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THE DIGITAL TURN IN THE PRESERVATION OF AUDIOVISUAL HERITAGE

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ABSTRACT

This article examines the transformation of film archives in response to the digital turn, tracing their historical role in analogue preservation through to the contemporary challenges of digital preservation. Drawing on a theoretical and documentary review, it analyses how film ontology and industrial standards shape archival practices. The article argues that the digital shift does not supplant the analogue paradigm but rather complements it within an ongoing evolutionary process. It proposes the integration of concepts such as convergence, remediation, and simulation to reframe the role of archives in the digital era and to strengthen their connection with film theory and the wider discourse on cultural heritage.

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1. Introduction

The role played by film archives in safeguarding audiovisual heritage has been fundamental to historical and cultural preservation, ensuring the conservation and dissemination of cinematic works for future generations. Nevertheless, this task has faced multiple challenges of various kinds.

The establishment of the first film archive, the Svenska Filmsamfundet, in 1933 marked an important milestone, yet it came 38 years after the official birth of cinema in 1895. This temporal delay had a significant impact, resulting in the loss of nearly 80% of the world's film history, a loss particularly acute in the period between 1900 and 1913. This situation led to the disappearance—uneven across different countries—of valuable cinematic collections, especially before the introduction of sound cinema in 1927. It represented an irrecoverable loss of the earliest filmographies of major figures in global cinematography during a time of considerable technological and narrative evolution (Prelinger, 2009).

The late recognition of cinema as an art form worthy of preservation was preceded by the emergence of film criticism (Gunning, 1990), which facilitated its self-awareness within a context initially marked by a perception of cinema as low culture and mere technological entertainment. Although from its beginnings there were visionaries such as Matuszewski (Mazaraki, 2004) who warned of the need to preserve audiovisual heritage, it was not until the 1930s that this legacy could be effectively protected through the founding of the first film archives.

The emergence of a new generation of pioneers—such as Iris Barry, Henri Langlois, and Lindgren—culminated in the creation of the International Federation of Film Archives (FIAF). This organisation represented a crucial step towards the institutionalisation and universalisation of cinematic heritage preservation, facilitating the development of documentation and methodologies that have remained essential tools for technical and historical knowledge to this day. The present work is framed within the objective of examining the current transition towards the digital from a historical perspective on these theories.

In addition to the chronological challenge in recognising its patrimonial and institutional value, film archives have had to confront the fragility and deterioration of cinematic materials. Likewise, the high volatility of early nitrate supports, later replaced by safety films made of cellulose triacetate, has been a constant source of concern. Contexts of armed conflict, censorship, and accidents such as fires have exacerbated these threats, further complicating conservation efforts.

The primary contemporary challenge for film archives lies in the inherent technological obsolescence of audiovisual media (Casetti and Odin, 2012), a historical phenomenon that demands continuous and adaptive effort in the face of each new industrial revolution and technological change. The transition from analogue supports to a digital paradigm poses the challenge of preserving cinema in the face of the loss of its materiality, now replaced by numerical data. This change is not only technical but also conceptual. It affects the very ontology of cinema by integrating it into a broader spectrum of digital media, challenging the historical pre-eminence of cinema in twentieth-century culture, where it is now merely one component among others. In this era, two separate historical trajectories—cinema and the computer—converge, as Manovich asserts:

The claim of modern media to create simulations of sensible reality is likewise cancelled; media are reduced to their original condition as information carriers, nothing more and nothing less. In a technological remake of the Oedipus complex, the son kills the father. The iconic code of cinema is discarded in favour of the more efficient binary. Cinema becomes a slave of the computer. (2005, p. 70)

The ontology of cinema, which had been based on the purity of photography (Esqueda-Verano, 2018)—identifying it as an object of its material substance and a mould of a reality connected with the spectator—shifts to a digital state, invisible to touch, calling into question this theory so deeply assimilated by film archives as a reference and raison d'être for their activity. This situation of film archives in relation to the audiovisual industry is highlighted by Alfonso del Amo, former conservator of the Spanish Film Archive, at the IV Meeting of Film Archives held at the Spanish Film Archive on 2 March 2020:

As organisations dedicated to cultural preservation, cultural archives have neither the authority to decide on the physicochemical and functional characteristics of their materials, nor on the production procedures followed in the creation of the works they must preserve; moreover, they lack the means to impose conservation criteria on the creators of those works or on the manufacturers of their materials and systems. (Del Amo, 2020)

The emergence of new media generates a convergence of digital archival practices and structures and proposes new forms of access. This situation confronts film archives with the criteria that should be followed, and cases have already arisen in which some archives have renounced the preservation of digital images. This new role for film archives is linked to the technological modernisation of their equipment, the uncertainty of conservation, copyright issues, and access to their collections in a complex context full of terminological ambiguities that confuse digitisation with preservation.

It can be observed that the evolution of cinema and film archives has been determined by the constant dynamic of technological change, understood as an intrinsic process of adaptation and transformation. The history of cinema reveals a continuous coexistence of techniques and formats that reinforces the need to preserve both content and its original support. Cinema thus reaffirms itself as an essential cultural and historical instrument, beyond its industrial dimension.

2. Research Objectives

- Main Objective (MO): To analyse how the transition to digital has transformed the ontology, practices, and challenges in the preservation of audiovisual heritage, evaluating the role of film archives in the face of this technological change.
- Specific Objective (SO1): To examine the historical evolution of analogue preservation standards and their adaptation to the digital environment.
- Specific Objective (SO2): To evaluate the impact of the digital paradigm on archival practice and film theory.
- Specific Objective (SO3): To identify the challenges and opportunities posed by digitisation in the policies of conservation and access to audiovisual heritage.

3. Methodological Aspects

From a methodological perspective, this study is situated within the philosophy of rapprochement between audiovisual archives and the academic community, a process whose historical antecedent was the FIAF Congress in Brighton in 1978 (Fossati, 2021, p. 21). What was then an approach by archives towards historiographical research has today transformed into a growing necessity for collaboration on the part of film archives.

This research, of an essayistic nature, is grounded in a critical bibliographical review encompassing a total of 39 documentary sources, including books, scientific articles, doctoral theses, and institutional documents. The selection of the corpus was carried out according to clearly defined criteria. Firstly, attention was given to the thematic relevance of the works, focused on audiovisual preservation, film theory, and processes of cultural digitisation. Secondly, the recency of the publications was considered, with particular emphasis on works produced in the last two decades—a period in which the convergence between the analogue and the digital has generated renewed academic interest. A third criterion, closely linked to impact, took into account each source's capacity to offer solid and applicable theoretical frameworks for analysing the technological evolution of the cinematic medium.

This study addresses the coexistence and historical development of analogue and digital standards, understood as products of a productive context that has shaped their configuration. Hence, the interest lies in compiling the various theories on the ontology of cinema in order to understand the classic confrontation between apocalyptic and integrated approaches (Eco, 1985), which cyclically emerges as a response to every technological change.

The first specific objective is articulated through a documentary review focused on identifying the contributions of prominent figures whose reflections have delineated the main theoretical discourses surrounding the ontology of cinema. Their intellectual authority and impact within the archival field allow these theories to be positioned as fundamental references for understanding the interpretive challenges posed by the digital paradigm.

The methodological approach has been conditioned by the evolution of scientific literature linked to the field of film archives across different historical stages. From studies centred on the analogue universe (Borde, 1991), through the most influential ethical and philosophical approaches (Cherchi Usai, 2005; Edmondson, 2008), to contributions that have examined the transition towards the digital environment (Fossati, 2021), the body of sources reflects a broad and representative panorama. Within this framework, Paolo Cherchi Usai and Giovanna Fossati have been taken as reference figures, whose works paradigmatically embody the two hegemonic theoretical positions that articulate the analogue-

digital dichotomy. Their presence in the literature lends scientific rigour to the analysis, both through the conceptual depth of their proposals and through the influence they exert on contemporary archival practice.

Furthermore, a historiographically meaningful periodisation has been established that distinguishes the analogue and digital stages, with the aim of contextualising the evolution of the cinematic standard from an industrial perspective. This temporal structuring facilitates understanding of the technological changes and their effects on preservation and restoration processes.

Based on the documentary review, the main research lines that have addressed the evolution of cinema—from its classic authors to the most recent works linked to the digital transition—are presented. Alongside these, contributions from the archival field are incorporated, enabling the establishment of useful conceptual distinctions for assessing current practices in film archives.

4. The industrial Standard

4.1. The 35mm Standard as Industry Standardisation and Analogue Reference for Archives

Although cinema is considered an art form, its production depends on industrial, technological, and economic factors. Industry standards normalise processes to ensure access and fair competition among participants in the production, distribution, and exhibition chain, offering clear economic advantages.

Within film historiography, various vicissitudes and particularities are analysed that shed light on critical aspects of its evolution. One such aspect is the question of cinematic authorship, in which the public presentation of films by the Lumière brothers is considered decisive in their recognition as the inventors of cinema, in contrast to Edison's Kinetoscope. Although the latter was an earlier invention, its limitation to individual stroboscopic viewing restricted its reach. Another crucial element was the transition of cinema from itinerant spectacles to the establishment of Nickelodeons. These were stable infrastructures that encouraged the formation of distribution networks to meet the demand for variety in cinema programming.

The expansion of the cinematic distribution chain, driven by increased demand, exposed the vulnerability of early film supports and prompted the need to produce new prints. This requirement in turn catalysed research and development into new film emulsions. The advent of the film industry was marked by fierce patent disputes, which led to the formation of exclusive captive exhibition circuits based on patents awarded to figures such as Lumière, Edison, and Joly, all of which proved incompatible with one another. This dynamic culminated in monopolistic strategies across production, distribution, and exhibition in the United States, a notable example being the creation of the Motion Picture Patents Company, also known as the Edison Trust (Slide, 2014). This entity constituted a trust that included the major American film companies, as well as foreign affiliates such as Pathé and Vitagraph, the principal film distributor George Kleine, and the largest supplier of raw film stock, Eastman Kodak. The underlying strategy aimed to limit foreign influence in the American film market and promote national production, although it covertly sought to eliminate direct competitors such as Biograph. The latter responded strategically by acquiring the Latham loop patent, which ultimately led to an agreement with Edison for its integration into the MPPC. This conglomerate operated in contravention of the principles set out in the Sherman Antitrust Act, enjoying a seven-year period of impunity during which it benefited from the complicity of certain federal officials and, in some cases, connections with organised crime networks (Academia-Lab, 2024).

Edison's protectionist stance, manifested through patent infringement litigation, underscores the complexity of interactions between innovation, regulation, and competition in the early days of the film industry. A direct consequence of this protectionism was opposition from a significant portion of self-proclaimed independent producers, many of whom came from Europe and settled in Los Angeles to establish Hollywood, taking advantage of its protectionist benefits combined with particularly favourable geographical and climatic conditions for film activity. The resulting litigation ended in 1915, tilting the balance against the interests of the MPPC, as the Federal Court had no choice but to acknowledge an abuse of position with respect to patents. At the same time, guild independence movements emerged in relation to production and economics, this time to devise entities of a purely technical nature, such as the Motion Picture Engineers founded by the former MPPC engineer Charles Francis Jenkins, which later led to the creation of the Society of Motion Picture Engineers (SMPE). These developments delivered the decisive blow to the Edison Trust, but they also had a major impact on the film industry by approving the 35 mm format as the universal standard.

Although initially fixed, the establishment of the 35 mm format remained open to successive modifications to adapt to variables such as theatre seating layout, screen aspect ratio, and future innovations in colour and sound. This standard—the only one genuinely regulated by international agreements—stood out for its wide acceptance among creators, manufacturers of materials, and cinema equipment, facilitating its widespread adoption and contributing to an increase in available inventories for the new format. The adoption of the 35 mm standard brought significant economic advantages to every link in the cinematic value chain, particularly in the field of exhibition, and promoted the flourishing of an international market in which cinema remained hegemonic to this day.

It also enabled established producers to erect competitive barriers against smaller companies, thereby effectively stabilising markets. However, this process of standardisation has also had a profound impact on the field of film archives, where 35 mm continues to serve as its primary reference despite the changes brought about by the digital paradigm. This has influenced preservation policies and allowed for deeper exploration of its characteristics, without diminishing the responsibility to manage other obsolete formats that are essential to understanding cultural heritage.

4.2. The DCI and Standardisation, Film Archives Amid the Digital Paradigm

Subsequent technological revolutions in the world of the image brought with them the emergence of television and video, inaugurating periods of audience competition that culminated in technical innovations concerning elements such as aspect ratio, sound, brightness, or colour. However, despite the introduction of formats such as the Todd-AO system, which eventually became the standard for 70 mm film, the pre-eminence of the quintessential cinematic standard continued to be 35 mm, both for the industry and for film archives. In the case of the latter, 35 mm is not only a historical reference but also the only truly global standard with over 100 years of proven non-obsolescence and demonstrated durability, evidencing a certainty of security that produces a hybridisation between innovation and tradition rather than a complete replacement of one technology by another.

The fatalism surrounding the announcement of "the death of cinema" has been a historical constant in response to every technological innovation. It was already the case with the advent of video, whose failure demonstrated that durability and preservation remain essential factors for the survival of the cinematic medium. A death first announced in a series of articles written by Maurice Bessy for the magazine Cinémonde (Borde, 1993, p. 51) and later exemplified in classics such as the work of Cherchi Usai (2005). It seems to refer not only to a persistent concern but also to a subtle discursive device that seeks to comprehend complex processes surrounding its continuous transformations and operations of animation, even transcending, through reflection on its end, film theory itself. This suggests a more nuanced interpretation of its evolution and its capacity to adapt and reinvent itself in the face of technological challenges (Miguel and Cruz, 2014).

This technological crisis poses challenges that surpass the accumulated body of knowledge held by film archives to date. The incursion of digital technology into the film industry dates back to the late 1970s, initially through the development of special effects under Francis Ford Coppola (Elsaesser, 2019). However, it was not until the arrival of the new millennium that producers such as George Lucas with his new trilogy and James Cameron through the 3D of Avatar decisively promoted the complete transition to digital, encompassing stages including production, post-production, and exhibition (Christie, 2016).

Digitisation introduces new media—a term coined by Manovich (2005, p. 73)—whose essence is transformed by being grounded in a binary numerical representation of zeros and ones. This change entails a series of defining characteristics: automation, whereby algorithms operate autonomously; a shift in the codec with the introduction of formats offering new capabilities; modularity, which allows processing in independent and reversible packages; and variability, which sustains the premise that everything is subject to change and never considered final. These characteristics produce a metastasis in image creation, where production grows exponentially, affecting its location and authorship. Particularly relevant for work in film archives is the concept of transcoding, which implies a change of support; in this era, all cultural knowledge, including analogue material, will be transformed and preserved in digital formats. Although this practice is central to new cultural policies as a primary implementation strategy, it carries the risk of being confused with preservation proper. While digitisation offers significant advantages for consultation and dissemination of material, it lacks guarantees of long-term stability and durability. An inherent risk in this process is that the loss of any fragment of information can result in the total loss of the material, unlike the analogue medium, where

the loss of one part does not necessarily compromise the integrity of the rest. The digital paradigm implies epistemological changes, whereby restoration ceases to be a technical practice and becomes a form of cultural mediation (Verhoeven, 2023), yet its preservation also requires understanding the materiality of data and its dependence on sociotechnical infrastructures (Blanchette, 2021).

The comfort zone represented for film archives by their knowledge of the 35 mm standard placed them in a position of conservation guarantees not exempt from resolving other problems related to their lack of visibility in society and their limited weight in cultural policies. This historical dominance of film archives over practical knowledge has fostered methodological stability that now faces disruption from the digital paradigm. Cultural policy must not overlook warnings regarding the need to include the ethical dimension of access and the right to collective visual memory (Sánchez-Biosca and Detell, 2022).

Therefore, it was not the film archives that signalled the paradigm shift, but rather the industry itself, through a seminal publication (Academy of Motion Picture Arts and Sciences, 2007), which predicted that the digital paradigm would become an unstoppable reality, differentiating the various phases in which this change would unfold progressively. The impact of this publication on archives was crucial in understanding that, if the industry had decided, film archives would have no choice but to readapt to the new change and would almost certainly need to use the new media for both preservation and relating them to analogue ones (Monasterio, 2023).

In the industrial sphere, it must be recognised that the report in question was not motivated by altruistic considerations. While the film industry shares with cultural archives an interest in preserving its films, its approach to these products is fundamentally oriented towards their viability and economic value as assets. In contrast, in the context of film archives, films are valued as works of art and historical documents. This distinction highlights the divergence of priorities between commercial preservation and cultural conservation of cinema, while also pointing to the subordination of film archives to knowledge that is the property of the industry that generates it.

Moreover, it is evident that cinema undergoes significant transformations in its convergence with digital television, a process that facilitates the expansion of available viewing modalities (Echegaray and Peñafiel, 2011). This development has enabled audiences to access personalised on-demand services with 2K and 4K quality, revaluing cinematic fiction as a product within a global framework. What were originally rental-based video distribution channels have evolved into platforms operated by content giants offering continuous streaming, as in the case of Netflix (Casado, 2019). From a technical perspective, the boundaries between film and video post-production have disappeared; this paradigm shift not only reflects an adaptation to contemporary consumption demands but also underscores the growing influence of digital technologies in reconfiguring the global media landscape (Fossati, 2021).

This policy of faits accomplis forced film archives to confront a reality from which they could not escape. Although tentative steps towards digital implementation had already been taken, it was within the framework of FIAF that the theoretical debates affecting the ontology of cinema were developed for its recognition within the new digital reality and its integration into the conservation policies of archives. Three distinct approaches were recorded: two opposing extremes representing the staunch resistance of José Manuel Costa from the Cinemateca Portuguesa and the full acceptance of Mark Paul Meyer from the Eye Film Institute in Amsterdam, along with an intermediate position from Nicola Mazzanti of the Cinémathèque Royale de Belgique (García Casado, 2016).

The formalisation of a digital standard analogous to what the standardisation of 35 mm represented in its time was brought about by the establishment in 2002 of a technical body known as Digital Cinema Initiatives (DCI), formed by the major Hollywood studios with the objective of creating voluntary specifications for an open digital cinema architecture. The aim was to guarantee a uniform and high level of technical performance, reliability, and quality control. DCI published the Digital Cinema System Specification (DCSS) in 2005. The recommendations of the FIAF Technical Commission on the deposit and acquisition of D-Cinema elements for long-term preservation and access (FIAF, 2010) were a document that did not seek to establish long-term preservation standards but rather to define acceptable formats for digital materials to be deposited in archives, given the doubts raised by the new cinematic works. Efforts oriented towards digital preservation focus on achieving a balance between technical excellence and pragmatic realities, thereby acknowledging the challenges and inherent uncertainty of this process. The fundamental elements of the Digital Cinema System (DCSS) include the Digital Source Master (DSM), the Digital Cinema Distribution Master (DCDM), and the Digital Cinema Package (DCP). All of these elements are compared below in Table 1, describing their DCSS elements, nomenclature, technical characteristics, and analogue equivalences.

Table 1. Elements of the Digital Cinema System Specification (DCSS)

DCSS element	Name	Technical characteristics	Analogue equivalents
Digital Source Master (DSM)	Digital Source Master	Varies from simple combinations of image and sound to complex sets of separate files; not defined by standards.	Varies, can range from Digital Betacam to HD tapes.
Digital Cinema Distribution Master (DCDM)	Digital Cinema Distribution Master	Set of original files to produce all projection copies; format according to defined standards, but flexible.	Comparable to a photochemical negative.
Digital Cinema Package (DCP)	Digital Cinema Package	Contains metadata, images, soundtracks, subtitles, etc. Format for projection, rigorously standardised and often encrypted.	Comparable to the 35 mm analogue standard, applied to the digital standard.

Source: (FIAF, 2010)

The DSM is not defined by any standard and can consist of virtually anything; it may vary from a single combined source of image and sound to a complex set of separate files. It does not represent the work in its final format and does not necessarily reflect how it will be exhibited in cinemas; in a way, it could be said to represent the raw materials of a production. The DCDM, analogous to a film negative, is the set of master files used to produce all projection copies for D-Cinema, adhering to defined standards but allowing some flexibility, meaning variations may exist from one to another. Despite potentially being voluminous, DCDMs usually exist only as virtual entities due to the practical difficulties of handling large files. The DCP, known as the Digital Print, is the digital copy that contains everything necessary for cinema projection and represents the work exactly as it is presented to the audience; it is strictly standardised and often encrypted to control access during its distribution in commercial cinemas.

The encryption specification for the DCP, using the Advanced Encryption Standard (AES), ensures that access to the work is fully controlled through a Key Delivery Message (KDM) that permits opening of the DCP only under specific conditions. The distributor can also create a special KDM that allows unrestricted access to certified servers, known as Trusted Devices, which are considered secure, enabling them to extract the corresponding AES source key for the DCP and decrypt it at any time. However, incompatibilities once again arise between the commercial interests of production companies and the conservators of archives, as this strategy presents risks for long-term preservation, such as the loss of the key or changes in server hardware, which could render the encrypted DCP unusable. On the other hand, unencrypted DCPs, despite using a compressed format, faithfully represent the work as it is shown to the audience and offer a more accessible solution for archives, albeit with limitations imposed by current technology that could affect its conservation value for future versions or editions of the work.

The FIAF Technical Commission recommends only unencrypted DCDM or DCP as viable formats for long-term cinematic preservation, noting that the DCDM is larger in size. The DSM may be used as a complement, but not as a substitute.

5. The New Preservation Framework in the Digital Turn

In the evolution of cinema, from its initial analogue manifestations to its current digital convergence, a profound transformation has been evident not only in the industrial production chain but also in the modes of conservation and presentation of cinematic materials by archives.

This technological metamorphosis, far from being merely technical, has been accompanied—and in many respects legitimised and guided—by the development of theoretical frameworks that have always sought to understand and define cinema (Bazin, 1965); something essential for contextualising preservation within archives. Film theories, in this context, through their historical authors, have not only provided analytical tools but have also enriched the understanding of the medium, attributing meaning and cultural and social relevance to it.

This began with the birth of film criticism and its recognition of cinema as an art form (Canudo, 1911). This concept of artistic visual representation expanded with the revolutionary emphasis placed by the early montage theories on its constitution as a language; and, indirectly, on its impact on the public (Eisenstein, 1999).

The exploration of the essence and potentialities of cinema did not stop there. Debates surrounding time in the dialectic between still and moving images produced the first incursions into its ontology, establishing divergent yet equally fundamental perspectives on the cinematic art (Arnheim, 1954; Bazin, 1965). While Arnheim defends the specificity of cinema as a medium based on visual perception and the illusion of movement generated by cinematic exhibition, Bazin advocated cinema's capacity to capture reality, drawing on photography—surely influenced by Matuszewski's realism—which suggests a documentary realism in which cinema acts as a truthful record of historical events.

In some way, the same bifurcation present from the origins of the medium was reproduced, exemplified in the primal narrative of cinema: on one side, the documentary realism of the Lumière brothers; on the other, the fiction and fantasy developed by Alice Guy and Georges Méliès. At the ontological level, this dichotomy gave rise to two currents of thought: one of a mental-cerebral character, which grants the spectator the possibility of reopening a lived past in the present through narrative mediation; and another of realist orientation, which conceives the image as a temporal arrest of a past reality sustained by compositional materiality.

The historical pre-eminence of the latter current, associated with the physical support and thus with the materiality of the cinematic image, has exercised a determining influence as an ontological framework in film archives. With the transition to the digital environment, this material reference disappears, but far from diminishing the relevance of these theoretical approaches, it has generated new challenges and opportunities for reflection. This has not only allowed the continuity of both interpretive currents but also the incorporation of perspectives from other fields of humanistic knowledge.

Academic research has delved into the semiological complexity arising from the intersection between technology and filmic text, establishing a structural linguistics rooted in the tradition of signs (De Saussure, 1945). However, the digital era poses a challenge to notions of realism, which regains ground through the introduction of the concept of indexicality, articulating a direct connection between signs and reality by discussing the physical link of images to the objects they represent (Peirce, 1931), but also with potential to generate meaning and emotions (Mitry, 2001). Drawing on these premises, various authors have explored the development of myths and the way visual signs communicate cultural meanings, focusing on the relationship between the referent and the real object (Barthes, 1986). Likewise, the reality of generated perceptions has been analysed, considering these as the result of specific codes (Benjamin, 1935; Metz, 1982).

Cinematic thought has expanded through contributions that address its ontology from the perspective of films' intrinsic capacity to function as philosophy. This view holds that the memories evoked by films intertwine with the spectator's personal memories, inviting philosophical reflection not about cinematic works but with them (Cavell, 1971). From the field of criticism, cinema has been recognised for its capacity to influence cultural and social perception (Sontag, 2005).

The essence of cinema has also been addressed from perspectives that highlight its nature as a medium for expressing psychological experiences (Münsterberg and Griffith, 2004), as well as from sociology, where it is considered revelatory of everyday reality and of the social unconscious (Kracauer, 1997). These diverse lines of thought, although differentiated, converge in the task of defining cinema in terms of time and image; the connection these have with social movements ultimately defines the theoretical framework (Deleuze, 1984).

The review of these various perspectives underscores the difficulty of consolidating a univocal definition of cinema. Moreover, technological changes invite a re-evaluation of what cinema is and how it relates to reality and the spectator, emphasising the complexity of film preservation when confronting the concept of the original, highlighting how its meaning varies according to the adopted theoretical framework.

This debate on the authenticity and authority of the object begins in reflections on the loss of the aura of art in its technical reproducibility (Benjamin, 1935). The discourse on authenticity and photographic realism, indexicality, and referentiality receives a new impetus with digital technology, raising questions about continuity or rupture between photochemical and digital images. In this way, some authors discuss human mediation in the reproduction of images, blurring the differences between analogue and digital technology, as neither can guarantee the existence of a definitive reality (Punt, 2004). Others argue for the multiplicity of the film until authenticity of the result becomes irrelevant whether it is a duplication in analogue or digital, opening the way to the possibility of creating an original from a copy regardless of its direction or redirection, as Groys suggests:

> Every change of context can be interpreted as a negation of a copy's status as a copy, as an essential rupture, as a new beginning that opens a new future. In that sense a copy is never a copy, but rather a new original in a new context. Every copy is in itself a flâneur, experiences time and once again its own profane illuminations, which turn it into an original. (Groys, 2009)

Yet even if they are of different natures, the indexicality of the digital as a referent of reality could be accepted if we refer to the fact that its mandate to reproduce reality is the same as that of photographic representation, albeit in a different manner (Soderman, 2007). Following this current of human mediation, it is pointed out that each copy of a film acquires authenticity upon entering the film archive, granting that mediation an institutional authority, rather than through the indexical link (Elsaesser, 2019).

Perhaps the tension between the various currents in accepting the originality of the work finds a better-accepted consensus in the recognition of cinema as an art form, in terms of the author's contribution—more centred on the conceptual theme and style (Benjamin, 1935; Canudo, 1911) than on the artefact as medium and support. It is precisely here that dilemmas arise regarding the concept of medium specificity, since while some authors attack it as an essentialist doctrine, questioning its validity for defining cinema as art (Carroll, 1996), others defend a non-essentialist approach that embraces the hybrid character of cinema in the multiplicity of its styles and media, reflecting its transitional nature (Rodowick, 2009).

Despite this, medium specificity remains a pillar for film archives, especially in the context of analogue preservation. From their beginnings, this approach to cinema as art has been crucial in their creation and is precisely what distinguishes them from other institutions such as art centres or museums. Yet the debate in some film archives about remaining faithful to medium specificity underscores a conscious decision not to adapt to the digital transition, thereby marking a clear distinction between analogue and digital:

> The effort to preserve a moving image in the state in which it was found (...) has, at least, some chance of being useful in promoting the concept of perishability, its potential and its limitations. It is a vain effort, but also fertile in implications. The preservation of the moving image is a necessary mistake. (Cherchi Usai, 2005, p. 67)

Others, however, may focus on prioritising fidelity to the author's stylistic or conceptual intentions, opening the door to acceptance of digitisation as a valid means of artistic preservation. Fossati invites us to reconsider and broaden our understanding of cinematic art by connecting it to the contemporary era:

> From this point of view, the profession of the film archivist can be compared to that of a doctor who facilitates the patient's process towards an inevitable death (...) However, the nature of cinema as proposed by Cherchi Usai is debatable. From my point of view, while artefacts deteriorate, films do not necessarily have to disappear with them. (Fossati, 2021, p. 192)

Another concept that adds to those of originality and cinema as art when addressed by archives is that of film as dispositif. This invites us to observe cinema from a broader perspective, transcending the idea that it is merely an abstract object. This perspective, introduced by Jean-Louis Baudry, centres on the importance of exhibition and how it interacts with the spectator, in a manner similar to Plato's allegory of the cave:

> It is always a matter of the scene of the cave: effect of reality or impression of reality. Copy, simulacrum, and even simulacrum of a simulacrum. Impression of reality or real, more-than-real? From Plato to Freud, the perspective is inverted, the approach is reversed — so it seems. One leaves the cave, contemplates the intelligibles, beholds their source, and when one returns, it is to denounce to the others, the prisoners, the dispositif of which they are victims; and to urge them to leave the dark room[1] . (Baudry, 1975, p.56, Autor´s translation)

[1] Original Version: II s'agit toujours de la scène de la caverne: effet de réel ou impression de réalité. Copie, simulacre, et même simulacre de simulacre. Impression de réalité ou réel, plus-que-réel? De Platon à Freud, la perspective se renverse, la démarche s'inverse — on dirait. L'un sort de la caverne, considère les intelligibles,

Subsequent arguments would expand this approach by arguing that the identity of a medium is not fixed, but depends on how it is presented and experienced across different devices over time, underscoring a dynamic nature especially in the digital era, where the multiplicity of screens and viewing formats challenges traditional notions of authenticity and originality (Kessler, 2016). The extreme of this multiplicity is represented in digital mobility through video game consoles, an extension of the audiovisual universe where cinema is no longer the sole and primary system, yet devices that are better understood as theoretical consoles—objects that pose theoretical questions about their hybrid status (Verhoeff, 2009).

From the perspective of film as dispositif, film archives are urged to adapt their preservation and exhibition practices, considering each film as an entity that interacts with the user in unique ways depending on the viewing context. This highlights the intersection between technology, filmic text, and spectator experience, opening new avenues for understanding the evolution of cinema as an art form in continuous dialogue with its medium.

Precisely, this dialogue affects the perception that archives and the industry itself have of film as technological innovation, due to its close relationship with filmmaking practice, restoration, and conservation rather than with pure theoretical analysis. In this space, cinema is recognisable as a field in constant evolution, where technological developments play a decisive role in what is possible in terms of production and cinematic restoration (Fossati, 2021).

Film archives consider the technological and performative character of cinema essential, understanding each projection as a unique event with external and creative variables. This approach emphasises both the physical preservation of the film and the recovery of the original cinematic experience, favouring a holistic approach to conservation.

The Crazy Cinématographe project, developed by the Cinémathèque de la Ville de Luxembourg in collaboration with the University of Trier, is an example of this performative consideration of early cinema, but it can also be applied to contemporary avant-garde production through the introduction of new elements in projection, such as the expansion of projectors, the application of filters, or hybridisations that turn works into multiple uses for different spaces, both cinematic and exhibition-based. Therefore, restoration in this theoretical framework urges us not to limit it to the mere manipulation of images, but to document the performative universe surrounding the work.

All this trajectory of theoretical considerations—particularly important in this era of the digital age—concerning whether there is a change in ontology with respect to the analogue or simply an evolution in the form of presentation of cinema is evaluated by Fossati. She proposes a perspective that considers cinema to be part of things that change over time and are inherently transitional, meaning that the transition from analogue to digital does not ontologically affect its artefact. She therefore suggests a fusion with new concepts:

> Based on this model that holds that the nature of cinema is not affected by technological change, I propose to revisit a series of key concepts introduced by new media theorists and adapt them to archival practice. These concepts are convergence, remediation, and simulation. (Fossati, 2021, p. 210)

Paradoxically, the concept of convergence should not imply absolute stability or unity, even though it operates constantly towards unification (Pool, 1983). The problem lies rather in anticipating which of these tendencies—where all media will converge—will ultimately prevail (Thorburn and Jenkins, 2004). The widespread belief that all images are already digital or will be is a matter of inevitability that has not yet materialised; it is a strategy of prediction (Rosen, 2001). In response to this determinism, Fossati suggests that this concept situates us in a process rather than a final point, to which she adds the concept of divergence: convergence of technology towards standards and divergence in the diversification of media.

Remediation presents itself as a crucial practice in updating the technologies of cinematic restoration. Oriented towards emulating or even surpassing preceding technologies with the aim of approaching the real (Bolter and Grusin, 1996), it is a relationship between old and new media in which they mutually improve in a collective process.

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contemple leur source, et quand il y revient, c'est pour dénoncer aux autres, les prisonniers, le dispositif dont ils sont les victimes; et les engager à en sortir, de la salle obscure.

Bolter and Grusin's theory postulates that remediation operates under the logics of immediacy and hypermediacy, two apparently opposed principles that guide the way media seek to present their content. Immediacy seeks to make the medium invisible in order to offer a direct experience of what is represented, while hypermediacy highlights the presence of the medium as part of the spectator's experience. In the field of cinematic restoration, the restorer acts as a mediator who navigates between these two logics, seeking a balance that respects both fidelity to the original material and clarity in the restoration process. The arrival of digital technology has intensified the role of remediation by enabling more radical interventions, while appealing to ethical discernment in its application. Case studies of this theory can be found in laboratories such as Haghefilm in Amsterdam and the Digital Film Lab in Copenhagen, which—aside from inherent economic viability issues in the sector—combine old and new technologies to achieve optimal results.

Finally, the concept of simulation is based on the idea of the capacity that digital technology possesses to simulate analogue reproduction media (Manovich, 2005; Rodowick, 2009). This ability to recreate images and modes of reproduction with precision constitutes a bridge between cinematic production and restoration, enabling a faithful recreation of images and elements that had previously deteriorated. A process that is not exclusive to the digital world and that had already existed to some extent in the analogue world. Simulation is an opportunity to reconnect with the experience of the original cinema, crossing boundaries between analogue and digital.

Boundaries between analogue and digital, between the scientific community and the world of film archives, require theoretical and practical tools to jointly address the present and future challenges of audiovisual conservation.

6. Conclusions and Discussion

The digital transition should be understood as a process of evolutionary continuity, rather than substitution, which configures a new epistemological framework for audiovisual preservation through strategies such as remediation and simulation. This research proposes an integrative reading between theory, technique, and archival practice, underscoring the need for sustainable policies that articulate cultural memory and technological innovation. The history of cinema demonstrates the constant coexistence of techniques and formats, which reinforces the importance of preserving not only the contents but also, wherever possible, their original supports as an essential part of their interpretation. The study demonstrates that the digital does not constitute an ontological rupture, but rather a coherent evolution consistent with the historical nature of cinema and highlights the central role of film archives as mediators in the preservation and projection of cinematic heritage in the digital environment.

In relation to the first specific objective (SO1), the historical analysis of preservation standards has made it possible to demonstrate that the evolution of cinema and film archives has been determined by the continuous technological changes of the industry. Far from constituting closed stages, the analogue and digital phases are today understood as instances of a single evolutionary process, where the coexistence of techniques, formats, and paradigms configures the mutable identity of the cinematic medium.

Regarding the second specific objective (SO2), the convergence between film theory, archival practice, and film restoration reveals a productive tension between the more conservative positions and those that integrate change. The positions represented by Cherchi Usai, who defends the preservation of the original experience, and Fossati, who values simulation as a legitimate form of reconstruction, illustrate a central debate: the need to maintain a balance between technical fidelity and conceptual authenticity in preservation processes. This tension reaffirms that the archive does not merely conserve objects but interprets and mediates the cinematic experience between past and future.

As for the third specific objective (SO3), digitisation poses new challenges and opportunities for conservation and access policies. The experience of video, whose failure demonstrated the importance of material durability and support stability, serves as a reminder that technological sustainability remains a fundamental principle in heritage management. In the current context, film archives must confront the obsolescence of digital systems and, at the same time, harness their potential to ensure broader, ethical, and democratic access to audiovisual heritage.

Finally, future lines of research could be oriented towards the development of ethical and technical protocols that guarantee sustainable digital preservation; the evaluation of the impact of artificial intelligence both on restoration processes and on contemporary forms of access; and comparative analysis of hybrid analogue-digital models implemented by different archives and laboratories on an

international scale. These directions point to a horizon of work in which interdisciplinarity, and critical reflection will be indispensable for addressing the challenges posed by audiovisual preservation in the twenty-first century.

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