 'further decrease in film stock production would impact our practices, especially getting new prints of nitrate collections' (Participant A) which, when considering the response to question 7, positions a potential production increase as currently beneficial, but with limited future impact, while a continued decrease would be detrimental.

9. How feasible do you think an increase in film stock production could be?

There was no answer given for this question.

10. Is there, or would there be, a need to increase film stock production above current levels in order to support archive preservation practices?

Participant A responded that there is a need for an increase because 'analogue material is still coming into the archive' and a production increase would 'allow further options of printing digital objects back onto film for long term preservation'.

(Participant A) This response positions analogue preservation, and film stock as a preferred long-term preservation option in the archive, and a production increase for film stock as needed by the archive.

5. Analysis

5.1 Introduction

As outlined in section 2.7, to the researcher's knowledge, a broader-scale analysis of archival practice to determine the viability of film stock as a preservation medium has not recently been undertaken. This chapter covers the analysis of the findings laid out in chapter 4, which will be supported in places by relevant literature and reference to the relevant findings.

5.2 Conceptual Analysis

A core issue in film preservation is the debate surrounding originality as outlined by Fossati (2018) and Busche, (2006) which places film in a comparatively unique position; as an inherently reproducible medium, film archivists have influence over which version of a film is considered definitive, meaning they must choose what to preserve, rather than being able to preserve a pre-defined "original". This is made both better and worse by digital's perfect reproducibility, as it solves the issue of information alteration in analogue migration, but abandons the concept of a definitive original item.

This raises the question of what defines preservation in film, given that preservation of an original item is conceptually unclear. Film restoration and associated migration fall under preservation practice according to Fossati (2018), Wallmüller (2007), and Busche (2006) and yet they alter elements of an item, which could be seen as both preserving a film while also not achieving the ideal of "true", unaltering preservation that maintains items in a static form, although it is important to note that this kind of preservation is arguably an ideal as environmental factors will always impact preserved items. Restoration of film could be seen as comparatively unique, given that "original" items are rarely worked on directly (Busche, 2006, p.6) and new items can be composite due to version variation, which as addressed in section 4.1, is at odds with key elements of the ethics that have been borrowed from fine art restoration practice. (p.6) The controversy surrounding digital composite

restoration is addressed by Bonnard (2016) however it could be argued that the disconnect between elements of accepted restoration ethics from another field and the practice of restoration in film are a factor in historical debates surrounding definitions of preservation, which has been exacerbated by digital restoration's abilities.

Although digital reproduction potentially solves the issue of information alteration during migration, definitions in the digital sphere also suffer from a lack of conceptual clarity (Crofts, 2008, pp.22-23, Cherchi Usai, 2009, pp.10-11) which could be due to the transitory position of the field as addressed by Fossati (2018) but may well cause issues with terminology in the future. This is because at present, there is a recognised lack of clarity surrounding definitions of preservation, digital preservation, and other associated terms. However, the standards for digital preservation are set by the standards for analogue preservation, and based on analogue knowledge, which as addressed in section 2.3 by Crofts (2008), Fossati (2018) and Bonatti and Legelius (2019) is disappearing in the next generation of archivists due to the speed of the digital shift. The risk could be in a situation where the next generation of archivists do not have the knowledge of analogue standards and concepts that definitions of digital practice are built upon, further confusing what is already not well-defined and resulting in misunderstanding of, or variation in, what should be a standard, well-defined practice. Confusion surrounding conceptual definitions of terminology for digital also impacts external differentiation between preservation and access (Cherchi Usai, 2009, pp.10-11) particularly as digital preservation, currently defined by analogue standards, does not technically exist yet, because there is no long-term passive preservation option that meets the standards or timeframe of analogue preservation. Therefore, this definition of digital preservation cannot be fully achieved and must instead be adapted to suit the best form of digital storage available currently.

Access may not be as conceptually debated as preservation, however, its position in relation to preservation of material objects can be seen as contradictory. As addressed in section 2.3, maintaining access is a key element of preservation that some archives feel they must now take on, but as with any material item, access and use will ultimately lead to degradation, counteracting preservation efforts. This dichotomy is arguably less of an issue in film archiving due to the use of copies, and

now the emergence of digitisation and digital copies that do away with material carriers entirely. However, while access copies provide a solution for analogue preservation and access issues, the future of digital preservation and access could still be seen as being unclear conceptually, because digital preservation technology has yet to fully emerge, leaving access and preservation in a practical and conceptual transition.

While debates concerning preservation definitions such as carrier/content and preservation/access did encourage the development of different definitions of preservation within the field, it is important to note that for most of film history the formats being debated were part of a group; the chemical makeup may have differed, but many of the basic elements of film stock were recognisable across its history. This restricted the conceptual debate to being in relation to that basic format, with either prioritisation of the carrier, or the content. (Fossati, 2018, p.325) However, it has been recognised that digital technology alters this debate, not only due to the identical reproducibility factor, but because the definition of preservation that values content does not recognise a difference between analogue and digital preservation, while the definition valuing the carrier does, (Fossati, 2018, p.325) potentially deepening the division within this conceptual debate. While a solution to carrier/content could be seen in the development of passive cold storage, preserving both, this solution reduces access and is therefore not ideal. It could in fact be argued that because of the lack of an ideal solution there can be no set conceptual definitions in the field for preservation, digital preservation, or access, beyond those that are generically applicable to most fields. Both digital and analogue preservation have issues, in practice and conceptually. As addressed in section 2.3, both have obsolescence problems, and as addressed previously in this section, digital has the advantage of comparatively unchanging reproducibility, but no long-term preservation option, while film stock has the advantage of long-term preservation, but imperfect reproducibility. In this way, they could be seen as differently viable preservation methods, which could account for the conceptual uncertainty and debate within the field recently as both practices are undertaken within archives.

5.3 Historical Analysis

Film preservation has by this point had just over a century of development, and while analogue practice has had time to develop and become viable, parallels could be drawn between the earlier stages of film preservation practice, and the current position of digital preservation practice within archives, potentially serving as a timeline for the development of digital practice, although this is not guaranteed. Both nitrate stocks and digital media are unstable, but as discussed in sections 2.5 and 4.2, the impact of this instability upon archival practice was only recognised after their use had been cemented, and continued to be a preservation issue even as practices evolved. However, this is only analogous, as digital media and nitrate stocks were unstable for different reasons; for digital media, the issue is rapid obsolescence, which while unsustainably costly and an information risk, is not harmful, where for nitrate the issue is extreme combustibility and its by-products, which is actively dangerous. Because of this active danger, standards for nitrate storage and preservation were developed far faster, and with more specificity, than the digital storage and preservation, as discussed in section 2.5, however this comparison between the two can still be useful for determining viability.

Early film archives and preservation standards were established in response to neglect, however despite archives emerging during this time, several factors contributed to what would later be recognised as a large-scale loss of information. One of the significant factors was the view of film as a commercial medium, which had, according to Grimm (2001) resulted in the common commercial practice of running films for a short period, before scrapping them for silver value, (p.22) a practice which undoubtedly led to the loss of many early films. Although practices and standards evolved as archives became more established, the dissonance between archival practice and industry requirements for film continued to clash, as long-term preservation was not prioritised in film stock production. (Gracy, 2013a, p.370) This is arguably reflective of early and contemporary digital technology's commercial position and rapid obsolescence, with a lack of standardisation due to early medium experimentation (Heckman, 2010, p.487) also reflected in the development of digital technology. It could potentially be argued that current digital technology is only now entering the phase where standards begin to develop, just as with film stock in the

1920's, placing it in a precarious but developing situation if its path towards preservation continues to reflect early analogue practices.

While war restrictions may have had an impact upon the preservation of film due to film stock availability and changes to film production, developments appear to have occurred when film became viable as an educational and advertisement medium, resulting in longer lifespans to make these films commercially viable. Acetate film stock was also developed as an alternative preservation format, however this notably led to the destruction of nitrate prints on a wide scale after safety copies were made, as documented by Spehr, (2013, p.153) an aspect of analogue practice that has not yet come to pass in digital preservation, perhaps because of the later cultural shift in film archives towards keeping nitrate (Lameris, 2017, pp.85-86) which may have informed against the widespread destruction of one format upon migration to another. The development of a more stable preservation medium, alongside the now-established archival infrastructure positioned film stock as a viable preservation medium, which was aided by emerging recognition of film and film preservation in academia during the 1960's. This shift in academia is arguably reflective of the knowledge shift in academia currently from analogue to digital practice, as addressed in section 2.2, with digital technology and practice now emerging as the new preservation format to be discussed. There is also, notably, the emergence of the argument that film archivists should attempt to become involved in shaping technology to suit archival needs, (Smith, 1974, pp.6-7) an argument mirrored in digital preservation development by Antoniazzi, (2020, pp.1668-1669) further suggesting that the development of these practices are analogous in some form.

The developing understanding of the scale of early information loss was also developing during this period, and would continue to develop across the next few decades, resulting in a push to plan for future preservation, to avoid such a failure again, (Wagner, 1969, p.126) which may be a reason why, as of yet, there has been no large-scale information loss, even if the risk is still very present. The recognition that film is only viable as a preservation medium if it is preserved is applicable to many, if not all formats and practices, but holds more urgency with unstable or short-lived mediums such as those present in digital due to the associated potential for rapid information loss.

With the beginning of digital practice emerging in archives from the early 2000's, the dichotomy between the two, causes a comparison of practice to become far easier. As previously discussed by De Lusenet (2003) digital technology was viewed as an access method, unsuitable for preservation (pp.113-115) perhaps in part because film stock was still viable as a preservation method, being produced, and having the infrastructure of archives and decades of practice development to draw upon. The preference for analogue over digital practice may well have been informed by this, and the fact that the ability of digital to emulate analogue aesthetics (Brown, 2013, pp.212-213, Loertscher et al., 2016, p.459) only occurred comparatively recently. This perspective of digital as the "lesser" preservation option could arguably be reflective of the early perspective of film as simply a commercial medium for entertainment, not worth preserving. The current position of practice in archives is transitional as addressed by Fossati (2018), with analogue practice still being employed for long-term preservation, while digital technology is employed for an increasing number of functions. Given the gradual overtaking of digital practice within archives, it could be fair to argue that analogue practice may not be viable as a preservation method if this pattern continues, and is arguably not a viable primary preservation method, as much of the commercial industry has now digitised. With the parallels that can be drawn between current digital preservation and early analogue preservation, it would appear that the risk of information loss is relatively high, particularly if time is not given to establish infrastructure to support digital preservation. This is an area where film stock is perhaps more viable currently than digital media, as the infrastructure and research supporting preservation already exists and is well established. Archives are now at a position of having digital practice and digital intake without established infrastructure, or long-term preservation comparable to that of film stock, which is an unstable, and uncertain place to be for the sector, posing a potential future information risk.

5.4 Literature Review

As addressed in section 4.3, film stock production has decreased, with higher prices for goods and services, which may be to ensure that it remains profitable, as a product servicing an increasingly niche market. Due to these costs, and the restricted number of film stocks specifically suited for archival use and preservation, analogue

preservation and restoration beyond passive cold storage appears increasingly unviable, particularly in the case of large-scale preservation or restoration projects. This, in turn, positions film stock as an increasingly unviable preservation method beyond individual item restoration or preservation work. With the closing down of Fujifilm's film stock production occurring as recently as 2013 (appendix 8.8) it can be fairly safe to argue that the decline of production will continue, although a decline in services associated with analogue preservation may not occur, or may occur in limited areas; the wide scale closure of analogue processing services mentioned by Elwes (2013, p.59) at the time of the digital shift would suggest a decline, however the need of archives to continue preservation of analogue collections could be enough incentive to maintain these services. Service provision is important to consider here, as for analogue preservation to be possible, services and film stock must be available for use. (Brand, 2012, p.93) A decline in processing services could be equally as damaging to film stock's viability as the decrease in production itself, as it would make it increasingly difficult for archives to preserve their existing analogue collections; this may be a motivator behind some archives expanding or establishing internal processing services. Given the above factors, particularly the restrictive cost of film stock and niche market, film stock as a product is growing increasingly unviable commercially as the digital shift continues. This in turn impacts its viability as an archival preservation method and given that it appears to be less commercially viable, it can be argued that an increase in production would be unlikely by this point.

Archives with some of the largest collections are arguably in a position where film stock is still viable as a preservation method, as they are more likely to have the funds or the infrastructure to store unstable analogue formats such as nitrate. Because of this infrastructure, the size of the collections, and the fact that many archives have more experience and knowledge with handling and storing film stock (Fossati, 2018, p.86) it could be argued that film stock must remain a viable preservation option for these archives, because of the scale of their analogue holdings and prior investment in infrastructure. However, these archives are also more likely to invest in large scale digital preservation or digitisation projects and attempt to standardise digital preservation and digitisation through policy, as addressed in section 4.3 and appendices 8.9 and 8.10, or via the use of comparatively stable digital storage carriers

such as LTO tapes. (Fossati, 2018, pp.95-96) These attempts to standardise and employ digital preservation suggest, if not acceptance of digital replacing analogue collections, at least an acceptance of the growing place of digital within archives, and the replacement of analogue film stock within the industry decreasing analogue intake. While these larger archives can be seen as influencing smaller archives through their support for digital preservation and digitisation via partnerships or programmes, it is still important to recall that they are more likely to employ analogue practice and preservation, because they are able to afford the cost. However, this may not be sustainable, due to the very aspect that requires film stock to still be a viable preservation option, the collection size. At 100k+ items, the likelihood of any of these archives being able to maintain the cost of purchasing film stock for analogue preservation of the entire, or even a significant portion of the collection is unlikely, which may well be a driving factor behind the digitisation and digital preservation programmes they run. In these cases, film stock is arguably a viable preservation method, but only on a smaller project scale, as it is neither a scalable, or long-term option, given that prices will likely increase, as production decreases due to a lack of commercial product viability.

As addressed in section 4.3, archives with 75k+ items are similar to those with 100k+ items; however, due to their reliance on outside services, (appendix 8.10) they may be a reason for such services, both analogue and digital, to continue operating. Because of the comparative cost of digital preservation (Fossati, 2018, p.300) and the increasing cost of film stock, these archives hold more reliance on analogue cold storage than large-scale projects, with digitisation occurring for access purposes, creating a blended practice in which film stock may be less immediately required. (appendix 8.9) However, despite smaller collections potentially making wider-scale active analogue preservation practice more feasible, due to the closure of analogue services post-digital shift, active analogue preservation may be less employed than more available digital preservation services. This could result in a gradual shift towards digital preservation within these archives which could eventually render film stock unviable due to a lack of service and goods availability.

50k+ archives appear to show more variation in balance of practice than larger or smaller archives. Some have digital preservation infrastructure, large-scale digital

preservation, and active digital policies like the Swedish Film Institute, EYE Filmmuseum, and Indiana University Libraries Moving Image Archive. (appendices 8.9 and 8.10) Others appear to engage with digital and analogue preservation practice in a similar way to the 75k+ archives, employing digital practice and digitisation for access and long-term cold storage for preservation. (appendix 8.9) Within the archives with digital preservation infrastructure and policies, analogue preservation still occurs, however it can be argued that film stock is not a viable preservation method in this case because digital infrastructure exists and has proven possible to maintain, sometimes on a collection-wide scale, leaving analogue collections as backups in passive cold storage, not requiring active preservation unless dire circumstances emerge. This choice to shift towards digital preservation may also be because the earlier practice of rescanning digital media to film stock has proven untenable with the cost increase, lowered production, and doubled storage requirements that result. (Fossati, 2018, p.95) Being smaller collections these archives must be more concerned with storage capabilities, as both physical and digital storage hold associated costs, and as previously addressed nitrate poses a particular storage issue (appendix 8.10) which may well have driven aspects of digitisation or digital preservation within these archives, migrating nitrate stock to safely maintain a complete collection in a single location. On the other hand, archives of this size more reliant on passive analogue preservation may do so because digital technology has proven to be too costly, complex, and unstable to establish in the past (Cave, 2008, p.6) which poses the risk of inaccessibility if analogue playback equipment and knowledge are not maintained, as discussed in section 2.3. Collection makeup being less commercial may also be an influencing factor in digitisation and digital preservation, as not only do they have more niche appeal, but they may also be shorter than commercial films, allowing for the digitisation and digital preservation of a higher percentage of certain collection elements. Due to the variation of practice within archives of this size it is more difficult to judge film stock's viability as a preservation method; however, given again the cost and decreased production, alongside the digital preservation rates amongst some of these archives and the tendency towards passive preservation in others, it could be said that film stock is useful, but perhaps no longer viable.

25k+ collections appear to have a greater reliance on outside grants and partnerships in order to achieve digitisation, which could be a factor in the lower levels of digitisation seen amongst some of these archives. (appendix 8.10) Although the scale of these archives means that the collections could theoretically be digitised in a way not possible for larger archives, the cost of doing so was prohibitive (Conrad, 2012, p.35) and arguably continues to be, due to the requirement for frequent migration addressed in section 2.5. In this way, digital preservation could be viewed as similarly unviable as film stock, with both being prohibitively expensive for these smaller archives. While passive preservation in cold storage is maintained, this still takes money from the budget, which forces a reduction in restoration work to maintain passive preservation, (Fossati, 2018, p.211) arguably making any form of active preservation compete with the broader passive preservation being undertaken. It has also been noted by Heckman (2010) that nitrate stock is more difficult to handle for smaller archives, due to various requirements and costs (p.485) that would be more easily absorbed in larger archives due to higher budgets and existing infrastructure. This difficulty could be a driving factor behind the prioritisation of high-risk items for digitisation or digital preservation (appendix 8.10) but could also potentially serve as a reason for the viability of film stock in these archives, as the infrastructure is established to handle passive analogue preservation, while digital infrastructure is still more reliant on external aid. The offering of analogue services, funding preservation efforts, could reflect the established analogue infrastructure and practice being employed as a result of the cost of digital preservation, but could also reflect the budgetary requirements of active preservation outstripping the existing budgets of these archives. However, the offering of these services could be seen as filling the gap left by commercial service closure post-digital shift, perhaps suggesting that even if film stock is costly, archives are attempting to maintain its viability for as long as possible. Film stock for these archives may well be a preservation ideal, and perhaps the only option without reliance on external aid; however, once again due to budgetary restrictions, cost increases, and production decreases, film stock is not a viable or affordable preservation method. Digital preservation in this case is also in a similarly unviable position for these archives without external aid, leaving them in a position where neither preservation option is truly, self-sustainably viable.

5.5 Interviews

The state of practice presented by Participant A's responses in section 4.4 is transferable to the situation in many archives explored in sections 4.3 and 5.4, with Participant A specifically citing 'the expense of digitization' as a barrier, relying on 'funding through projects' (Participant A) in order to undertake digitisation, which is arguably a barrier to archives of all sizes, as larger collections become increasingly unfeasible to digitise or digitally preserve entirely. Notably, Participant A states that they 'do not yet have a digital preservation infrastructure', but that "“preservation” of those digital assets involves storage on LTO 6 tapes'. (Participant A) LTO tapes are, based on the literature review findings and academic literature, a common digital storage option for film archives, but as addressed in section 2.5 this kind of digital storage still requires regular migration, and is as a result, costly. (Antoniazzi, 2020, p.1664-1665) The use of LTO tapes within an archive does not guarantee an associated digital preservation infrastructure, as there are few archives in the literature review that have an internal digital preservation infrastructure established. In line with a majority, if not all archives in the literature review, Participant A states that 'all film is preserved on site in specialist temperature and humidity controlled vaults' (Participant A) which is to be expected given the span of practice addressed in the historical review that would allow for analogue infrastructure to become well-established, and arguably necessary for a film archive to operate at all. The statement that they 'prefer analogue preservation as it's far more straightforward' and recognise the 'potential for information to get lost if it's not included in the digital asset' (Participant A) arguably reflects this long-established practice and the complex nature of digital media evolution and aligns with the perspectives of archivists as addressed in sections 2.2 and 2.3. The lowering of film stock production addressed throughout this project could be seen as influencing the adoption of digital preservation before infrastructure is established, as is the case as stated by Participant A, arguably supports Cave's (2008) argument that analogue is being forced into obsolescence before digital can take its place, (p.3) an argument that is supported by many archive's continued reliance on analogue passive preservation practices, as addressed in the literature review.

The fact that ‘preservation practices and digital strategy have changed drastically over the past 5-10 years, and staff has had to train and learn about new digital technologies’ (Participant A) is reflective of the knowledge gap discussed in sections 2.3 and 2.5 and could be seen as evidence of maintaining and developing practice knowledge. However, it also supports the across-the-board shift seen from the literature review, with archives interacting with digitisation or digital preservation, requiring some form of practice and policy change to adjust. The drastic change referenced by Participant A could also reflect the rapid development and obsolescence of digital technology, and the digital shift within the industry. The ‘impact in the ease with which we can buy conservation materials’ (Participant A) for analogue practice supports the archival impact of the decline of film stock and associated services addressed in the analysis of film stock production companies in section 5.4. However, Participant A predicts that for future practice ‘basic preservation practice for film – stored in a cool, dry place – will remain the same as it’s most effective’, (Participant A) which while at odds with the decline in film stock and associated services, does support the established analogue infrastructure of most archives in the literature review. The fact that film stock and analogue practice are established, and reliable enough to be predicted to last arguably positions film stock as viable, if not practical in the current production climate, due to the decrease in production. While film stock is predicted to remain relatively unchanged, Participant A is of the opinion that more recent, fragile or obsolescence-prone formats ‘will be the thing that changes where it may only be preserved in its digital format’. (Participant A) This information risk for more recent formats was predicted by archives, and arguments were made to deal with this risk, as addressed in sections 4.2 and 5.3, and digital preservation of these formats currently could either be interpreted as the solution having finally been developed, or the preservation plans for these formats being under-prioritised until this point. However, this does not change the fact addressed in section 2.5 that digital preservation to analogue standards does not exist in a viable, wide-scale form for archives.

The response that an increase in film stock production ‘would make our conservation / preservation work easier’ (Participant A) is again supportive of the findings from the literature review that film archives still hold large analogue

collections relative to their digital ones, with a few notable exceptions as addressed in section 5.4. The statement that ‘a further decrease in film stock production would impact our practices’ (Participant A) is supportive of the prior impact of industry digitisation upon archival practice, as addressed in section 2.2 and explored in section 5.4. That a current production increase would be beneficial, and a future decrease impactful, could support that, given the existing analogue infrastructure, an ideal path would be to increase film stock production to allow for a longer transition period, allowing digital media to stabilise and become suitable for long-term preservation, at which point an analogue decrease could potentially be less impactful. However, the limited impact of a future increase in production predicted by Participant A supports the fact that digital preservation and digitisation have become widely used in film archives as seen in sections 4.3 and 5.4, and appear to have been adopted as the next phase of archival practice. While Participant A did not respond to the question concerning the feasibility of a production increase, this has been addressed in section 5.4, with an increase in production being deemed unlikely due to a lack of commercial viability and niche market, consequently making film stock increasingly unviable. However, Participant A does state that an increase in production is needed, as ‘analogue material is still coming into the archive’, and an increase would ‘allow further options of printing digital objects back onto film for long term preservation’ (Participant A) which supports the findings of the literature review that many archives still rely on analogue practice and film stock for long-term preservation of their collections. An increase in production would also potentially make analogue goods and services more affordable to archives, as scarcity and a need for profitability is a driving factor behind the cost increase by producers as addressed in section 5.4. However, a decrease in production is far more likely than an increase, particularly as digital adoption continues to progress within archives.

6. Conclusion

6.1 Key Findings

While it has been addressed across this project that film stock is a viable preservation method in isolation, it cannot be ignored that the digital shift within the industry has caused film stock use and production to become unsustainable (Ingravalle, 2019, p.372) resulting in it no longer being viable as a primary preservation method. While passive cold storage preservation is still widely used amongst archives and is viewed as reliable, this method of preservation runs the risk of information becoming inaccessible or lost if no affordable migration option emerges. The reliance on passive storage is arguably due to the necessity of frequent migration in digital formats, which grows more costly the more items are held on digital formats, as all would need to be migrated to avoid obsolescence and associated information loss. A result of this dichotomy is the middle ground developed within many archives, where digitisation occurs for access and passive analogue practice for long-term preservation. While this may be a viable solution now, there will be a point where analogue material requires migration, and the decline in film stock production will mean there is little or no analogue option, so migration to a digital medium will have to occur, regardless of if it is suited to long-term preservation. Based on the findings of the historical review, this could pose a risk of large-scale information loss if digital preservation practice follows a similar development path to analogue preservation practice, and it would perhaps be more ideal for digital preservation practice, standards, and technology to be developed before the complete obsolescence of film stock.

Fossati (2018) argues that the fate of film stock is less important than the impact of the digital shift upon archival practice. (p.25) Given the industry digitisation, the push to develop digital practice and infrastructure in archives can now be seen as standard, as much of their intake would likely be digital media. This drive, combined with the production decrease, will eventually result in film stock becoming an unviable preservation option at intake, and less viable for existing analogue collection items as the percentage of digital items held increases. At present, archives are required to

manage the workload of both digital and analogue preservation, and will be required to continue managing it, (Carroll, 2005, p.22) however preservation practice has reached a kind of stalemate; smaller archives cannot independently afford digital or analogue preservation at a mass scale, and larger archives can afford to undertake both, but cannot scale up these efforts due to collection size, hence the reliance on passive preservation. Neither digital nor analogue preservation is wholly viable as each has its own flaws, but the transition is continuing regardless. As Ingravalle (2019) argues, the establishment of film archives began the museumification of film stock as a medium, (p.374) but the decreasing production pushed it further, (p.386) driving film stock into obsolescence.

An ideal solution to this issue would be to increase film stock production to serve archives, allowing for a longer period of transition so that digital mediums and formats can stabilise, and standards and practices for long-term preservation can be properly developed and planned for. However, given that producers have no clear incentive to increase production for a niche market and arguably even less incentive to lower costs to make analogue preservation affordable, the position of film stock as increasingly unviable is unquestionable, even if it is preferred within the community.

6.2 Future Research Potential

The future use of film stock as a preservation method outside the film sector is limited, due to the discussed decrease in production. However, there was early interest in employing film stock for document preservation (Kuhlman, 1935, pp.189-214) which, with current developed practice, could be viable for passive, long-term preservation of images of documents as backups for both the originals and in particular any digital versions, or born-digital items. Film stock's lifespan may not be as long as some other mediums, but it is currently longer than digital media lifespans, and has the infrastructure to support passive preservation, where digital preservation is still being actively developed (Keller et al., 2019) and requires more investment as an active form of preservation. As addressed previously, the main barriers to this are cost and limited

supply, so such use could not be widespread, but could potentially be useful in at-risk cases.

This research contributes to the academic debate and discussion surrounding film stock as a preservation method by examining reported archival practice of film archives in America and Europe. This debate is wide-ranging and well-established, and while authors such as Fossati (2018) have contributed more to this debate than this research possibly can, this research provides an overview of contemporary film stock production and practice positions at this point in film archiving, which could be useful for future research or historical understanding concerning this topic. It also examines film stock's current viability as a preservation method at a point where much contemporary research in this area has greater focus on digital preservation practice, potentially serving as an alternative research perspective. However, it is important to note that as a dissertation, the realistic impact of this research may be limited as addressed in section 1.5. Despite this fact, this research could still be useful as to the researcher's knowledge, a broader scale overview and examination of archival practice, particularly to determine film stock's preservation viability, has not recently occurred and examinations of research practice that have been discovered were restricted to select archives. While this research may not be useful in a practical sense, it could be seen as contributing to the filling of a research gap, and potentially be employed to support further research and debate. The dichotomy of film stock and digital media may now have shifted in the favour of digital, however, that does not mean that film stock should not still be examined, evaluated, and appreciated as a preservation method.

7. References

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8. Appendices

8.1 Dissertation Reflection

Reflection

I initially chose to research film stock's viability as a preservation method for film archives because of a love for film and an interest in combining it with the information gained across my time studying Library Science at City. I was already aware of the obsolescence of film stock, but had no real in-depth knowledge, so I knew that I would have to become familiar with a lot of concepts and literature very quickly. With this, and the dissertation process as a whole being restricted by COVID-19, most of the time spent on the project was online, at my desk at home. Even with these restrictions I quickly came to realise that the span of literature within the research area was broad, and in some cases very specific. As a result I initially struggled to find focus, particularly as this was a new research area to me.

The process of developing and undertaking interviews was also new and although upon reflection it may well have been better to conduct them in-person, this was not possible due to the pandemic, and because of this factor I accepted from the research proposal onwards that they may not return any responses. Being new to the process of developing and undertaking interviews, I was also unsure whether I would be able to create one that would provide relevant data for the project, resulting in even more reading of literature before beginning to draft the interview. After further research following the research proposal, I also became concerned that my initial parameters for archives to include in the selective critical literature review were too limiting to produce useful data. Initially I planned to only include European and American film archives with majority film stock holdings, however most film archives also held other collections that outnumbered their film stock holdings and so I decided that the parameters had to change. While my literature research was narrowing down, my parameters for archives were expanding, resulting in a broader analysis than I had envisioned when writing the research proposal.

The conclusion that film stock was not truly viable as a preservation method was not surprising, as I was already familiar with the production decline from literature research by the time of writing the research proposal. What came as more of a surprise was the transitional state of practice found in archives, and the fact that, according to the standards of the field, digital preservation practice was also not technically viable but the transition was still occurring, without any clear long-term digital preservation method to move forward to. I also expected, despite being aware of the production decline, that there would be greater use for film stock as a preservation method outside the field. However, upon organising my conclusions it became clear that if the production decrease and its associated issues were great enough to make film stock unviable for film archives, they would also limit film stock's practical use in other fields as well.

While this project was not an easy undertaking, it was a worthwhile one, as through it I learned more about my own capabilities, including that I am able to take on, and maintain work ethic and interest in, extended projects. I have learned more, both on a broad scale and in a level of depth, about film archive practice, history, and theory, obsolescence, and digital cinema than I ever would have without undertaking this project and have gained a deeper appreciation for film archives and the work they do as a result.

8.2 Research Proposal

Research Proposal

Working Title

Examining Analogue Film's Viability as a Preservation Method for Film Archives

Introduction

Film stock as a medium has existed for a century as a way to capture life in motion. Although it has developed since its inception, it has remained recognisable from one iteration to the next and the preservation methods surrounding the film industry reflect this with a developing understanding of how to care for film stock. However, unlike older standardised formats such as books the digital revolution of the film industry has led to digital technology replacing analogue film stock for shooting

purposes, a move 'not so much about aesthetics as economics, driven largely by market forces and the interests of global manufacturing corporations, not necessarily by the needs of the industry itself'. (Crofts, 2008, p. 8) This declining use has resulted in a decline in film stock production, which could have consequences for film archives.

In light of this, this research project will examine the viability of analogue film stock as a preservation method for film archives. It will explore the impact of lowered film stock production on film archives, film as a medium and the history of its preservation, digital preservation practices, and analyse the potential viability of increasing analogue film stock production. This will be achieved through a variety of desk research methods, in combination with several email interviews with film archive curators.

Aims and Objectives

The overall aim of this research project is to determine the viability of analogue film stock as a preservation method for film archives, particularly in comparison to current digital preservation practices.

The objectives of this research are:

- To identify how the lessening of analogue film stock production due to industry digitisation has impacted analogue film preservation practices in film archives.
- To assess analogue film as a medium for preservation in film archives in comparison to current digital preservation practices.
- To evaluate the viability of increasing analogue film production by critically analysing the potential benefits and costs to film archives and analogue film stock producers.
- To propose potential uses for analogue film as a preservation medium outside the film sector.

Scope and Definition

The research will be restricted to large-scale film archives in Europe and America, active at the time of research, that are considered significant in the field due to age, preservation efforts, or collection size, i.e. the BFI National Archive, AMPAS Film Archive, Cinematheque Francaise, etc. Research will also be restricted to archives within this criteria that hold large amounts of film stock of various ages, in order to examine the range of issues posed by the practices of preserving different common film stocks. However, due to the theoretical nature of the project, any findings could potentially be applied to archives of any size holding film stock.

For the purpose of this research, film archives are defined as large-scale archives that hold majority film stock in their collections. While this may be accompanied by ancillary film materials, television, or photographic material, these elements must be in the minority. This definition does not include archives where film stock is the minority element of the collection, and does not include archives dealing exclusively with television, photographic, or ancillary film materials. However, as some preservation elements from television and photography also apply to film stock preservation, examples from these fields may be employed illustratively in the project where appropriate.

For the purpose of this research, preservation is defined as the processes involved in maintaining a document for future access, including acquisition, processing, treatment, and storage. Access, while a key aspect of preservation, will be considered separately for the purpose of this research in the context of the technology required to access film stock, and its preservation. Access via digital means will also be considered separately from preservation, due to archive-associated services offering digital access to archive content, while preservation occurs on analogue film stock holdings.

For the purpose of this research, analogue film stock is defined as widely used, industrially produced film stock across the history of film, including cellulose nitrate, cellulose acetate, and polyester safety stock. This definition does not include film stock created using homemade or custom chemical mixes, or any analogue mediums associated with film such as magnetic tape.

Research Context

This research is being undertaken because film stock functioned as a major preservation method for film archives with film stock holdings, and the drop in analogue film stock production due to industry digitisation could potentially result in large amounts of information loss.

Possible factors in this potential information loss include a loss of knowledge concerning the processing, treatment, and application of film stock due to lack of exposure, which could result in a loss of access to archival film stock holdings and the information they contain. The drop in analogue film stock production could also result in information loss at the point of acquisition and processing due to potential lack of conformity in the chemical makeup of film stock as access to standardised stock decreases, causing preservation issues related to correct treatment and storage. The position of digital preservation having 'crucial issues in terms of format standardization, longevity, and back compatibility' (Crofts, 2008, p. 10) also has the potential to result in information loss due to its more active preservation requirements in comparison to passive analogue film stock preservation.

The benefits of this research are that it provides an evaluation of the viability of analogue film stock as a medium, and of the potential viability of increasing film stock production for the purposes of archival preservation, developing the discussion around film preservation. It also provides an evaluation of digital preservation practices, and the potential viability of encouraging longer transitional periods between preservation mediums, in order to allow for the stabilisation of the digital medium as its 'fast-paced planned obsolescence is still incompatible with trustworthy preservation infrastructure within film heritage'. (Antoniuzzi, 2020, preprint p. 10)

Literature Review

Format and medium obsolescence can be seen as one of the persistent threads of technological development, with the rise of digital technology only increasing the rate at which this obsolescence occurs. As a result, 'media-land is strewn with the ruins of clunky media formats, costly equipment, and darkened rooms with projectionists' (Widzinski, 2010, p. 358) which inevitably has an impact upon archives attempting to preserve mediums and formats deemed obsolete with the development of technology, such as film archives which hold analogue film stock.

The transition from analogue to digital has impacted almost every aspect of the information world, including film archives and the wider film industry, with discussions around analogue film stock centring around these two areas. Previous research around the increase in industry digitisation and film archives such as that undertaken by Crofts (2008) shows concern for how the adoption of digital in the film industry and in cinemas could impact analogue film's production and preservation (pp. 1-35) while more contemporary research from Antoniuzzi (2020) places focus on digital preservation practices, their development within the film sector, and the issues that accompany such quickly developing technology. (preprint, pp. 1-16) Conrad (2014) analyses both analogue and digital preservation methods for film stock, and establishes that while digital preservation is employed for elements of the film preservation process, there is a resistance to using digital exclusively. (pp. 27-43) This resistance to total digital preservation, and the issues with digital preservation as addressed by

Antoniazzi (2020, preprint, pp. 1-16) reveal the core of the potential problem posed by lowering analogue film stock production.

This issue is recognised by Cave (2008) who argues that analogue film has been forced into obsolescence before digital preservation can rise to meet the challenges and demands of film archives, (p. 3) and while Bonatti and Legelius (2019) explore the potential for long-term digital preservation for film archives in practice through the Swedish Film Institute's digital archive, (pp. 144-150) they also recognise that it is important to 'keep and pass on the knowledge of people who have been working here a long time, in an analog film environment, to the new people'. (Bonatti and Legelius, 2019, p. 146) The question of preserving not just film stock but the knowledge and technology surrounding it is addressed in Lenk's (2014) examination of the rise of digital projection, and questioning of whether it will result in archive's analogue film stock holdings becoming inaccessible due to technological obsolescence rather than poor preservation. (pp. 100-110) Lameris and Flueckiger (2019) also address this, discovering that students on their course 'knew very little about analog film, far less than a few years ago, when digital projection became standard', (p. 95) reflecting the real danger that knowledge surrounding the handling of analogue film stock could disappear and potentially harm film archives with large amounts of film stock in their collections.

This previous research inspires the question of whether analogue film should be permitted a longer lifespan for the purposes of bridging the gap between analogue and digital, and in order to keep alive the knowledge and technology surrounding analogue film stock management and prevent possible information loss. The theoretical viability of this is what this research project aims to examine. Crofts' (2008) article *Digital Decay* and Fossati's (2018) *From Grain to Pixel: The Archival Life of Film in Transition* revised edn. will be important to the research of this project, with the former serving as an introduction to this area of research, and the latter useful for examining contemporary debates in the field, as well as the impact of digital adoption upon film archive practices, and as an exploration of the materiality of film as a preservation medium. Film archive journals such as *The Moving Image: The Journal of the Association of Moving Image Archivists* (2001-2019) will also be important to understanding contemporary debates surrounding analogue film and film archives, and current developments in the field that will impact this project's critical analysis of the benefits and costs of increasing analogue film stock production. Brown (2013) and Kramer-Smythe (2019) will aid in the understanding of the more generally applicable elements of digital preservation and how it should function in practice, and inform the understanding of the increasingly inter-disciplinary nature of digital preservation.

Methodology

The primary method of research for this project will be desk research, in combination with several interviews conducted via email. It is however important to note at this point that these interviews may not be possible due to the impact of the COVID-19 pandemic, and so allowances will be made for this in the undertaking of the desk research. Desk research in combination with email interviews as a research approach is suitable for this project due to the evaluative and theoretical nature of the research question, the historical aspects of film stock preservation that must be considered, and the limited feasibility and usefulness of conducting in-person research due to the theoretical nature of the research question and the variety of archive locations.

In order to explore definitions of preservation and access for analogue and digital film stock preservation practices, elements of conceptual analysis will be employed. This will support the comparative assessment of historical analogue preservation practices and digital preservation practices. A historical analysis will be used to examine analogue film preservation practices in order to

compare them to current digital preservation practices. This will also assess analogue film stock's viability as a medium for preservation, in order to compare it to current digital mediums. The historical analysis will support a selective critical literature review that will be used to identify the impact of lowered analogue film stock production on film archive's preservation practices. The literature review will also explore the current state of analogue film stock production, and evaluate the viability of increasing analogue film stock production through a critical analysis of the benefits and costs to film archives and analogue film stock producers. The literature review will be supported by email interviews with film archive curators in order to gain a contemporary perspective on the issues.

Any data gathered from interviews will be retained securely in encrypted files on my City, University of London OneDrive, or in encrypted files on a password-protected USB drive. Any personal identifying data will be removed before data is included in the project. Upon conclusion of the project, data will be securely disposed of.

Dissemination

Reflections on the research process will be published via Twitter and my course blog. Upon approval, the completed dissertation will be deposited in the CityLIS Humanities Commons repository.

Work Plan

Date	
May – mid June	<ul style="list-style-type: none"> - Continue literature review. - Begin collection and organisation of literature and references for historical/conceptual/literature analyses. - Complete and submit any outstanding elements required by ethics review for approval by supervisor, including interview schedule. - Select and approach potential interview subjects.
Mid June – July	<ul style="list-style-type: none"> - Continue to collect and organise literature and references for historical/conceptual/literature analyses in accordance with methodology. - Complete write up of literature review. - Collect and organise interview data and add into selective critical literature review structure accordingly. - Draft full dissertation outline for write up guidance.
August – September	<ul style="list-style-type: none"> - Write up historical/conceptual/literature analyses and interview data. - Write up/review any other elements of dissertation as needed. - Draft and write up conclusions. - Complete formatting, appendices, and references.
End of September	<ul style="list-style-type: none"> - Complete final reference and formatting checks. - Complete final grammar and readthrough checks. - Submit dissertation.

Depending upon the response rate for the email interviews, the collection of data may not factor into this work plan, in which case the time will be dedicated to further building the literature and resources for the various desk research analyses. Writing up of elements outside the analyses and interview data will be ongoing throughout May, June, and July, but time will be allocated during the August and September write up to allow for a varied workload.

Resources

As research for the project will be undertaken via desk research, no travel should be required to undertake this project and it is predicted that no costs will be incurred. Resources will be sourced from the City, University of London library catalogue, or other freely available library catalogues as required, and from publicly available sources such as the websites and other digital presences of film archives and analogue film stock producers.

Ethics

Ethical issues arising from the inclusion of participants via the use of email interviews in the research process are addressed in the ethics form below. In order to combat any ethical issues, all participants will be asked to give informed consent to participate, and will be made aware of the purpose of the research. It will be made clear to participants that they may choose not to participate in parts of the project, or withdraw entirely at any time, with no consequence. Participants will be made aware that all data collected will be securely stored, that any personal identifying data will be removed and data anonymised before inclusion in the project, and that if they withdraw before publication of the dissertation their data will be securely disposed of and not used in the dissertation. It will be made clear to participants that data collected will be securely disposed of upon completion of the project.

Confidentiality

Confidentiality issues could arise from the undertaking of email interviews as part of the research for the project. To combat this, any personal identifying data will be removed, and the data anonymised before it is included in the project. Data will be securely held in encrypted files on my City, University of London OneDrive or in encrypted files on a password-protected USB drive. Data will be securely disposed of upon completion of the project. Participants will be made aware that they may withdraw at any time before publication of the dissertation, and that if they choose to withdraw their data will be securely disposed of and not used in the dissertation.

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Research Ethics Review Form: CityLIS dissertation projects

CityLIS students undertaking their dissertation project are required to consider the ethics of their project work and to ensure that it complies with research ethics guidelines. Usually approval will be given by the supervisor, but in some cases a project will need approval from an ethics committee before it can proceed.

In order to ensure that appropriate consideration is given to ethical issues, all students must complete this form and attach it to their dissertation proposal. There are two parts:

PART A: Ethics Checklist. All students must complete this part.

The checklist identifies whether the project requires ethical approval and, if so, where to apply for approval.

PART B: Ethics Proportionate Review Form. Students who have answered "no" to all questions in A1, A2 and A3 and "yes" to question 4 in A4 in the ethics checklist must complete this part. The project supervisor has delegated authority to provide approval in such cases that are considered to involve minimal risk.

A.1 If you answer YES to any of the questions in this block, approval will be needed from an appropriate external ethics committee for approval. Consult your supervisor if you think this may be the case.		<i>Delete as appropriate</i>
1.1	Does your research require approval from the National Research Ethics Service (NRES)? <i>e.g. because you are recruiting current NHS patients or staff?</i> <i>If you are unsure try - https://www.hra.nhs.uk/approvals-amendments/what-approvals-do-i-need/</i>	NO
1.2	Will you recruit participants who fall under the auspices of the Mental Capacity Act? <i>Such research needs to be approved by an external ethics committee such as NRES or the Social Care Research Ethics Committee - http://www.scie.org.uk/research/ethics-committee/</i>	NO
1.3	Will you recruit any participants who are currently under the auspices of the Criminal Justice System, for example, but not limited to, people on remand, prisoners and those on probation?	NO

	<i>Such research needs to be authorised by the ethics approval system of the National Offender Management Service.</i>	
A.2 If you answer YES to any of the questions in this block, approval will be needed from the Senate Research Ethics Committee. Consult your supervisor if you think this may be the case.		<i>Delete as appropriate</i>
2.1	Does your research involve participants who are unable to give informed consent? <i>For example, but not limited to, people who may have a degree of learning disability or mental health problem, that means they are unable to make an informed decision on their own behalf.</i>	NO
2.2	Is there a risk that your research might lead to disclosures from participants concerning their involvement in illegal activities?	NO
2.3	Is there a risk that obscene and or illegal material may need to be accessed for your research study (including online content and other material)?	NO
2.4	Does your project involve participants disclosing information about special category or sensitive subjects? <i>For example, but not limited to: racial or ethnic origin; political opinions; religious beliefs; trade union membership; physical or mental health; sexual life; criminal offences and proceedings</i>	NO
2.5	Does your research involve you travelling to another country outside of the UK, where the Foreign & Commonwealth Office has issued a travel warning that affects the area in which you will study? <i>Please check the latest guidance from the FCO - http://www.fco.gov.uk/en/</i>	NO
2.6	Does your research involve invasive or intrusive procedures? <i>These may include, but are not limited to, electrical stimulation, heat, cold or bruising.</i>	NO
2.7	Does your research involve animals?	NO
2.8	Does your research involve the administration of drugs, placebos or other substances to study participants?	NO
A.3 If you answer YES to any of the questions in this block, then approval will be needed from the Computer Science /Library and Information Science Research Ethics Committee (CSREC). Consult your supervisor if you think this may be the case.		<i>Delete as appropriate</i>
3.1	Does your research involve participants who are under the age of 18?	NO
3.2	Does your research involve adults who are vulnerable because of their social, psychological or medical circumstances (vulnerable adults)? <i>This includes adults with cognitive and / or learning disabilities, adults with physical disabilities and older people.</i>	NO
3.3	Are participants recruited because they are staff or students of City, University of London? <i>For example, students studying on a particular course or module. If yes, then approval is also required from the Head of Department or Programme Director.</i>	NO
3.4	Does your research involve intentional deception of participants?	NO
3.5	Does your research involve participants taking part without their informed consent?	NO

3.5	Is the risk posed to participants greater than that in normal working life?	NO
3.7	Is the risk posed to you, the researcher(s), greater than that in normal working life?	NO
<p>A.4 If you answer YES to the following question and your answers to all other questions in sections A1, A2 and A3 are NO, then your project is of minimal risk. If this is the case, then you can apply for approval through your supervisor under PROPORTIONATE REVIEW. You do so by completing PART B of this form.</p> <p>If you have answered NO to all questions in the checklist, including question 4, then your project does not require ethical approval. You should still include the form in your dissertation proposal.</p>		<i>Delete as appropriate</i>
4	<p>Does your project involve human participants or their identifiable personal data?</p> <p><i>For example, as interviewees, respondents to a survey, or participants in testing.</i></p>	YES

PART B: Ethics Proportionate Review Form

If you answered YES to question 4 and NO to all other questions in sections A1, A2 and A3 in PART A (checklist) of this form, then you should complete PART B of this form to submit an application for a proportionate ethics review of your project. Your supervisor has delegated authority to review and approve this application under proportionate review. Your proposal, including this ethics application, must be approved by your supervisor before beginning the planned research.

If you cannot provide all the required attachments (see B.3) with your project proposal (e.g. because you have not yet written the consent forms, interview schedules etc), you must submit the missing items to your supervisor for approval prior to commencing these parts of your project.

Your supervisor may ask you to submit a full ethics application through Research Ethics Online, if they are unable to give approval.

B.1 The following questions must be answered fully.		<i>Delete as appropriate</i>
1.1.	Will you ensure that participants taking part in your project are fully informed about the purpose of the research?	YES
1.2	Will you ensure that participants taking part in your project are fully informed about the procedures affecting them or affecting any information collected about them, including information about how the data will be used, to whom it will be disclosed, and how long it will be kept?	YES
1.3	When people agree to participate in your project, will it be made clear to them that they may withdraw (i.e. not participate) at any time without any penalty?	YES
1.4	<p>Will consent be obtained from the participants in your project?</p> <p>Consent from participants will be necessary if you plan to involve them in your project or if you plan to use identifiable personal data from existing records. "Identifiable personal data" means data relating to a living person who might be identifiable if the record includes their name, username, student id, DNA, fingerprint, address, etc.</p> <p><i>If YES, you must attach drafts of the participant information sheet(s) and consent form(s) that you will use in section B.3 or, in the case of an existing dataset, provide details of how consent has been obtained.</i></p> <p><i>You must also retain the completed forms for subsequent inspection.</i></p> <p><i>Failure to provide the completed consent request forms will result in withdrawal of any earlier ethical approval of your project.</i></p>	YES
1.5	Have you made arrangements to ensure that material and/or private information obtained from or about the participating individuals will remain confidential?	YES

B.2 If the answer to the following question (B2) is YES, you must provide details		<i>Delete as appropriate</i>
2	<p>Will the research be conducted in the participant's home or other non-University location?</p> <p><i>If YES, you must provide details of how your safety will be ensured.</i></p>	NO
B.3 Attachments		<p>YES NO Not Applicable</p>

All of the following documents must be provided to supervisors if applicable. If they are not available when the proposal is submitted, they must be approved by the supervisor later.			
Details on how safety will be assured in any non-University location, including risk assessment if required (see B2)			X
<p>Details of arrangements to ensure that material and/or private information obtained from or about the participating individuals will remain confidential (see B1.5)</p> <p><i>Any personal data must be acquired, stored and made accessible in ways that are GDPR compliant.</i></p> <p>Any data gathered from interviews will be retained securely in encrypted files on my City, University of London OneDrive, or in encrypted files on a password-protected USB drive. Any personal identifying data will be removed and anonymised before data is included in the project. Upon conclusion of the project, data, records of data, and records associated with data will be securely disposed of. All participants will be asked to give informed consent and read the participant information sheet before participating in the project. Participants will be made aware of how their data will be used in the project, and the purpose of the research. Participants will be made aware that anonymised versions of their interview data may be included in the appendices of the project for research transparency purposes. Participants will be made aware that they may choose not to participate in parts of the interview, or withdraw from the project at any time before publication of the dissertation without consequence, and that if they choose to withdraw, records of or records associated with their data will be securely disposed of and their data will not be used in the dissertation.</p>	X		
Full protocol for any workshops or interviews**	X		
Participant information sheet(s)**	X		
Consent form(s)**	X		
<p>Questionnaire(s)**</p> <p><i>sharing a Qualtrics survey with your supervisor is recommended.</i></p>			X
Topic guide(s) for interviews and focus groups**	X		
<p>Permission from external organisations or Head of Department**</p> <p><i>e.g. for recruitment of participants</i></p>	X		



Fig 1: City, University of London Logo (City, University of London, 2021)

Image Source: <https://www.city.ac.uk/>

City, University of London (2021) *City University of London Logo* [Logo]. Available at: <https://www.city.ac.uk/> (Accessed 6 May 2021)

Participant Information Sheet – City, University of London

REC reference number, date, and version of information sheet

Version 1.0

02/05/2021

Title of Study

Examining Analogue Film's Viability as a Preservation Method for Film Archives

Principal Researcher

Nina Byrom (Researcher)

Dr Lyn Robinson (Supervisor)

You are being invited to take part in this research study. Before deciding whether you would like to take part, it is important for you to understand why the research is being done and what it would involve for you as a participant. Please take time to read the following information in this document carefully and discuss it with others if you wish to. Please ask if there is anything unclear to you in this document, or if you would like more information. You will be given a copy of this information sheet to keep for your records.

What is the Purpose of the Study?

This research study is being undertaken as part of a dissertation for the City, University of London Library Science MSc Programme. The duration of the dissertation and research study will be from 31 March 2021 to 1 October 2021, when the dissertation will be submitted. The intended aim of the dissertation and the research study is to identify the impact of lowered analogue film stock production upon film archive preservation practices, examine how viable analogue film stock is as a preservation method for film archives in comparison to digital preservation, and the viability of theoretically increasing production of analogue film for use in film archival practices.

Why Have I Been Invited to Take Part?

You have been invited to participate in this research study because you hold a curatorial position within a film archive that has a significant amount of analogue film stock in its collection, and can provide a current perspective on the states of analogue and digital preservation practices that will be valuable to this study. There will be a maximum of two other participants in this study, in order to gain a suitable level of expert perspectives. Your decision to take part or refuse to take part in this study will have no effect on your employment, professional prospects, or other aspects of your job.

Do I Have to Take Part?

Participation in this research study is voluntary and you may choose to refuse participation in part or all of the study. You can withdraw at any stage of the study without being penalised or disadvantaged in any way. It is up to you to decide to take part in the study or refuse to take part in the study. If you do decide to take part in the study you will be asked to sign a consent form. If you do decide to take part in the study you are still free to withdraw from the study at any time, without giving a reason. Once the data you provide has been published as part of the dissertation, you will no longer be able to withdraw your data. Any data collected up to the point of your withdrawal from the project will be securely disposed of and no longer included in the dissertation.

What Will Happen If I Take Part and What Do I Have to Do If I Take Part?

If you decide to take part in the study, you will be sent a set of interview questions to answer via email. Questions will concern the current states of analogue and digital preservation practices in film archives, the impact of lowered analogue film stock production upon film archive preservation practices, and the potential impact of increasing analogue film stock production upon preservation practices. These interview questions will be semi-structured and there will only be one interview, although follow up questions may be asked in order to gain clarity about the answers you give. Answering the questions should take between twenty to thirty minutes on average, depending upon the answers you give. The time period for participating in the study will last from 15 June 2021 to 31 July 2021.

If you decide to take part in the study, you will be expected to provide answers to the set of interview questions sent to you via email, and clarify your answers if necessary in follow up questions. If you give consent, your anonymised answers will be directly quoted in order to support an evaluation of the viability of increasing analogue film stock production to support archives, and to identify the impact of lowered analogue film stock production upon film archive preservation practices. As previously stated, you may choose not to take part in part or all of the study, and may withdraw from the study at any time before the dissertation is published.

What Are the Possible Disadvantages, Risks, and Benefits of Taking Part?

There is a risk in participating in this study that information may be lost, or stolen, and to combat this all information will be kept securely and confidentially, and anonymised before inclusion in the project. There are no direct benefits for participants who choose to take part in this study. Research findings from this dissertation contribute to the discussion surrounding analogue film stock and digital preservation and evaluate the potential of increasing the production of analogue film stock to serve archives.

How is the Project Being Funded and Are There Conflicts of Interest?

This project has no funding sources. There are no conflicts of interest held by the researcher, or City, University of London.

What Should I Do If I Want to Take Part?

If you choose to take part in this study, please return the completed consent form and answer and return the interview questions that will be sent to you as part of the study. Please also answer any follow up questions to clarify your answers to the interview questions if necessary.

Data Privacy Statement

City, University of London is the sponsor and the data controller of this study based in the United Kingdom. This means that we are responsible for looking after your information and using it properly. The legal basis under which your data will be processed is City's public task.

Your right to access, change or move your information are limited, as we need to manage your information in a specific way in order for the research to be reliable and accurate. To safeguard your rights, we will use the minimum personal-identifiable information possible (for further information please see <https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/lawful-basis-for-processing/public-task/>).

City will use your name and contact details to contact you about the research study as necessary. The only people at City who will have access to your identifiable information will be Nina Byrom. City will keep identifiable information about you from this study for 0 years after the study has finished.

You can find out more about how City handles data by visiting <https://www.city.ac.uk/about/governance/legal>. If you are concerned about how we have processed your personal data, you can contact the Information Commissioner's Office (IOC) <https://ico.org.uk/>.

Confidentiality of Participants

Upon collection of the data you provide, the only person who will have access to the personal data is the researcher. Confidentiality will be ensured by not collecting more personal identifiable data than is necessary, removing any personal identifiable data before inclusion in the dissertation, and anonymising answers received from the study before inclusion of direct quotations in the dissertation. In the case of reporting illegal activity, violent action, abuse, harm to others, self-inflicted harm, confidentiality cannot be ensured. Records will be stored on the researcher's City, University of London OneDrive in encrypted files, with backups kept on an encrypted USB drive in encrypted files. Data will be kept for the duration of the project. Upon conclusion of the project, all records and record backups will be removed and permanently deleted, and all emails containing data related to the records will be permanently deleted. Anonymised versions of the interview data collected may be included in the appendices of the dissertation for the purposes of research transparency.

What will Happen to the Results?

Upon completion of the project, the dissertation will be deposited in the CityLIS Humanities Commons group. Future dissertations or research may build upon the project, but the anonymity of the data included in the project will be maintained in accordance with the confidentiality statement outlined above. If you wish to receive a copy of the dissertation, you will be able to access it via the CityLIS Humanities Commons repository group.

Who Has Reviewed the Study?

This study has been approved by the project supervisor, Dr Lyn Robinson at City, University of London.

What If There is a Problem?

If you have any problems, concerns or questions about this study, you should ask to speak to a member of the research team. If you remain unhappy and wish to complain formally, you can do this through City's complaints procedure. To complain about the study, you need to phone 020 7040 3040. You can then ask to speak to the Secretary to Senate Research Ethics Committee and inform them that the name of the project is 'Examining Analogue Film's Viability as a Preservation Method for Film Archives'

You can also write to the Secretary at:

Anna Ramberg
Research Integrity Manager
City, University of London, Northampton Square
London, EC1V 0HB
Email: Anna.Ramberg.1@city.ac.uk

Insurance

City University London holds insurance policies which apply to this study, subject to the terms and conditions of the policy. If you feel you have been harmed or injured by taking part in this study you may be eligible to claim compensation. This does not affect your legal rights to seek compensation. If you are harmed due to someone's negligence, then you may have grounds for legal action.

Further Information and Contact Details

Researcher:
Nina Byrom
Nina.Byrom@city.ac.uk

Project Supervisor:
Dr Lyn Robinson
+44(0)20 7040 8390
L.Robinson@city.ac.uk

Thank You for taking the time to read this participant information sheet.



Fig 1: City, University of London Logo (City, University of London, 2021)

Image Source: <https://www.city.ac.uk/>

City, University of London (2021) *City University of London Logo* [Logo]. Available at: <https://www.city.ac.uk/> (Accessed 6 May 2021)

Consent Form – City, University of London

Name of principal investigator/researcher

Nina Byrom (Researcher)

Dr Lyn Robinson (Supervisor)

REC reference number

Title of study

Examining Analogue Film’s Viability as a Preservation Method for Film Archives

Please tick or
initial box

	I confirm that I have had the above study explained to me and have read and understood the participant information sheet dated 02/05/2021, Version 1.0, for the above study, which I may keep for my records. I have had the opportunity to consider the information and ask questions which have been answered satisfactorily.	
	I confirm that I understand how my data will be securely used, stored, and disposed of for the above study.	
	I understand that my participation in this project will involve completing an email interview, and answering any follow up questions for the purposes of clarification of the interview answers given.	
	I understand that my participation is voluntary and that I am free to withdraw without giving a reason and without being penalised or disadvantaged.	
	I understand that I will be able to withdraw my data up to the time of publication, 1 October 2021, and that upon my withdrawal my data will be securely disposed of and not be included in the project.	
	I agree to the use of anonymised direct quotes from my interview data, in the study.	
	I understand that an anonymised version of my interview data may be included in the appendices of the project for research transparency purposes.	
	I agree to City recording and processing this information about me. I understand that this information will be used only for the purpose(s) explained in the participant information sheet and my consent is conditional on City complying with its duties and obligations under the General Data Protection Regulation (GDPR).	
	I agree to take part in the above study.	

_____	_____	_____
Name of Participant	Signature	Date
_____	_____	_____
Name of Researcher	Signature	Date

When completed, 1 copy for participant; 1 copy for researcher file.

8.3 Interview Questions



Fig 1: City, University of London Logo (City, University of London, 2021)

Image Source: <https://www.city.ac.uk/>

City, University of London (2021) *City University of London Logo* [Logo]. Available at: <https://www.city.ac.uk/> (Accessed 6 May 2021)

Interview Questions – City, University of London

Name of principal investigator/researcher

Nina Byrom (Researcher)

Dr Lyn Robinson (Supervisor)

REC reference number

Title of study

Examining Analogue Film’s Viability as a Preservation Method for Film Archives

This interview is being undertaken as part of a dissertation for the City, University of London Library Science MSc Programme. It is meant to determine your perspective on the topics of the current

states of analogue preservation practices and digital preservation practices, the impact of lowered film stock production upon preservation practices, and the potential impact of increasing film stock production upon preservation practices.

This interview should take between twenty and thirty minutes to answer on average, although this depends upon the length and detail of your answers. You are under no obligation to answer all, or any of the questions if you do not wish to, and can withdraw without consequences from the study at any time until 17 September 2021. If you withdraw, your data will be securely disposed of and not used in the dissertation. Upon conclusion of the project all data collected and records associated with the data will be securely disposed of. All data collected will be anonymised and personal identifiable data removed before inclusion in the dissertation, and be stored on the researcher's City, University of London OneDrive in encrypted files, with backups kept on an encrypted USB drive in encrypted files.

- 1. What is the title of your role within the archive?**

- 2. Roughly how many items of film stock, i.e. cellulose nitrate, cellulose acetate, polyester safety stock, are held in the archive?**

- 3. How frequently are analogue preservation practices and digital preservation practices employed for the archive's film stock holdings? Preservation practices in this case refer to the processes involved in maintaining film stock for future access.**

- 4. Do you have a preference for analogue preservation or digital preservation, and if so, why? Analogue preservation of a document and digital preservation of a document can be defined by whether the end result to be preserved is an analogue or digital document.**

- 5. Has there been any impact upon the archive's preservation practices, knowledge of preservation practices, or upon the archive more generally, because of the digitisation of the film industry? Has there been any impact because of the drop in film stock production?**

- 6. What do you think the future of preservation practices for film stock holdings could be? Are there any notable benefits or risks associated with this?**

7. **Would an increase in film stock production have an impact on the archive's current preservation practices?**

8. **Would an increase in film stock production have an impact on the future of preservation practices?**

9. **How feasible do you think an increase in film stock production could be?**

10. **Is there, or would there be, a need to increase film stock production above current levels in order to support archive preservation practices?**

11. **Is there anything you would like to add about the topics covered in this interview?**

Thank you for participating in this research.

If you have any questions, please feel free to email me at nina.byrom@city.ac.uk and I will be happy to answer them.

8.4 Interview Responses



Fig 1: City, University of London Logo (City, University of London, 2021)

Image Source: <https://www.city.ac.uk/>

Interview Questions – City, University of London

Name of principal investigator/researcher

Nina Byrom (Researcher)

Dr Lyn Robinson (Supervisor)

REC reference number

Title of study

Examining Analogue Film's Viability as a Preservation Method for Film Archives

This interview is being undertaken as part of a dissertation for the City, University of London Library Science MSc Programme. It is meant to determine your perspective on the topics of the current states of analogue preservation practices and digital preservation practices, the impact of lowered film stock production upon preservation practices, and the potential impact of increasing film stock production upon preservation practices.

This interview should take between twenty and thirty minutes to answer on average, although this depends upon the length and detail of your answers. You are under no obligation to answer all, or any of the questions if you do not wish to, and can withdraw without consequences from the study at any time until 17 September 2021. If you withdraw, your data will be securely disposed of and not used in the dissertation. Upon conclusion of the project all data collected and records associated with the data will be securely disposed of. All data collected will be anonymised and personal identifiable data removed before inclusion in the dissertation, and be stored on the researcher's City, University of London OneDrive in encrypted files, with backups kept on an encrypted USB drive in encrypted files.

1. What is the title of your role within the archive?

XXXXXXXXXXXX

2. Roughly how many items of film stock, i.e. cellulose nitrate, cellulose acetate, polyester safety stock, are held in the archive?

Estimated XXXXXXXXXXXX

3. How frequently are analogue preservation practices and digital preservation practices employed for the archive's film stock holdings? Preservation practices in this case refer to the processes involved in maintaining film stock for future access.

Because of the expense of digitization, ours is usually funding through projects and as such, happens with different frequency. For instance, we've just completed a

large digitization project in the **XXXXXX** in which we digitized over 100 hours of content, and the **XXXXXXXXXXXXXXXXXX** programme allowed us to digitize over 150 hours of content. We do not yet have a digital preservation infrastructure, so “preservation” of those digital assets involves storage on LTO 6 tapes. As for film preservation, all film is preserved on site in specialist temperature and humidity controlled vaults. Nitrate is the exception which is held in specialist facilities at **XXXX**.

- 4. Do you have a preference for analogue preservation or digital preservation, and if so, why? Analogue preservation of a document and digital preservation of a document can be defined by whether the end result to be preserved is an analogue or digital document.**

Personally I prefer analogue preservation as it's far more straightforward and proven to last hundreds of years if stored properly. There's also potential for information to get lost if it's not included in the digital asset, for instance stock dates on the edge of films.

- 5. Has there been any impact upon the archive's preservation practices, knowledge of preservation practices, or upon the archive more generally, because of the digitisation of the film industry? Has there been any impact because of the drop in film stock production?**

Yes, our preservation practices and digital strategy have changed drastically over the past 5-10 years, and staff has had to train and learn about new digital technologies. There has also been an impact in the ease with which we can buy conservation materials like film leader or film cans for storage.

- 6. What do you think the future of preservation practices for film stock holdings could be? Are there any notable benefits or risks associated with this?**

I think basic preservation practice for film – stored in a cool, dry place – will remain the same as it's most effective. When it comes to video tape, given the fragility of the formats and lack of playback equipment, I think this will be the thing that changes where it may only be preserved in its digital format.

- 7. Would an increase in film stock production have an impact on the archive's current preservation practices?**

It would make our conservation / preservation work easier, as mentioned above, supplies are hard to come by.

- 8. Would an increase in film stock production have an impact on the future of preservation practices?**

No, however a further decrease in film stock production would impact our practices, especially getting new prints of nitrate collections.

9. How feasible do you think an increase in film stock production could be?

n/a

10. Is there, or would there be, a need to increase film stock production above current levels in order to support archive preservation practices?

Yes, analogue material is still coming into the archive, and it would allow further options of printing digital objects back onto film for long term preservation.

11. Is there anything you would like to add about the topics covered in this interview?

Thank you for participating in this research.

If you have any questions, please feel free to email me at nina.byrom@city.ac.uk and I will be happy to answer them.

8.5 Participant Information Sheet



Fig 1: City, University of London Logo (City, University of London, 2021)

Image Source: <https://www.city.ac.uk/>

City, University of London (2021) *City University of London Logo* [Logo]. Available at: <https://www.city.ac.uk/> (Accessed 6 May 2021)

Participant Information Sheet – City, University of London

REC reference number, date, and version of information sheet

Version 1.1

30/05/2021

Title of Study

Examining Analogue Film's Viability as a Preservation Method for Film Archives

Principal Researcher

Nina Byrom (Researcher)

Dr Lyn Robinson (Supervisor)

You are being invited to take part in this research study. Before deciding whether you would like to take part, it is important for you to understand why the research is being done and what it would involve for you as a participant. Please take time to read the following information in this document carefully and discuss it with others if you wish to. Please ask if there is anything unclear to you in this document, or if you would like more information. You will be given a copy of this information sheet to keep for your records.

What is the Purpose of the Study?

This research study is being undertaken as part of a dissertation for the City, University of London Library Science MSc Programme. The duration of the dissertation and research study will be from 31 March 2021 to 1 October 2021, when the dissertation will be submitted. The intended aim of the dissertation and the research study is to identify the impact of lowered analogue film stock production upon film archive preservation practices, examine how viable analogue film stock is as a preservation method for film archives in comparison to digital preservation, and the viability of theoretically increasing production of analogue film for use in film archival practices.

Why Have I Been Invited to Take Part?

You have been invited to participate in this research study because you hold a curatorial position within a film archive that has a significant amount of analogue film stock in its collection, and can provide a current perspective on the states of analogue and digital preservation practices that will be valuable to this study. There will be a maximum of four other participants in this study, in order to gain a suitable level of expert perspectives. Your decision to take part or refuse to take part in this study will have no effect on your employment, professional prospects, or other aspects of your job.

Do I Have to Take Part?

Participation in this research study is voluntary and you may choose to refuse participation in part or all of the study. You can withdraw at any stage of the study without being penalised or disadvantaged in any way. It is up to you to decide to take part in the study or refuse to take part in the study. If you do decide to take part in the study you will be asked to sign a consent form. If you do decide to take part in the study you are still free to withdraw from the study at any time, without giving a reason. You will be able to withdraw your data up to 17 September 2021, 2 weeks before the time of publication. Once the data you provide has been published as part of the dissertation,

you will no longer be able to withdraw your data. Any data collected up to the point of your withdrawal from the project will be securely disposed of and no longer included in the dissertation.

What Will Happen If I Take Part and What Do I Have to Do If I Take Part?

If you decide to take part in the study, you will be sent a set of interview questions to answer via email. Questions will concern the current states of analogue and digital preservation practices in film archives, the impact of lowered analogue film stock production upon film archive preservation practices, and the potential impact of increasing analogue film stock production upon preservation practices. These interview questions will be structured and open-ended and there will only be one interview, although follow up questions may be asked in order to gain clarity about the answers you give. Answering the questions should take between twenty to thirty minutes on average, although this will depend upon the answers you give. The time period for participating in the study will last from 15 June 2021 to 31 July 2021.

If you decide to take part in the study, you will be expected to provide answers to the set of interview questions sent to you via email, and clarify your answers if necessary in follow up questions. If you give consent, your anonymised answers will be directly quoted in order to support an evaluation of the viability of increasing analogue film stock production to support archives, and to identify the impact of lowered analogue film stock production upon film archive preservation practices. As previously stated, you may choose not to take part in part or all of the study, and may withdraw from the study at any time before the dissertation is published.

What Are the Possible Disadvantages, Risks, and Benefits of Taking Part?

There is a risk in participating in this study that information may be lost, or stolen, and to combat this all information will be kept securely and confidentially, and anonymised before inclusion in the project. There are no direct benefits for participants who choose to take part in this study. Research findings from this dissertation contribute to the discussion surrounding analogue film stock and digital preservation and evaluate the potential of increasing the production of analogue film stock to serve archives.

How is the Project Being Funded and Are There Conflicts of Interest?

This project has no funding sources. There are no conflicts of interest held by the researcher, or City, University of London.

What Should I Do If I Want to Take Part?

If you choose to take part in this study, please return the completed consent form and answer and return the interview questions that will be sent to you as part of the study. Please also answer any follow up questions to clarify your answers to the interview questions if necessary.

Data Privacy Statement

City, University of London is the sponsor and the data controller of this study based in the United Kingdom. This means that we are responsible for looking after your information and using it properly. The legal basis under which your data will be processed is City's public task.

Your right to access, change or move your information are limited, as we need to manage your information in a specific way in order for the research to be reliable and accurate. To safeguard your rights, we will use the minimum personal-identifiable information possible (for further information

please see <https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/lawful-basis-for-processing/public-task/>).

City will use your name and contact details to contact you about the research study as necessary. The only people at City who will have access to your identifiable information will be Nina Byrom. City will keep identifiable information about you from this study for 0 years after the study has finished.

You can find out more about how City handles data by visiting <https://www.city.ac.uk/about/governance/legal>. If you are concerned about how we have processed your personal data, you can contact the Information Commissioner's Office (IOC) <https://ico.org.uk/>.

Confidentiality of Participants

Upon collection of the data you provide, the only person who will have access to the personal data is the researcher. Confidentiality will be ensured by not collecting more personal identifiable data than is necessary, removing any personal identifiable data before inclusion in the dissertation, and anonymising answers received from the study before inclusion of direct quotations in the dissertation. In the case of reporting illegal activity, violent action, abuse, harm to others, self-inflicted harm, confidentiality cannot be ensured. Records will be stored on the researcher's City, University of London OneDrive in encrypted files, with backups kept on an encrypted USB drive in encrypted files. Data will be kept for the duration of the project. Upon conclusion of the project, all records and record backups will be removed and permanently deleted, and all emails containing data related to the records will be permanently deleted. Anonymised versions of the interview data collected may be included in the appendices of the dissertation for the purposes of research transparency.

What will Happen to the Results?

Upon completion of the project, the dissertation will be deposited in the CityLIS Humanities Commons group. Future dissertations or research may build upon the project, but the anonymity of the data included in the project will be maintained in accordance with the confidentiality statement outlined above. If you wish to receive a copy of the dissertation, you will be able to access it via the CityLIS Humanities Commons repository group.

Who Has Reviewed the Study?

This study has been approved by the project supervisor, Dr Lyn Robinson at City, University of London.

What If There is a Problem?

If you have any problems, concerns or questions about this study, you should ask to speak to a member of the research team. If you remain unhappy and wish to complain formally, you can do this through City's complaints procedure. To complain about the study, you need to phone 020 7040 3040. You can then ask to speak to the Secretary to Senate Research Ethics Committee and inform them that the name of the project is 'Examining Analogue Film's Viability as a Preservation Method for Film Archives'

You can also write to the Secretary at:

Anna Ramberg
Research Integrity Manager

City, University of London, Northampton Square
London, EC1V 0HB
Email: Anna.Ramberg.1@city.ac.uk

Insurance

City University London holds insurance policies which apply to this study, subject to the terms and conditions of the policy. If you feel you have been harmed or injured by taking part in this study you may be eligible to claim compensation. This does not affect your legal rights to seek compensation. If you are harmed due to someone's negligence, then you may have grounds for legal action.

Further Information and Contact Details

Researcher:

Nina Byrom

Nina.Byrom@city.ac.uk

Project Supervisor:

Dr Lyn Robinson

+44(0)20 7040 8390

L.Robinson@city.ac.uk

Thank You for taking the time to read this participant information sheet.

8.6 Consent Form



Fig 1: City, University of London Logo (City, University of London, 2021)

Image Source: <https://www.city.ac.uk/>

City, University of London (2021) *City University of London Logo* [Logo]. Available at: <https://www.city.ac.uk/> (Accessed 6 May 2021)

Consent Form – City, University of London

Name of principal investigator/researcher

Nina Byrom (Researcher)

Dr Lyn Robinson (Supervisor)

REC reference number

Title of study

Examining Analogue Film's Viability as a Preservation Method for Film Archives

Please tick or
initial box

	I confirm that I have had the above study explained to me and have read and understood the participant information sheet dated 30/05/2021, Version 1.1, for the above study, which I may keep for my records. I have had the opportunity to consider the information and ask questions which have been answered satisfactorily.	
	I confirm that I am above the age of 18.	
	I confirm that I understand how my data will be securely used, stored, and disposed of for the above study.	
	I understand that my participation in this project will involve completing an email interview, and answering any follow up questions for the purposes of clarification of the interview answers given.	
	I understand that my participation is voluntary and that I am free to withdraw without giving a reason and without being penalised or disadvantaged.	
	I understand that I will be able to withdraw my data up to 17 September 2021, 2 weeks before the time of publication, and that upon my withdrawal my data will be securely disposed of and not be included in the project.	
	I agree to the use of anonymised direct quotes from my interview data, in the study.	
	I understand that an anonymised version of my interview data may be included in the appendices of the project for research transparency purposes.	
	I agree to City recording and processing this information about me. I understand that this information will be used only for the purpose(s) explained in the participant information sheet and my consent is conditional on City complying with its duties and obligations under the General Data Protection Regulation (GDPR).	
	I agree to take part in the above study.	

Name of Participant

Signature

Date

Name of Researcher

Signature

Date

When completed, 1 copy for participant; 1 copy for researcher file.

8.7 Email Template

Initial Permissions Email Template [27/05/2021]

Dear Sir/Madam,

I am a postgraduate student, currently studying an MSc in Library Science at City, University of London. For my dissertation I am researching the viability of analogue film stock as a preservation method for film archives.

The intended aim of the dissertation is to identify the impact of lowered analogue film stock production upon film archive preservation practices, examine how viable analogue film stock is as a preservation method for film archives in comparison to digital preservation, and the viability of theoretically increasing production of analogue film stock for use in film archival practices.

As part of this research I am looking for contemporary perspectives from film archive curators on the current states of analogue and digital preservation practices in film archives, the impact of lowered analogue film stock production upon film archive preservation practices, and the potential impact of increasing analogue film stock production upon preservation practices.

Any film archive curators that participate would be invited to answer a set of interview questions via email concerning the topics outlined above, with potential follow up questions being asked for the purpose of clarifying the answers they provide. Their answers would be employed to support an evaluation of the viability of increasing analogue film stock production to support archives, and to identify the impact of lowered analogue film stock production upon film archive preservation practices. The research would add to the discussion surrounding analogue film stock and digital preservation and evaluate the potential of increasing the production of analogue film stock to serve archives.

Would you be happy to give permission for your film archive's curators to participate in this research if they wish to do so? All data involved in the dissertation research will be anonymised, to ensure participant confidentiality. I would be grateful if this request could be passed on to whoever would be able to grant the relevant permission in this case, if you yourself are unable to do so.

Thank you for taking the time to consider my request.

All the best,

8.8 Film Stock Producers List and References

Current Film Stock Producers and Suppliers

Company	Date Founded	Location	Currently manufactures film stock?	Number of film stocks suitable for archival use	Experienced film stock manufacturing decrease?
ORWO UK	1909	Germany	X	1	Unclear
	2020a		2020a; 2020b		
Fujifilm	1934	Japan		1	X
			No date a; no date b		No date c
Eastman Kodak	1892	USA	X	6	X
	2021h		2021a; 2021b; 2021c; 2021d; 2021e; 2021f		2021h
Spectra Film and Video	Unclear	USA		0	
			No date a		

Reference List

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ORWO UK (2020b) *ORWO PF2 16mm and 35mm b/w print film*. Available at: [ORWO PF2 16mm and 35mm b/w print film | ORWO UK \[Accessed: 19 July 2021\]](#)

Spectra Film and Video (no date a) Film. Available at: [Film - Spectra Film & Video \(spectrafilmandvideo.com\) \[Accessed 20 July 2021\]](#)

8.9 Film Archives List

European and American FIAF Member Film Archives holding 25,000+ collection items

Name 100k+ 75k+ 50k+ 25k+	Location	Founded	Collection size (based on website)	Mandatory Deposit?	Undertakes digital preservation, or digitisation?	Undertakes analogue preservation, or passive storage?
Library of Congress Visual Conservation Centre (Library of Congress)	USA	2007	6300,000		Both	Both
			No date b		No date a; no date c	No date a; no date c
Gosfilmofond of Russia	Russia	1933	1081,916		Digitisation	Both

			2021a		2021b	2021a; 2021c
UCLA Film & Television Archive	USA	1965	350,000		Both	Storage
			2014c		2014a; 2014b	2014b
Royal Film Archive of Belgium Cinematek	Belgium	1938	265,000		Both	Storage
			2021b		2021a; 2021b	2021a; 2021b
Filmoteca Española	Spain	1953	236,000	X	Both	Both
			No date c	No date b	No date a	No date a
Academy Film Archive (Academy of Motion Picture Arts and Sciences)	USA	1927	230,000		Digitisation	Storage
			2021c		2021d; 2021b	2021a
Filmarchiv Austria	Austria	1955	203,340	X	Digitisation	Both
			No date c; No date e	No date a	No date g; No date b; No date f	No date d; No date b
Screen and Sound Archive (The National Library of Wales)	UK	2001	200,000	?	Both	Storage
			No date d; No date c		No date c; 2017; No date a	No date b
BFI National Archive (BFI)	UK	1935	190,000		Both	Both
			2021b; 2021c; 2021d; 2021e		2021a; 2011; 2019	2021a; 2011
Arhiva Nationala de Filme	Romania	1957	170,000	X	Digitisation	Both
			2012a	2012c	2012b	2012a
CNC	France	1946	110,000	X	Digitisation	Both

			No date d	No date e	No date a; No date c	No date a; No date b; No date c
Národní filmový archiv (NFA)	Czech Republic	1943	110,000	X	Digitisation	Both
			2021b	2021e	2021b; 2021d; 2021c	2021a
Cinémathèque Suisse	Switzerland	1943	85,000	X	Both	Storage
			2014d	2014e	2014b; 2014c; 2014a; No date a	2014c
Slovak Film Institute	Slovakia	1963	80,000	X	Digitisation	Both
			No date b	No date c	No date a	No date a
Swedish Film Institute	Sweden	1933	74,000	X	Both	Both
			2015b	2017	2020; 2015c; 2015d; 2019	2015a; 2020; 2015c; 2015e
Indiana University Libraries Moving Image Archive (Indiana University)	USA	2009	70,000		Both	Storage
			2021e; 2021f; 2021g; 2021h		2021a; 2021b; 2021c; 2021d	2018
YFA/NEFA	UK	1998	70,000		Digitisation	Storage
			2021c		2021a	2021b
Cinematheque of the Republic of North Macedonia	North Macedonia	1974	64,000		Digitisation	Storage
			2018		2018	2018
Cineteca Nazionale	Italy	1935	60,000	X	Digitisation	Both
			No date a	No date e	No date b; No date c; No date d	No date a; No date b; No date c; No date d

EYE Filmmuseum	Netherlands	1946	55,000	X	Both	Both? Storage?
			No date e	No date f	No date a; No date b; No date c; No date d; No date e; 2018	No date e; 2018
Bulgarian National Film Archive	Bulgaria	Unclear	55,000		Digitisation	Storage
			2005		2005	2005
Cinémathèque de Toulouse	France	1964	53,000		Digitisation	Storage
			2015		2015	2015
North West Film Archive (Manchester Metropolitan University; NWfilmarchive)	UK	1977	50,000		Digitisation	Storage
			2021a		2021b; 2010	2021b
Moving Image Archive (National Library of Scotland)	UK	1976	46,000	?	Digitisation	Storage
			2021d		2021d; 2021b; 2021a	2021c
Harvard Film Archive	USA	1979	40,000		Both	Both
			2021b		2021a	2021a
Cinémathèque Française	France	1936	40,000		Both	Both
			2013b		2013a	2013a
Cineteca di Bologna	Italy	1962	40,000		Digitisation	Both
			No date c		No date a; No date b	No date a; No date b
Det Danske Filminstitut	Denmark	1972	40,000	X	Both	Both
			No date d	No date e	No date a; 2018	No date c; No date d; No date f

Chicago Film Archives	USA	2003	30,000		Digitisation	Both
			No date a		No date a; No date b	No date a; No date b; 2021
Irish Film Institute	Republic of Ireland	1943	30,000		Digitisation	Storage
			No date c		No date b; 2013	No date a
Deutsche Kinemathek	Germany	1963	26,500		Both	Storage
			2021a		2021b	2021a
Filmoteca Valencia	Spain	1985	26,000		Digitisation	Storage
			No date b		No date a	No date a
Lichtspiel Cinematheque	Switzerland	2000	25,000		Digitisation	Storage
			No date c		No date a	No date c; No date a

8.10 Film Archives List Reference List

Reference List

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