

FINAL REPORT



MEDIA
DIGITIZATION
AND
PRESERVATION
INITIATIVE



2015 - 2021



MEDIA DIGITIZATION AND PRESERVATION INITIATIVE

FULFILLING THE PRESERVATION
MISSION OF THE ACADEMY





Clockwise from upper left: The Memnon film digitization studio; Memnon scientific incubator used for baking tapes; a Memnon staff member cleaning discs using an ultrasonic cleaner; a turntable in the IU audio preservation studio

HUNDREDS OF THOUSANDS OF AUDIO, VIDEO, AND FILM OBJECTS, many of them unique and some quite valuable, were stored across Indiana University. Many were in well-maintained spaces like the Ruth Lilly Auxiliary Library Facility, but many others were moldering away in attics, old desk drawers, and forgotten shelves all over IU's many campuses. It was only a matter of time before most, if not all, of them would be too damaged to play back, or the machines capable of playing them back would be obsolete and hard to find in good working order.

In his State of the University address in October 2013, Indiana University President Michael A. McRobbie announced the creation of the Media Digitization and Preservation Initiative (MDPI). MDPI's mission was to digitize a large subset of these endangered items and make them available to scholars all over the world. President McRobbie cited as the foundation for this endeavor the three long-held missions of academia—the creation, dissemination, and preservation of knowledge. As an academic institution, it was IU's duty to ensure the content contained on these fragile items would not be lost forever.

"For over 25 centuries, the great universities of the world have always had three fundamental missions: the creation of knowledge (that is, research and innovation), the dissemination of knowledge (that is, education and learning), and the preservation of knowledge."

*Indiana University President Emeritus
Michael A. McRobbie*

IU launched MDPI in 2015, beginning a six-year journey to complete this ambitious challenge. It became the largest university-led media preservation project in the U.S., and one of the largest in the world at the time. By all accounts, the initiative concludes as a successful project with more than 350,000 items digitized and stored for posterity.

Visit mdpi.iu.edu for more information.





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Assistant Film Archivist Alicia Hickman reshelves film in the Ruth Lilly Auxiliary Library Facility (ALF)

INTRODUCTION

MDPI EXECUTIVE DIRECTOR DENNIS CROMWELL

It has been my pleasure to lead MDPI from early 2017 to its conclusion. I took over for Laurie Antolovic, the initial executive director, upon her retirement. These four years were some of the most rewarding of my entire career. The MDPI staff represents global experts in audio, video, and film preservation.

We highlight some of the many contributions they made to the field and presentations they conducted across the globe later in this report. MDPI also included dozens of collaborators from across the university and working teams that spanned numerous units. The logistics team, or SMART—Strategic Media Access Resource Team—worked with units across all of the IU campuses to collect and prepare hundreds of thousands of items for digitization. At one point, more than 40 student employees were working as part of SMART, along with professional staff. Over the years, MDPI, the IU Libraries, and Memnon Archiving Services hired hundreds of students, providing employment and career opportunities.

Central to MDPI's success was the fact that no one unit within Indiana University could complete this overwhelming task alone. A close working relationship between the Office of the Vice President for Information Technology (OVPIT) and the IU Libraries was essential. OVPIT set to work planning a viable, efficient workflow, implementing digitization practices, and managing the substantial technology challenges a project of this size presented. IU Libraries provided functional expertise and the massive logistical structure for moving 350,000 items across the university. IU

Libraries also began work on how fully digitized items would be accessible to scholars for future research.



MDPI served more than 80 units that held media collections across all campuses. It became a collaboration of librarians and archiving specialists working with the internationally respected UITS storage and networking technicians.

In addition to the items digitally transferred and stored, the project:

- Developed and implemented a quality control program for all digitization work
- Built a post-processing system that automated the embedding of metadata, software-based quality control, the creation of derivatives, and the creation of preservation packages for long-term storage
- Created a database that tracked and managed the recordings through the digitization process

Another unique aspect of the project was the public-private partnership with Memnon Archiving Services, a Sony company at the time. The close working relationship provided benefit to both IU and Memnon. We made each other better.

Upon MDPI's completion, media preservation at IU moved to a new phase. Mike Casey, the founding technical director, is now employed by IU Libraries, which took over management of the IU digitization studios in the Innovation Center. The studios will digitize newly acquired audio and video recordings as well as work through a backlog of items that could not be digitized by Memnon's parallel transfer workflows. Also, some additional film scanning continued with IU staff learning to use the scanning equipment.

Staff who worked on the project are now moving on to new roles, many within IU, and with some taking opportunities to apply their skills at places like the National Archives and the Library of Congress. The impact and benefit of MDPI will last for decades, and I am so proud to have played a small role in its success.



MDPI BY THE NUMBERS



236,396
audio recordings digitized

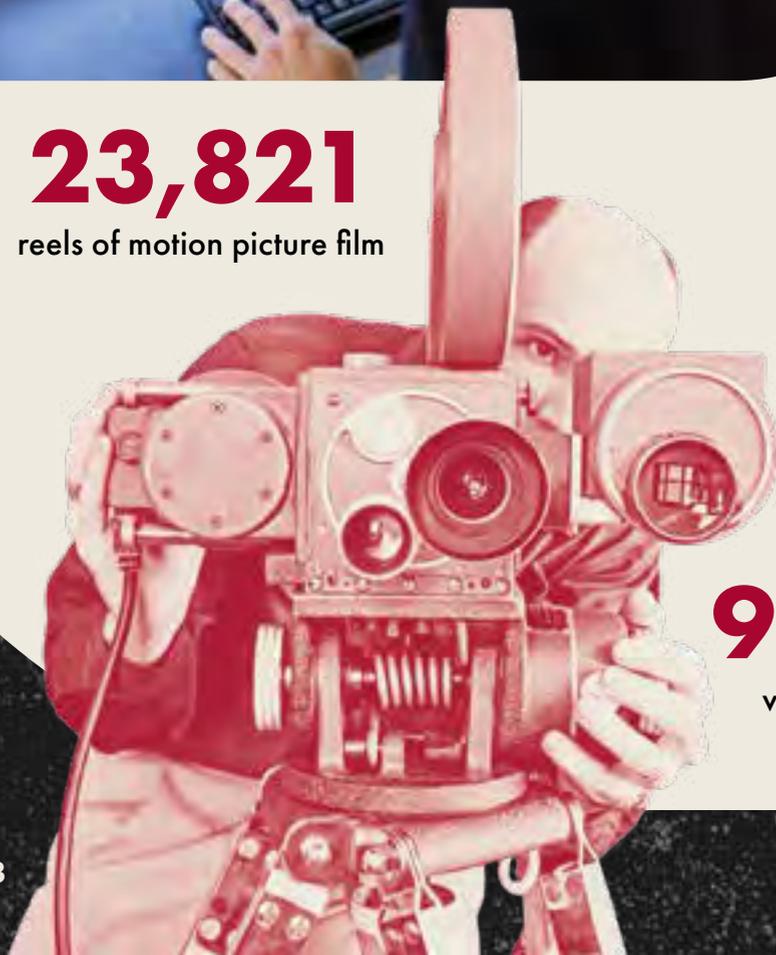


7,450
aluminum and
lacquer discs

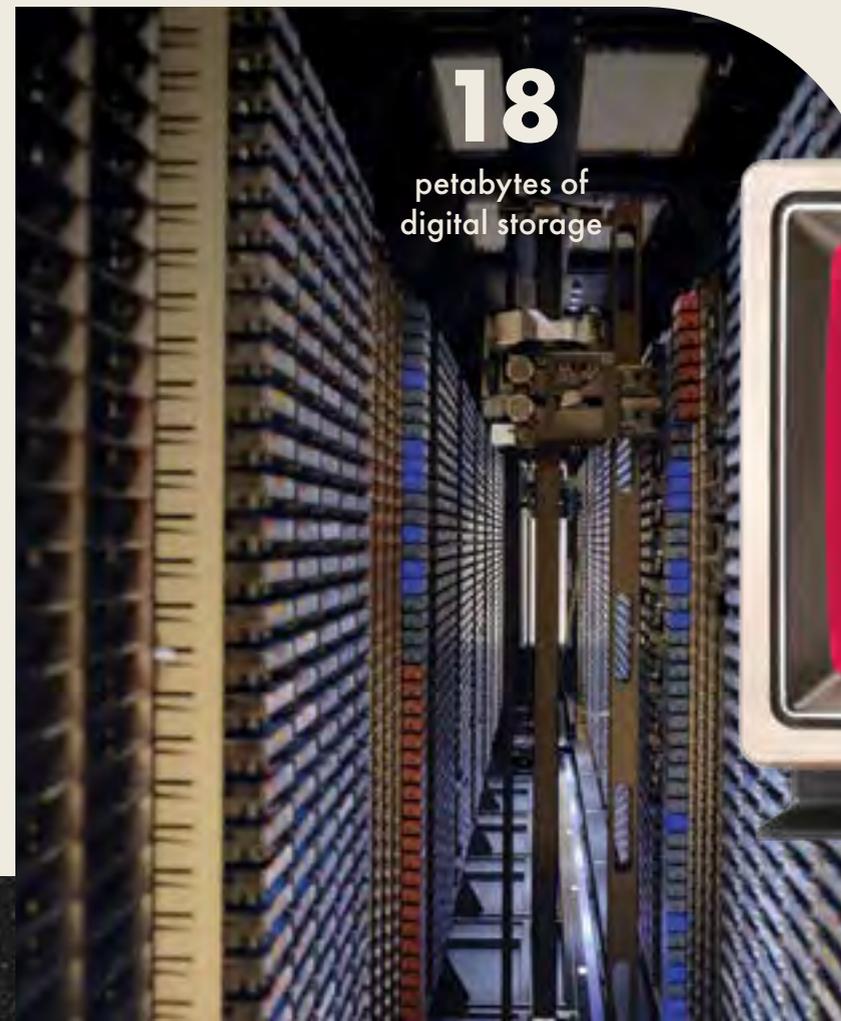


6,643
wax cylinders

23,821
reels of motion picture film



97,395
video recordings



18
petabytes of
digital storage



302,981
hours of content

(the equivalent of watching or
listening to content for 16 hours a day,
every day, for nearly 52 years)



OLD, RARE, AND FRAGILE MEDIA

Virtually all the media recordings digitized by MDPI could be considered old, and some have the dubious distinction of also qualifying as rare or fragile. When old intersects with rare and fragile, life becomes particularly harrowing for the digitization engineer who may face severe challenges in achieving the best playback possible. For some recordings, any playback at all may be a challenge.



ALUMINUM DISCS

The aluminum disc was developed in the late 1920s. Aluminum disc recordings tend to be unique and are often the product of field research by various academic disciplines. The recording is embossed (not cut) into the bare metal. MDPI digitized 1,305 aluminum discs.

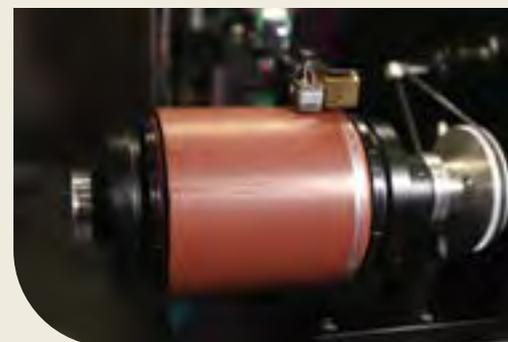
LACQUER DISCS

Add a coating to the aluminum disc and you get another old and fragile format: the lacquer disc. Lacquers, which are also typically one of a kind, consist of a black nitro-cellulose lacquer coating on an aluminum or glass base. Chemically unstable, lacquers are the poster child for media degradation because of the dramatic way in which they fall apart. The recorded content is held in the coating, which has a nasty tendency to crack, peel, and delaminate from the aluminum base. The results are catastrophic, and the content may be lost for good. MDPI was able to rescue 6,145 lacquer discs from this fate.



MAGABELT

Old disc recordings are not the only ones plagued with preservation problems. The Magnabelt format, introduced in 1961 by IBM for business dictation, can be considered rare and fragile at the very least. The recorded signal is captured in magnetic material deposited on a mylar belt, which is susceptible to creasing. MDPI digitized 43 Magnabelts held by IU Libraries in its Modern Political Papers Collections, Birch Bayh papers.



OPEN REEL VIDEO FORMATS

Videotape is not immune to the preservation problem trifecta of old, rare, and fragile. Take the various 1/2-inch open reel video formats as examples. The most common is EIAJ. Introduced in 1969, it is among the first truly "portable" videotape formats. The CV format also known as "skip field" was developed prior to EIAJ by a few years. EIAJ and CV reels look the same but are not interoperable. Most 1/2-inch videotape suffers from binder failure that can result in severe oxide shedding and unplayable tapes. These items must be cleaned and baked before playback to enable a reasonable chance of success. MDPI digitized 519 EIAJ and CV tapes.



QUAD VIDEOTAPE

The 2-inch videotape format, also known as Quad, could hardly be considered rare, at least in the mid-1950s and early '60s when it was the first and only broadcast videotape format. However, the format and its supporting technologies are now so obsolete that it is considered highly endangered and a top priority for digitization. MDPI was able to digitize all of IU's known Quad holdings using an expert external vendor. This consisted of 207 tapes from the University Archives, ATM and the IU Libraries Moving Image Archive.





WAX CYLINDERS

The oldest IU recordings are on wax cylinders. These are antiquated audio recordings made of thin brown or black wax. They can be easily damaged just by the heat from your hands, and dropping one could destroy it. IU Libraries' Archives of Traditional Music holds a large collection of about 7,000 wax cylinders recorded in the field, representing one of the largest non-commercial collections in the world

Many of these are unique recordings of Native American culture beginning 125 years ago. Some are among the earliest known recordings in China from 1901. Many are recordings of extinct languages. MDPI was able to transfer more than 6,600 cylinders. They are now preserved for posterity, and many are available for future scholarship.

A set of wax cylinders digitized by MDPI may be the oldest true stereo recordings in the world, predating the oldest previously confirmed stereophonic recordings by more than a quarter century.

A cylinder ready for playback on the Endpoint machine

Berthold Laufer, a German anthropologist and historical geographer, made history with the sound recordings he made in 1901, though he may have been unaware of it. He recorded what are believed to be the world's oldest stereo recordings while on an expedition in China. The pairs of recordings feature vocalists on one cylinder and an orchestra on the other, performing Chinese folk and opera music in Shanghai. Patrick Feaster, media preservation specialist for MDPI, developed custom software to merge the music from the two cylinders to create a stereo recording. Much of this work was done remotely during the early months of the pandemic.

IU audio preservation engineer Dan Figurelli uses the Endpoint Cylinder Transfer Machine

THE ENDPPOINT CYLINDER TRANSFER MACHINE

Digitizing wax cylinders brought a unique need to the table—namely, finding high-quality, professional equipment that could play them. The MDPI team tested the four options that could be considered professional at the time and chose the Endpoint Cylinder Transfer Machine, invented by Los Angeles colleague Nick Bergh.

Bergh's invention uses an optical laser to measure the distance from it to the cylinder, which allows for centering the cylinder playback mandrel precisely according to the shape of each cylinder. This is necessary because cylinders can become misshapen over time, resulting in wow and flutter—a "wavering" sound from speed fluctuations—during playback. A grant from the



National Endowment of the Humanities allowed IU to buy the very first production model. The Library of Congress, the National Museum of the Czech Republic, the Swiss National Sound Archives, and Stanford University followed IU's lead and purchased machines as well.

"They don't sound quite like recordings that were made to be listened to in stereo because they weren't, but they do give a wonderful sense of being in the space where these sounds were being made. You can really, at least in some of the cases, get a sense for the instruments being arranged in a space around you, and that's just something that we've not had at all for anything close to this age."

Patrick Feaster, media preservation specialist, MDPI



INNOVATION

It is often said that “necessity is the mother of invention.” Necessity has driven significant innovation in MDPI that will benefit other organizations undertaking media digitization initiatives. It is a paradox that the old, almost obsolete technology that holds our rich content requires innovative approaches to faithfully create preservation files. That is exactly the necessity the MDPI staff faced. In addition to the wax cylinder playback machine, MDPI has made the following contributions in this space.

NOISE REDUCTION

Audiocassettes encoded with Dolby noise reduction are notoriously difficult to digitize. Even if metadata make clear the presence or absence of Dolby or the type used when it is present, it is often impossible to make it sound as intended during playback. This may be due to several factors, including years of degradation. To address this issue, MDPI built a workflow that enabled the preservation of several versions for future flexibility and choice.

VIDEOTAPE CLEANING

Cleaning videotapes is a standard process used to support better playback during digitization. The rare ½-inch open reel video formats from the 1960s and '70s presented a challenge since no cleaning machine was readily available. MDPI staff converted a ½-inch Studer open reel audio tape machine to serve as a cleaner for ½-inch open reel video formats. This involved installing ½-inch tension-sensor roller assemblies, stabilizer and pinch-roller sub-assemblies, and guide rollers. Staff then rigged it up on a motorized Pellon Electro Sound tape wiper.

This worked well for EIAJ, but the Studer spindles were a fraction too large to fit the reels from the CV format. IU

Mechanical Instrument Services CAD designed and milled smaller spindles so that those 119 tapes could be cleaned more easily. We cleaned more than 500 ½-inch tapes in IU’s collections using this device.

MOLD REMEDIATION

MDPI, collaborating with audio engineer Jeff Brown and the University of North Carolina, created procedures for and a workflow for treating open-reel audio tapes that had fungal issues. The tapes were dry wiped using Pellon paper on a tape machine enclosed in a plexiglass case. A HEPA filter and vacuum assisted with managing mold spores, and Iris ports were available for the operator’s hands and arms. This procedure enabled the safe removal of most of the mold from the tape.



The mold remediation machine in action



An IU audio preservation studio at the Innovation Center

DV VIDEO

Another interesting paradox is that the innovations of the day that brought digital video to magnetic tape (such as the digital video, or DV, format) presented some of the most difficult transfer challenges. In a global collaboration with Brecht Declercq from the Flemish national A/V archive and with Memnon Archiving Services, MDPI developed a DV workflow that preserved both the signal coming from the FireWire output of the playback deck and the signal generated by the Serial Digital Interface (SDI). The FireWire output produces the raw data from the tape, which, due to severe degradation issues, may be challenging to watch. On the other hand, SDI applies error correction algorithms with the goal of doing whatever is needed to achieve playback that is as seamless as possible. However, this may result in altered data. In MDPI’s workflow, the raw DV file was defined as the preservation master and the error-corrected SDI version served as a preservation master-intermediate file. These two files were produced during one playback pass using methodology developed by Memnon.

INNOVATING MANAGEMENT OF A DIGITIZATION PROJECT

MDPI was the largest media preservation project ever undertaken in higher education and one of the biggest projects of its kind. Effective management was key. To improve workflows, MDPI used the Theory of Constraints, which is a methodology typically used in the business world to increase throughput in manufacturing operations. It was readily adaptable due to the factory-like approach MDPI took toward media digitization.

The Theory of Constraints has also been adapted to support IT operations, especially influencing the DevOps approach. Similarly, MDPI staff borrowed aspects of the Agile Scrum methodology to manage media preservation and digitization projects and staff. Scrum allowed staff to focus time on priority tasks and maintain a focus of constant delivery along with constant improvement.

Finally, MDPI used risk management techniques to conceptualize and operationalize quality control. Management applied these techniques to decide which files to quality control so that the focus was either on the highest priority or the most likely to fail.

INFORMATION TECHNOLOGY

IU brought nationally recognized information technology expertise to this project, especially in networking and massive storage systems. That deep IT experience allowed IU to execute this large-scale digitization effort and achieve what many peer institutions could not.

For many years, Indiana University strategically invested in research technologies that enabled a broad scope of scholarly activity. These investments supported managing and moving hundreds of petabytes of data for more than 300 disciplines. By leveraging this existing infrastructure and expertise, MDPI was able to budget the incremental cost rather than attempting to build a preservation infrastructure from scratch or depending completely on commercial cloud services.

Still, the task was daunting. Memnon was processing hundreds of items a day.

An hour of film creates more than a terabyte of data, and more if it is scanned at a higher resolution.

All the media scanning took place in the digitization facility, and then the data was moved to the IU Data Center for post-processing and long-term storage. At peak, MDPI was transferring more than 30 terabytes a day. An interruption or delay in movement and processing could cause production to stop.

The IT challenges did not end when the digital content reached the Data Center. Automated checks were employed to ensure the packages adhered to all appropriate preservation standards as well as MDPI specifications, had not lost data, and had passed a variety of quality control checks. Access copies had to be created in various encoding

formats so that users could play them. The preservation files were written to the archive and then replicated from the IU Bloomington Data Center to the IUPUI Data Center, and the access copies were written to storage that was accessible from the media collections manager. A third copy of the digital content was then created to be stored in a safe out-of-region location, thus meeting important preservation standards.

The bulk of the process and workflow software was written at IU using several open-source components. The media collections manager is an open-source product, but IU wrote and managed most of its code. This required IT staff from UITS and the IU Libraries to collaborate to deliver a robust and stable environment.



Data tapes in the Scholarly Data Archive at the Data Center



Above: The Informatics and Communications Technology Complex at IUPUI

Below: The Data Center in Bloomington

FILM DIGITIZATION

MDPI built on the early successes in digitizing audio and video recordings to implement a highly successful film digitization process. IU was able to digitize over 23,000 films, which represents a significant portion of the university's vast film holdings.

Collection holders selected films to be scanned that represent culturally, historically, scholarly, and artistically significant works within IU's diverse collections dating from the 1920s through the 2000s. Films selected for digitization strengthen and support the mission of IU to "create, disseminate, preserve, and apply knowledge" by increasing access to unique content for students, researchers, and community members for generations to come.

Through MDPI, IU successfully scanned more than 23,000 reels of film.

Over the course of approximately four years, IU developed and implemented a unique workflow in partnership with IU Libraries Moving Image Archive, IU University Information Technology Services, IU Library Technologies, IU Auxiliary Library Facilities Management Services, and Memnon Archiving Services.

Experienced audiovisual archivists reviewed, inspected, and prepared more than 34,000 reels of film, carefully selecting versions of films that represented the highest quality when multiple versions of titles existed. Technical and descriptive metadata was generated to enhance existing records. Through the development of custom-built databases, all reviewed films were clearly trackable



and identifiable throughout the multi-year project. In accordance with industry standards of best practices for film handling, Memnon staff members were trained in cleaning, inspecting, and repairing film. Digital files were created from Memnon's scans in accordance with industry standard best practices for digitizing films for both preservation and access.

Using a combination of automatic quality control (QC) created by IU Library Technologies, as well as manual QC performed by trained audiovisual specialists, all films scanned received a thorough review of image and sound quality. During the process of manual QC, IU was able to identify several complications inherent to the scanning software and hardware Memnon used. Through research and development, IU's QC team was able to



Canisters of film reels sit on a shelf at the Ruth Lilly Auxiliary Library Facility (ALF)

make recommendations that have positively improved the audiovisual digitization field at large.

Guided by international standards, digital restoration and post-production work was performed on approximately 50 titles. The detailed work of digital restoration increased the accessibility and usability of many titles that were damaged or faded due to age. Many of these restored films were exhibited to the public through in the interactive Big Red Bus, an exhibit at the Mathers Museum of World Cultures, and a video tribute featured in the 2020 Bicentennial Ceremonies. Additionally, many of the restored works have been featured in film screenings around the world in locations such as Germany, Italy, and Portugal.

Naz Pantaloni, IU Libraries copyright program librarian, led a team of IU law students to complete copyright research. IU Libraries Moving Image Archive added descriptive cataloging and has already seen a significant increase in requests for films because of improved searchability and accessibility.

MDPI's efforts around film digitization were a groundbreaking step within audiovisual digitization in the United States. It is estimated that approximately 20% of IU's film holdings were digitized through MDPI. The archival community at large will continue to look to IU as an example for collecting, archiving, preserving, digitizing, and making accessible moving image heritage.



PARTNERSHIP WITH MEMNON ARCHIVING SERVICES

A Memnon video digitization rack



Public-private partnerships are used by governments, school systems, public universities, and other organizations to decrease cost while increasing expertise on a project. There are many successful examples of these relationships, and just as many failures.

IU was faced with two problems that caused a paradox. The first was that the university needed outside expertise to create the process and techniques to perform digitization at scale. The second was that the logistics of shipping hundreds of thousands of physical objects to an off-site facility and daily transferring many terabytes of digital data back to IU was deemed unfeasible. IU needed an in-house outsourced model. It sent requests for proposals to several companies to create such a facility on an IU campus.

The IU Innovation Center in Bloomington

Memnon Archiving Services, a firm from Brussels, Belgium, rose to the top. It had the expertise to address the requirements, and it had established similar remote facilities across the globe. Still, the IU model would be different, and it endured its own evolution from a true IU facility using external consulting to a Memnon facility at IU Bloomington that could do work for IU and others.

Memnon was purchased and sold by Sony during the life of the project, and a global pandemic threatened

the Memnon business model. Through all these challenges, a deep working collaboration between IU and Memnon developed. Informal and formal meetings occurred at all levels of the organization. Staff jointly worked on problems, and they developed mutual respect for each other. IU made Memnon, already a good company, better, and Memnon helped develop deep expertise in the IU staff. One of the greatest compliments to this aspect of the project frequently came from the many visitors who toured the facility. They would sometimes become confused about whether an employee worked for IU or Memnon, or if a studio was a university- or company-run room. The lines between organizations blurred. This was the only way a project like MDPI could succeed, and indeed one of the responders to the original RFP opined that what the university was hoping to achieve was impossible.

Much credit goes to staff from IU and Memnon who made this partnership not just succeed but exceed expectations. It is a model that other national archives and large museums have replicated. It still stands unique in higher education.



“Memnon is proud to have been part of MDPI. This project was a large and, ultimately, highly successful undertaking that required a strong partnership between IU and Memnon, and we are all better for it.”

Andrew Dapuzzo, director US Operations, Memnon Archiving Services



MAKING CONTENT AVAILABLE

The preservation of more than 350,000 items is an amazing accomplishment. It is, however, only part of the story. MDPI was charged with not only preservation, but also making the materials available for scholarly work.

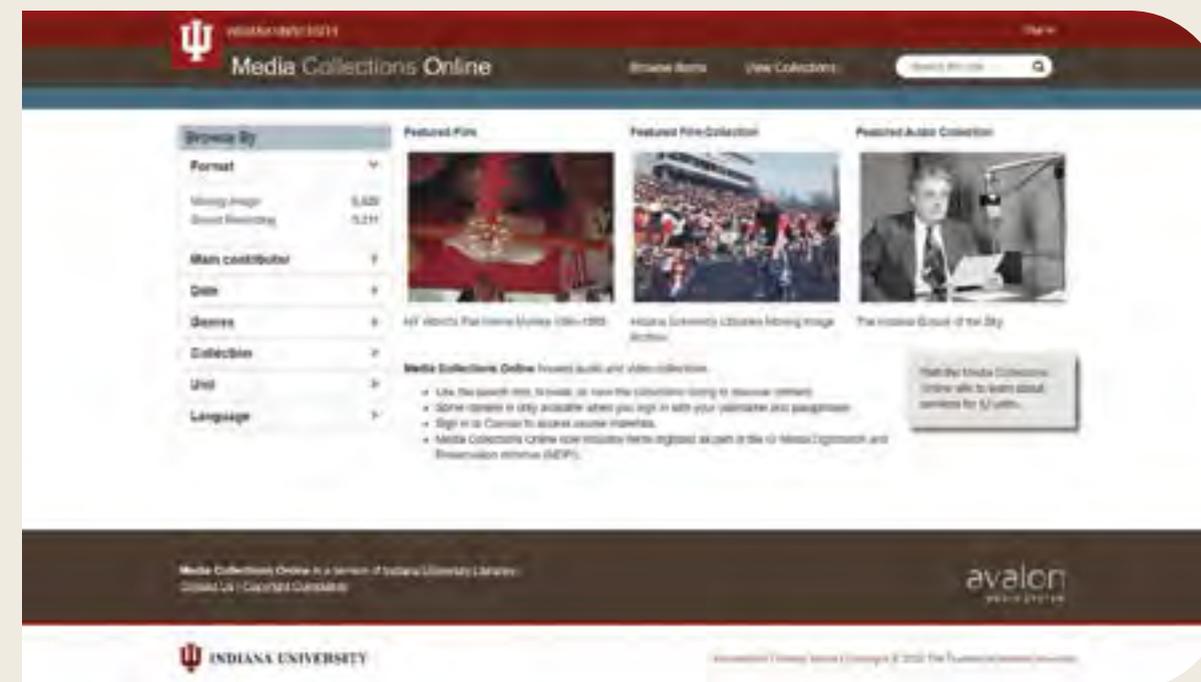
Much of this work is painstaking and includes defining appropriate metadata that will allow for successful searches, researching copyright or other restrictions on the content, and publishing with the appropriate access level (public, university constituents, or restricted to certain audiences).

IU Libraries created an outstanding environment to make

digitally preserved content available to the appropriate audience. Media Collections Online (MCO), based on the IU Libraries-developed Avalon Media System, provides online access to audio, video, and film collections held in IU Libraries and archives, and for select scholarly projects both inside and outside the university. It provides a web-based, easy-to-use interface for the playback of online media. Features include Canvas integration, closed-caption support, external embedding of media, and access restrictions for materials. Collection managers can import items individually or in batches, import metadata directly from IU Library Catalog, and define structural metadata.

Avalon also provides the ability for content managers to move MDPI-digitized items selectively from a closed version of the software to the published version. More than 200,000 items have been moved to MCO, the vast majority available to the entire university community. Content is being made available each day as collection staff work through the material.

With support from the Mellon Foundation, IU Libraries is also experimenting with use of artificial intelligence-based tools to improve efficiency of workflows.



IU's Media Collections Online portal, making a vast library of media accessible to the public



Films of historical value to IU, such as 1960's Marching Hundred (left) and A Team That Wouldn't Be Beat: 1975-76 Season Highlight Film (right), are both available via MCO

MDPI IMPACT

The impact of MDPI on its home institution—Indiana University—was immediate and far-reaching. The initiative digitized and preserved nearly all the audio and video recordings in IU’s media-holding units, plus more than twenty thousand motion picture films. IU researchers were able to leverage MDPI’s work to obtain external funding and gained a vast portfolio of media to consult in their work, while the possibilities for creative activity at IU expanded to include the incorporation of archival material.

MDPI’s impact was not limited to IU. As one of the earliest, largest, and most comprehensive university-based media preservation programs, MDPI provided a model of how the digitization of cultural heritage and archival collections, along with organizational recordings, could be accomplished efficiently. This model was available to the media preservation community to learn from as new projects were created and developed.

At least eighteen organizations exploring media preservation—including university libraries, national libraries, broadcasters, museums, and others—visited the MDPI digitization facility for in-depth tours and discussions. This included a number of international

visitors. Many participated in one or two days of meetings with MDPI staff, while others completed hands-on training in digitization, quality control, or other relevant topics. The feedback was universal and consistent. The MDPI model influenced thinking about large-scale media digitization workflows, vendor relationships, quality control, and more.

MDPI staff discussed the project’s model and contributed to the community through numerous presentations and workshops at regional, national, and international conferences, including the Association of Moving Image Archivists, the International Association of Sound and Audiovisual Archives, and the Association for Recorded Sound Collections. MDPI was a major contributor to IU’s hosting of the Biennial Audio-Visual Archival Summer School that brought 50 people from across the U.S. and the world to Bloomington to delve into preservation techniques. MDPI also generated publications on such topics as quality control, preservation principles, video preservation formats, the impact of degradation and obsolescence, and others.

“MDPI, in conjunction with earlier scene-setting efforts at IU, truly helped set the stage for NYPL’s post-2014 ramp-up to mass digitization.... IU was a touchstone and reference in both a very general sense (‘mass media digitization can be done at high quality and scale’) and in a number of technologically specific ways.”

Ben Turkus, manager, Media Preservation Labs, New York Public Library



Clockwise from upper left: Former MDPI Executive Director Laurie Antolovic gives a presentation to kick off MDPI. MDPI and Memnon staff gather to celebrate the first 200,000 digitized items. Brett Scheuermann of Memnon describes film digitization during a tour and attendees of the Biennial Audio-Visual Archival Summer School participate in a session on film preservation

“Your model and support were incredibly useful to us in learning more about scaling up possibilities for AV, but in also advocating for the cause and cultivating essential stakeholders.”

Crystal Sanchez, digital video specialist, Smithsonian Institution



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