

NFC's Research Project on the Sustainability of Digital Film Materials

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As a leading institution of film archiving in Japan, the National Film Center, the Museum of Modern Art, Tokyo (NFC) has been responsible for safeguarding the national film heritage since its opening in 1970. Currently, however, the NFC is functionally unable to preserve either digitized collections or born-digital elements. Both (and the latter in particular) require care and maintenance that differs fundamentally from the traditional practices required for analog film preservation. Accordingly, the NFC applied for, and was granted, a subsidy, the Program to Assist Promotion of Priority Areas in Art and History Museums, by the Agency for Cultural Affairs. This subsidy (18 million JPY = 1.4 million USD per year) enabled the NFC to commence this ongoing research project, the “National Project for the Sustainability of Born-Digital Cinema,” or the “BDC project” for short. This government-funded research project started in October, 2014 and will be concluded in March, 2017. It addresses various archival challenges to preserving and accessing digital film materials. What follows are the preliminary results and conclusions.

The urgency of this research derives not only from the NFC's sense of duty as keepers of the frame but also from the fact that no one is legally obliged to preserve digital film history: in Japan, Article 3-7 in the Enforcement Order of the Copyright Act (Cabinet Order No. 335 of December 10, 1970) stipulates that the NFC is one of the official archives for preserving copyrighted audiovisual materials; but the deposit of film work is not a legal obligation. The predecessor of the NFC was a film library in the National Museum of Modern Art. It opened in Kyobashi, Tokyo, in 1952, and had been modeled after the Museum of Modern Art in New York City. The film library expanded into a more autonomous department of cinematography when the museum's headquarters and its art collections moved to Takebashi, their current location, in 1969. Since 1970, the NFC has focused on collecting and preserving Japan's film heritage to pass on to future generations.

The NFC's collections, which now consist of approximately 75,000 Japanese and foreign films, as well as non-film materials such as posters, stills, scripts, and ephemera, have been built not with any legal deposit system, but with voluntary deposits, donations, and purchases. Each year, more than 1,500 reels of Japanese film are acquired, catalogued, and neatly stored. However, even though the NFC, as a unique national institution specializing in cinematography, strives to collect and preserve film materials, its collections represent only a small fraction of Japanese film history, as *Table 1* shows.

Table 1.
Number of Japanese feature films preserved by the NFC

Period	Feature film release	In the NFC's collection	Rate of Preservation
1910s	2826	5	0.2%
1920s	3711	141	3.8%
1930s	5089	543	10.7%
1940s	1401	417	29.8%
1950s	3750	943	25.1%
1960s	4480	1086	24.2%
1970s	3675	945	25.7%
1980s	3050	919	30.1%
1990s	2562	471	18.4%
2000s	3499	281	8%
2010-2014	2609	21	0.8%
Total			16%

Note: "Feature film release" from the 1950s is based on the official number of the MPPAJ.
Source: Own elaboration.

The low survival rate of silent films is relatively common within the film archival community due to destruction by wars, natural disasters, fires, or any kind of intentional destruction occurring before the dawn of film archiving. Yet, the considerably low preservation rate for films made after 2000 should rather be critically acknowledged. The number of overall films produced obviously increases from year to year, but the NFC is still fully occupied acquiring analog film materials produced in the twentieth century and its acquisition levels never seem to keep pace. The rapid technological advancement in digital filmmaking may accelerate their obsolescence: soon after they are produced, the technology used to produce them becomes outdated. Let this be a warning: the period between 2000 and 2015 onward could become a gaping lacuna in our continuous film history.

With an aim to uphold high standards and reliability in the preservation of Japan's film heritage, and to promote acquisition activity, the NFC needs to create the best physical environments for future digital collections. To this end, the team visited several memory institutions holding both analog and digital audiovisual collections, and consulted essential literature on the topic of digital preservation: *Digital Dilemma* (2007); *Long-Term Management and Storage of Digital Motion Picture Materials* (2011); and *Digital Dilemma 2* (2012), published by the Academy of Motion Picture Arts and Sciences, as well as online resources, such as the Library of Congress' *The Signal* and the National Diet Library's *Current Awareness Portal*. Thus, we began our research by consulting the leading audiovisual archives' experiences and practices, as well as state-of-the-art technology in digital preservation. Following successful trends in the audiovisual archive community may help define the most material-driven and sustainable system for the NFC at this time.

However, it is also imperative to identify the NFC's particular needs, capabilities, and priorities. Archiving practices naturally differ from institution to institution, depending on each organization's structures, resources, missions, or policies. Specific digital preservation policies must adapt to the needs of the archival objects, but at the same time must also optimize the costs and the human resources available to sustain archival activities long-term. For instance, the solution to an essential problem in digital preservation, the so-called "vender lock-in," can ideally be the application of open-source software, which requires an IT team to maintain. When there is no IT team available, another possible solution could be a solid data center run by a government agency, or the frequent review of preservation policy and implementation plans that can help the institutions avoid

proprietary commercial systems. Although the pros and cons of any potential solution vary, the ideal solution should retain the principle of digital preservation, which the Library of Congress clearly defines as “the active management of digital content over time to ensure ongoing access” (Digital Preservation, n.d.). The research team believes that “sustainability” is the key to maintaining the above principle. The “sustainability” of archival activities, infrastructure, and resources lays the foundations for a use and reuse cycle of cultural heritage. Therefore, in addition to the broader research on current technological trends and the examples set by institutions which preceded us, the project team needs to clearly define the NFC’s particular difficulties in order to determine what is necessary for the NFC to evolve into a hybrid archive that maintains care for both analog and digital collections.

METHODS

Research Team and Topics

The members of the BDC project, including a chemist, an engineering technologist, IT architects, a film historian, and an archivist, seek to achieve the abovementioned goals by concentrating on the following four topics, which cover the various archival issues involved with undertaking digital preservation:

1. Sustainable systems for preserving born-digital motion picture materials.
2. Institutional digitization strategies for public access.
3. Technological trends and international discussions, including legal issues, among archival communities.

4. Advanced archival education and training programs for handling digital collections.

According to each member's expertise and interests, the team divided the above topics into further sub-projects, collaborating with third-party vendors, organizations, cinema-industry professionals, and researchers. Ultimately, the set of deliverables determined by the research will clarify the type of facility needed, as well as the practical process that proper digital preservation requires, and will provide feasible suggestions that the NFC can integrate into a new policy and strategic plan for digital preservation.

RESULTS (WORK IN PROGRESS)

This section briefly reports on the current progress of a few sub-projects of the four main topics.

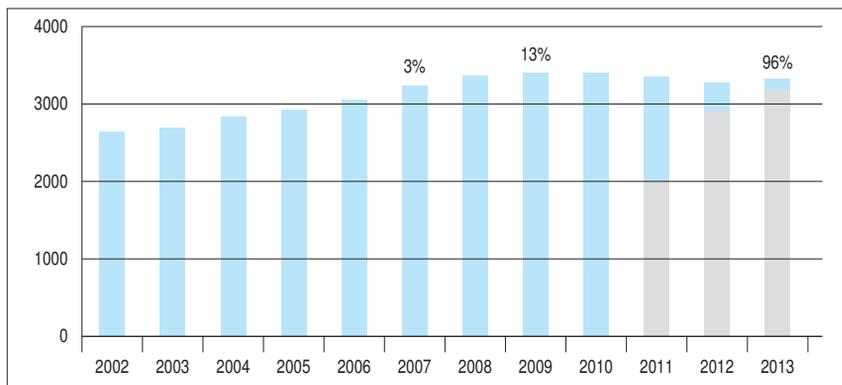
Topic 1. Sustainable systems for preserving born-digital motion picture materials

This topic covers the issues of handling and preserving digitally-created and finished materials (known as “born-digital”). The two sub-projects for the topic introduced here are a) Research on the digital shift in Japanese film production and b) Examination of the long-term preservation formats for digital moving image data.

This research began with an overview of the current state of digitization in the Japanese cinema industry, in order to address the technological changes in filming and to estimate how much data and which types of original formats exist. In *Table 2*, the portion shaded gray shows the number of

analog film projections per year, while the portion shaded black represents digital projections.

Table 2.
Number of digital cinema screen in Japan



year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Number of Screen	2635	2681	2825	2926	3062	3221	3359	3396	3412	3339	3290	3318
Regular Cinema	1239	1148	1059	972	832	767	700	673	638	565	525	487
Cinema Complex	1396	1533	1766	1954	2230	2454	2659	2723	2774	2774	2765	2831
Digital Projection	0	0	0	0	0	98	173	442	980	1991	2897	3172
Percentage of Digitization	0%	0%	0%	0%	0%	3%	5%	13%	29%	60%	88%	96%

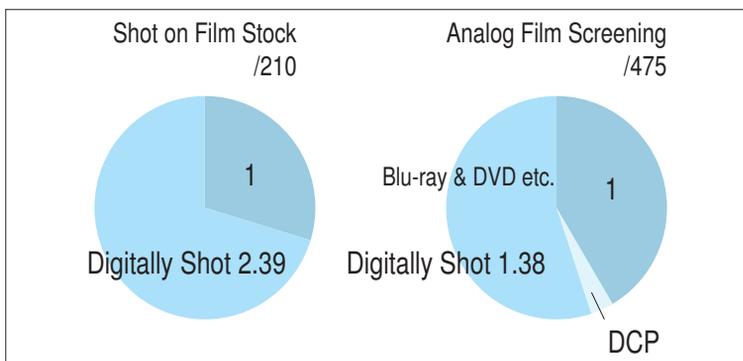
Source: Own elaboration.

With the help of a list created by independent collaborator Mr. Teruo Oka, who watches as many Japanese films theatrically released as possible, the team studied the pattern of production in 2009 in greater detail and noticed that the official number of 448 releases provided by the Motion Picture Producers Association of Japan (MPPAJ) is far fewer than the 654 titles that actually premiered on screen that year. Although the parameters that define a commercial theatrical release are undisclosed by the MPPAJ, for Mr. Oka,

a “released film work” meets the following conditions: 1. Released in any format, but must have premiered on screen; 2. Screened for more than seven days; 3. Screened more than once a day; and 4. An admission fee was required. This comparison suggests there is a high risk of loss of independent filmmakers’ works that are publicly screened but not officially recorded by the MPPAJ, due to a possibly over-narrow definition of film work. Similarly, the ambiguity of the statistical parameters defining what makes a “Japanese film release” implies the difficulty in determining what objects should be archived—especially when financial and human resources are limited by the available resources of the institution. Where the capacity of digital storage must be finite, the policy for dividing what is collected from what is not is crucial.

Concerning the rolling technological transition in film production, the left-hand pie chart in *Table 3* illustrates that in 2009, digital footage outweighed analog footage more than two-to-one.

Table 3.
Analog vs. Digital Production in 2009

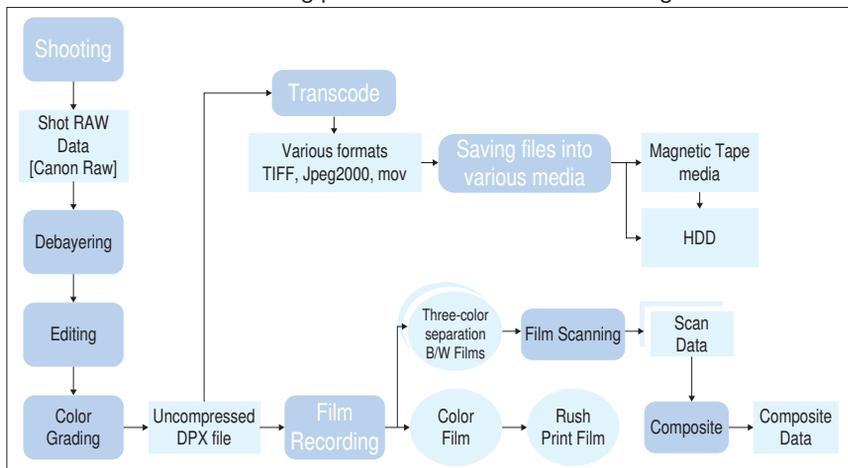


Source: Own elaboration.

The right-hand pie chart shows that in that year, the screening of analog films had only just started to decline and that most digital screenings were on Blu-ray or DVD. The lack of standardized sources for such consumable media, which, by definition, differ in audiovisual quality, is conceivable and also problematic. Our research continues to analyze the digital shift by using Mr. Oka's lists and notes that document the trends in screening practices between the years 2009 and 2011.

The second subproject of the first topic is to examine the preservation format for digitally-shot and finished work. One of our research members participated in the entire production process of a 15-minute 4K clip, except the shooting, which was done with an EOS C500PL camera (see *Table 4*).

Table 4.
Workflow for examining preservation formats for born-digital material



Source: Own elaboration.

After the raw images were developed, edited, and color corrected in DCI P3 color space, the original file was ex-

ported as a 10-bit DPX file that was then converted to TIFF, lossless JPEG2000, and QT. Both LTO tape and HDD, holding the files with MD5 checksum, were placed on a shelf. The team plans to do analytical playback and inspective verification while moving the files to storage systems that will be built next year. In parallel with the digital duplication, the 10-bit DPX file was also recorded on film by using separation masters and color negatives.

One of the clear findings of this process was that film recording for preservation, with separation masters in particular, could simulate nearly perfect visual quality which expresses the producer of the clip's intent, with the help of special color charts produced by partner company, IMAGICA Corp. However, the high expense involved in using this technique renders it impractical, except in selective preservation. For the original frame rate of 60 fps, which is 2.5 times the speed of the regular 24 fps, 2.5 times the regular length of film stock was needed. Furthermore, the three-strip system, of course, requires triple reels that take up physical space. In terms of its practicality, our findings partly support one of the conclusions in the European film archives' report, *Challenges of the Digital Era for Film Heritage Institutions* (2011), recommending that born-digital material should be preserved digitally.

Topic 2. Institutional digitization strategies for public access

This topic addresses the concern that the NFC ought to better serve the public demand for access to archival materials. The sub-projects here attempt to create the suitable workflows for digitizing analog film and non-film collections. As the public's expectations of digital access grow,

the NFC needs to redesign its collection database online, which is currently limited to providing only basic information about Japanese feature films. The better the accessibility and capability of the digital tools, the more possibilities there will be for users to rediscover the collections. Disregarding the likelihood that digital replicas of analog film works will eventually replace their decomposing originals, the team decided to prioritize the practicality and purpose of facilitating access to analog and non-film materials through digitization. The NFC chose a few significant titles for digital restoration projects by producing dupe negatives and often collaborating with major production companies. It also made telecine copies of thousands of titles in possible demand, which researchers can access on-site. The works put in the digitization packages for these two sub-projects—60 animated films produced before World War II and 6,000 cinema posters—were strategically chosen because they covered a broad spectrum of quality and production values in order to look for balanced practices at the different levels between high-end and light digital restoration with limited resources. Although there is no alternative but to outsource digitization within our project framework, the team is establishing a strategic and effective workflow from material selection to the dissemination planning. This will expand into a mass-digitization project in the future.

Topic 3. Technological trends and international discussions, including legal issues, among archival communities

The topic reflects the growing need for archives to catch up with the state-of-the-art technology and the international standards in the field of digital audiovisual preservation. As a sub-project, comprehensive research for this topic, invol-

ving interviews, literature investigation, and active attendance at informative meetings, reinforces the team's knowledge foundation. Our main areas of interest were the leading archives' practices, such as acquisition of born-digital materials, digital storage and content management systems, metadata, data integrity and security, effective digitization projects, dissemination plans with copyright issues, and legal support for audiovisual archival activities. The team has visited memory institutions holding audiovisual collections in the US, the UK, France, the Netherlands, Denmark, Norway, Sweden, Finland, Australia, and New Zealand.

Through visits and studies, the team discovered that Japan lacks a digital audiovisual preservation community, albeit technologically advanced. This observation led to the creation of a forum that gathered professionals from wider, but related, areas in digital preservation and audiovisual archiving to share their thoughts and practices for the first time. Japan Broadcasting Corporation (NHK), and the National Diet Library have undertaken their own digital services for many years. However, their knowledge of digital material handling and preservation does not cross over into other institutions holding audiovisual collections. This seems to keep each material-driven community isolated from the rest; each separately discussing the same topic but barely communicating with one another. As the borders of the disciplines, museums, libraries, and archives are disappearing, and we are moving toward a comprehensive cultural heritage portal on the Internet, it is important to share knowledge and experience across disciplines to optimize the power of digital technology. The forum will continue to discuss future cloud-storage solutions with systems liberated from the recurring insecurity of discontinued and obsolete digital me-

dia, involving commercial IT vendors, research universities, film production companies, and memory institutions.

Topic 4. Advanced archival education and training programs for handling digital collections

A sub-project of this topic aims to create a series of educational programs for practitioners who have dealt with audiovisual collections and are now facing the digital shift in many practical forms. While we were launching this research project, a meeting was held in Tokyo, which brought together four municipal institutions (Kawasaki City Museum in Kanagawa, The Museum of Kyoto, Hiroshima City Cinematographic and Audiovisual Library, and Fukuoka City Public Library) holding film collections. One of the issues discussed and clarified at that meeting was the difficulty of updating the knowledge and skills of audiovisual archivists to properly maintain digital materials. In the digital age, audiovisual archivists need to manage a large set of digital assets related to a film work, but also maintain traditional archival care for physical materials; the traditional archivists must make a conceptual leap to see themselves as asset managers. Despite the fact that no one has yet provided the education to integrate such needs, the decentralized structure of Japan's film archiving should be effectively maintained and the hub-institutions would be better off growing and joining together. Based on a questionnaire given to practitioners in archives, libraries, and museums, as well as cinema-industry professionals, the research team selected the learning topics of data handling, metadata, and copyrights. The invited lecturers (from a post-production company, an IT research service, and a copyright office, respectively) will provide workshops and seminars in February 2016, and this lecture

series will continue with the other scheduled subjects, such as Digital Cinema Package, storage systems, security, and mastering the workflow of digital film production.

TENTATIVE CONCLUSION

The research activities described above are still ongoing. However, the preliminary consensus of the team is that digital preservation requires not only new operations and strategic plans, which now include constant monitoring and scheduled migration to keep the digital assets accessible, but also a wider interdisciplinary view of the digital collections, which allows communication with professionals in digital preservation beyond the disciplines or institutional tasks. The research will be concluded with a symposium held in Tokyo in January 2017.

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