Case Study

Collections: A Journal for Museum and Archives Professionals
2022, Vol. 18(2) 258–279

DOI: 10.1177/15501906211052720
journals.sagepub.com/home/cjx
SAGE

Practical Remote Workflow Solutions for Complex Digital Projects: Opportunities in a Pandemic

J.A. Pryse[1]

Abstract

The spread of COVID-19 has created numerous challenges in the field of archive management. Limited in-house office space, furloughs of personnel, and inconsistency, has highlighted the potential for the Carl Albert Congressional Research and Studies Center Archives (Center) to develop and implement improved accessibility measures to thousands of linear feet of material. Addition ally, the Center has found unique opportunities to collaborate with multiple academic institutions to propose large-scale digitization program exhibitions using the Center's remote workflow model. One of the largest, most complex collections the Center has worked with during this time is the Political Commercial Collection (the Collection), which holds 119,000 film, audio, and videotape recordings of commercials aired between 1936 and present. It is the largest collection of political commercials in the world. The Center has developed a working pilot digitization project that has currently resulted in access to 16,000 digital videos for public researchers and over 10,000 available for on-line streaming during the pilot phase between April 16, 2020, and December 1, 2020. This paper presents the practical application of the Center's simplified "Linear Reciprocity Workflow Model" to provide a systematic solution for digital and long-term preservation of complex collections. The Center has proven that limited personnel and reduced resources need not interrupt continued access to archival repositories.

Keywords

archive, digital preservation, workflow, pandemic, digital workflow

[1]University of Oklahoma, USA

Corresponding Author:
J.A. Pryse, University of Oklahoma, 630 Parrington Oval, Oklahoma City, OK 73112, USA.
Email: japryse@ou.edu

Introduction

The Carl Albert Congressional Research and Studies Center (Center) is a unique and nonpartisan institution that strengthens representative democracy through scholarship, learning, and service. Established in 1979 by the Oklahoma State Regents for Higher Education and the Board of Regents of the University of Oklahoma, the Center is a living tribute to the ideals, leadership, and accomplishments of the Honorable Carl Albert During the past three years, the Center's Archive has received numerous accolades and grants as well as private support to advance technological abilities of the archive and to improve collection accessibility. With confidence from the Univer sity and the financial need to support historical materials, the Center was awarded custodianship of one of the largest collections on campus, the Julian P. Kanter Political Commercial Archive.[1] The Kanter Archive has a world-renown reputation as the "Louvre and the Fort Knox of political commercials" which includes the "largest and most comprehensive collection of broadcast polit ical advertising in the world—has been designated as one of "America's Treasures" by the White House Millennium Council and the National Historic Preservation Trust."[2] Continued support and preservation of the Collection requires immediate migration and preservation action.

Background and Significance of the Collection

The Kanter Archive originated, in 1985, with the purchase of a collection of 25,000 political com mercials from a private collector, Mr. Julian P. Kanter. Now with more than 119,000 individual commercials, the current expanded archive is nationally and internationally recognized as a major research resource.

The Collection is the largest collection of political radio and television commercials in the world and the only collection that covers all levels of political campaigning with rare film, audio, and videotape recordings aired from 1936 to present. The Collection is a unique historical resource in which more than 65% of video and 85% of the film holdings are not available elsewhere.

During the past five decades, television's role in the political system has increased so dramatically that it is now the dominant form of communication in the political system. While news coverage and debates are undoubtedly important, multi-media advertising has become the most important aspect of communication between candidates and voters.[3]

1. January 2020, the Center was officially assigned as the custodian of the Collection, as a "rescue" measure during extensive budgetary cutbacks within the University.
2. Haynes, K. J., Kaid, L. L., and Rand, C. E. "The Political Commercial Archive: Management of Moving Image and Sound Recordings." *American Archivist* 59, (1996) 48–61.
3. Spending for television and radio time in the 1988 presidential campaign exceeded $80 million; and, with a third candidate in the race in 1992, broadcast advertising expenditures topped $120 million. The Wesleyan Media Project reports, "over $1.5 billion in estimated ad spending

Table 1. Count of Political Commercials by Office.

Office	Total	Republican	Democrat	Other
Senate	26,741	12,605	12,888	1,218
House of reps	24,291	10,899	12,767	1,240
Governor	22,114	9,735	11,229	1,150
President	14,139	5,266	7,878	995
Ballot measures	8,948	417	446	8,074
City and county offices	5,913	1,056	2,783	2,085
Other	4,773	911	1,432	2,424
State senate	2,612	989	1,158	465
Judicial offices	2,469	436	571	1,462
Attorney general	2,163	678	1,258	227
State house of reps	2,008	711	838	459
Lieutenant governor	1,625	521	1,004	100
Minor offices	2,054	381	731	482
Total	119,850	44,605	57,983	20,381

A natural consequence of this growing importance of television advertising has been an increase in scholarly research[4] The Center's implementation of new workflow measures and procedures to provide access to the Collection has dramatically changed visibility, funding, and sharing of archival materials.

Description of the Collection

The Collection contains T.V. commercials and televised debates from every election year from 1952 to present.[5] All levels of races are included: presidential, U.S. senatorial, gubernatorial, and other statewide offices, congressional, state legislative, county, and municipal, judicial, school board, etc. The archive has materials from all 50 states and some international countries. It also contains ads for and against ballot issues (or propositions) and an increasing number of advocacy commercials that deal that public and social policy questions. Additionally, the Collection has recently acquired many new items from other countries, broadening the international appeal of the collection.[6]

The Collection contains materials from every presidential election, thousands of gubernatorial and lieutenant gubernatorial races, senate and congressional races, and thousands of statewide, local, and district elections (Table 1).

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on TV, digital and radio in the presidential general election between April 9 and October 25. $991 million (65%) of that spending was from candidates, while outside groups account for the rest.

4. Ridout, Travis N., Michael M. Franz, and Erika Franklin Fowler. "Advances in the Study of Political Advertising." *Journal of Political Marketing*, 13, no 3 (2014): 175–94.
5. Wood, S. C. "Television's First Political Spot Ad Campaign: Eisenhower Answers America." *Presidential Studies Quarterly*, 20, no 2 (1990): 265–83.
6. Currently the Collection has political ads from: Afghanistan, Aruba, Australia, Brazil, Canada, China, Costa Rica, Dominican Republic, Europe, Germany, Greece, Guam, Israel, Italy, Japan, Netherlands, Soviet Union, Tasmania, Trinidad and Tobago, Turkey, Ukraine, United Kingdom, Virgin Islands, and Yugoslavia.

Table 1 provides a broad summary of the collection by political office and party. There are just over 50,000 congressional commercials with a relatively even breakdown between the two parties. With an additional 22,000 ads from gubernatorial campaigns and thousands of others from state level races, the collection provides vast geographic coverage to analyze campaigns and political communication at both national and sub-national levels. The nearly 15,000 presidential ads com plement the statewide races to provide a broad base of commercials. There is also a significant number of ads from other offices that are usually not studied in a way we will make possible after completing this project.

One major advantage that comes from creating public access to the Collection is allowing the Center to overcome problems that plague a great deal of research and political analysis scholarship. Although this has changed some recently, most analysis research uses an arbitrary start date of when digitized materials become available. For example, research using the Congressional Record as a corpus starts analysis in 1989 (101st Congress).[7] The Collection, however, starts when political commercials first aired and is the only collection with the depth and breadth to allow for the comprehensive types of analysis we propose. In addition to office, year, and party, some of the ads in the collection have been coded by original format, length of ad, company that filmed the ad, name and gender of candidate, title, subject, and occasionally topical keyword research.[8] Much like archival metadata collection, the political science field collects data to generate categories or concepts from raw data.[9] Thus, creating logical search structures and open access to the Collection requires intensive analysis of current workflow processes.

Before developing new a workflow and preservation system, it is important to identify and prioritize the long-term procedures currently in place. The PCC initially relied on the report of a panel of consultants with experience in film and video preservation. This panel of consultants was con vened in the Fall of 1988 and traveled to Norman, Oklahoma to consider the bibliographic control and preservation needs of the archive.[10]

The Center has made some extraordinary progress since the fall of 1988. Storage of archival masters and conservation treatment has been performed on a number of collection materials:

- Bibliographic control has been applied to the collection which provides local, cloud, and super-computing accessibility/research;
- 2004, the Center was awarded a "Save America's Treasures" grant in the amount of $135,000 by the U.S. Department of Interior/National Park Service to support the creation of preser vation and use copies in appropriate archival formats[11]

7. Library of Congress. 2020.
8. Allen Mike, *The Sage Encyclopedia of Communication Research Methods*. (London: Sage Publications Ltd, 2017).
9. Given.
10. Wood, "Television's First Political Spot Ad Campaign: Eisenhower Answers America," 265–83.
11. Haynes et al., "The Political Commercial Archive: Management of Moving Image and Sound Recordings," 48–61.

Before the Center's acquisition of the Collection, all preservation efforts and public access capabilities were carried out by one Collection Curator and assisted by student personnel. Internal funds for these efforts, historically, have been very limited, consisting of only a few thousand dol lars per year and supplemented greatly by grant funding from the U. S. Department of Education and the Kerr Foundation.[12]

Workflow mechanisms in place at the time of the Center's acquisition were traditional and standardized in line with the finances and personnel then available. An allencompassing workflow system with validated control methods had not been created until the Center's acquisition in 2020. Most in-house preservation and digitization project access was prioritized based on patron or scholar request.

Challenges

Before the Center's intervention and acquisition, there were two main ways to access the collection as it currently exists, both starting with the non-searchable online finding aid. If a scholar requested to view a limited number of ads, PCC would "loan" the files out on a drive or upload to a cloud folder. If the request were to access ads in bulk, they had travel to Oklahoma and spend time in the archive itself. This practice severely limited the number of scholars who had the opportunity to work with the collection to those that have available resources. While research from the collection has been featured in prominent outlets, the collection has been extremely underutilized and falls under the category of a "hidden collection."[13] By moving the collection online, the Center has increased the number of users who can access the materials. The Center's metrics demonstrate the increasing demand for access to the Collection. During the pilot phase of the project that was deployed in April 2020, the Center's YouTube channel with just over 2,500 ads received over 44,000 views with limited promotion.

The Center faced additional challenges as a result of the COVID-19 pandemic. Archives have faced tremendous challenges to continue providing discoverable materials to the public, process ing existing physical collections, and disseminating materials to long-term preservation quality storage platforms. The Center, historically, has relied on student employment or internship position placement in place of hiring permanent staff to provide handson education through practical skill set application while concurrently processing collections.

The nature of archival work, whether in-person or through remote approaches, is extensively contingent on specialized training. Without the ability to employ students, the Center, is solely reliant on two fulltime archivists and student internship placement, for credit. In addition to the collection, the Center manages millions of

12. Kanter, Nimmo, "Kanter Political Commercial Archive. Studies in Communication, Media, and Public Opinion. Oklahoma City, Oklahoma (C-SPAN)."
13. Rebecca S. Albitz, "Locating Moving Image Materials for Multimedia Development," *The Reference Librarianm*, 34 no. 71 (2008): 99–110; Finkel and Geer, "A Spot Check: Casting Doubt on the Demobilizing Effect of Attack Advertising." *American Journal of Political Science*, 42, no 2 (1998): 573; Geer, *Defense of Negativity: Attack Ads in Presidential Campaigns. Studies in Communication, Media, and Public Opinion* (Chicago: University of Chicago Press, 2006).

items that include 61 congressional collections and 25 political collections, totaling over well over 10,000 linear feet of archival materials.[14] The Center also facilitates a number of online collection archives as well as multiple grant funded digital projects, which require extensive digital preservation, metadata collection, and longterm digital content management. Successful use of current resources necessitates efficient workflow develop ment. The Center applies the proposed "Linear Reciprocity Model," which focuses on production efficiency and prevention of informational flow barriers.[15]

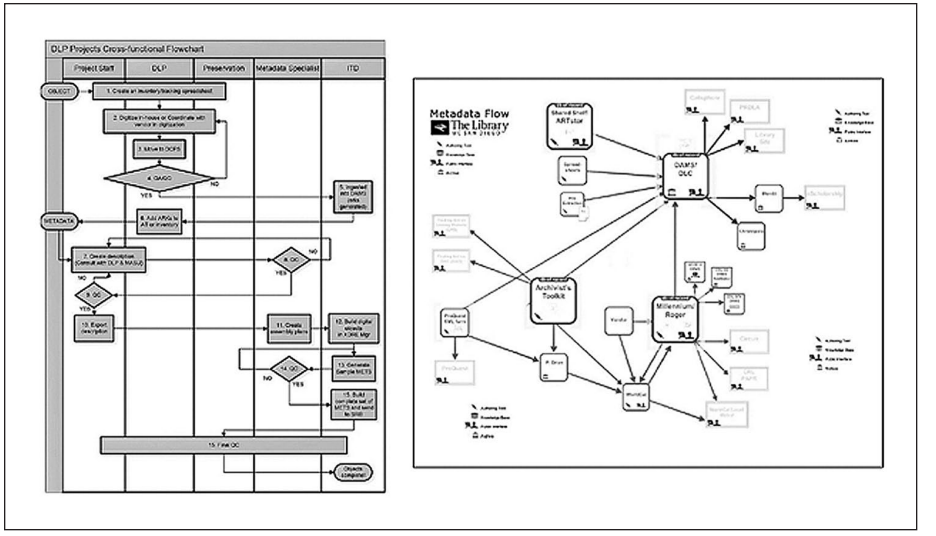
Together with increasing expenditures and decreasing financial resources at the University, managing collections has become progressively more demanding. First, platforms appropriate for long-term archival use and access of digital files, the ability to integrate with existing systems, and the ability for user streaming, come with a substantial yearly cost.[16] By petitioning for private donations and application for grant funding to support the needs of the Center, the platform chal lenge has been solved through a recent gift from a private donor that will endow the yearly costs for a digital platform, indefinitely. Platform procurement supports the Center's remote workflow program by providing back-end accessibility for present and future remote work opportunities. Accessing digital materials and the ability to apply working data creation, migration scheduling, and "live" visibility to reinforce quality assurance measures, provides continuity that supports the mission of the Center.

Workflow Model Analysis

Content process management is vital for cultural heritage institutions' core purposes to collect, preserve, and provide access to data over the digital life cycle of historical materials. The capabil ity of a cultural heritage organization to ingest information into a networked information system requires the controlled measure of exclusiveness within the system itself. The componential con ditions within the information system can be defined by a series of management actions, processes, and policies from one module to the next. The existing theoretical models are absent of practicality and lack the attention to evolving technology.

Efficiency in archival information system relies on the sequencing of actions to effect long-term preservation and discoverability of all digital content17. Logically, the flow of data within a system connects through channels or pathways much like the

14. The Political Communication Collection (physical) contains 2000 square feet of storage with thousands of analog containers, boxes, and cold storage materials.
15. Pryse, "1954 Dejur Grundig Steno-Cassette Digitization: Carl Albert Center Archives A/V. Congressional Archives Carl Albert Center YouTube Channel," 2020, available at: https://www.youtube.com/watch?v=Da1mlCzKsQ0&list=PLf4g93KWAK-GS5g6sfovcdsKk9-5HefYt.
16. A naive approach might be to upload videos to YouTube for viewing after a watermark is applied. However, YouTube does not meet archival standards since there is no guarantee it will exist in the future. Therefore, it is only appropriate as a secondary platform but not primary. Archival management platforms with the capabilities to archive and exhibit digital materials can cost $15,000 a year to $100,000 a year depending on storage, applications, and utilization.



Workflow Model 1. Cross-functional workflows from UC San Diego metadata-flow and digital life-cycle workflow.

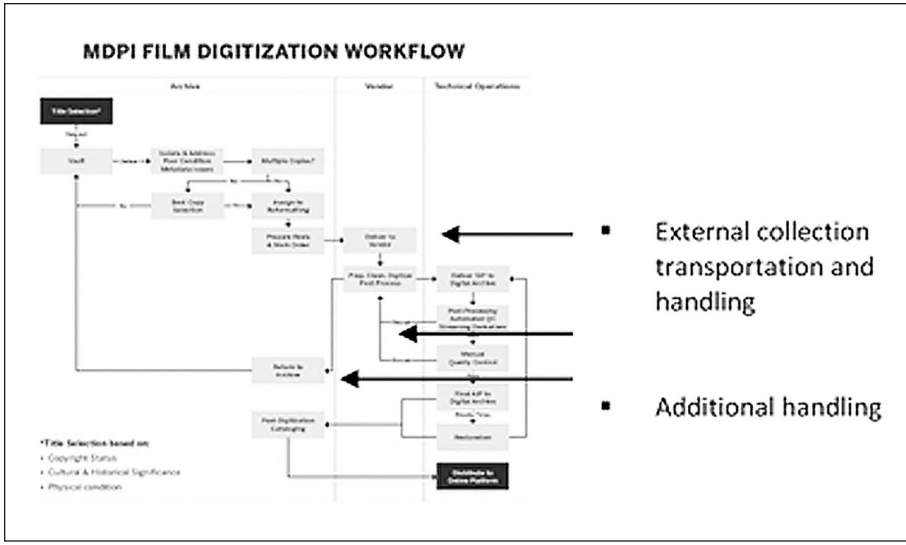
electrical currents through connected wires. The arranging of those lines determines system success. They also determine the weakness to the current or flow of data.[17]

Examining multiple archive and library collection workflow processes directed the Center's evaluation to streamline cross-functional controls to create a balanced, linear process [Workflow Models 1–3]. The Center's clearest advantage is the single entity organizational structure. In-house col lection access and the aforementioned staff skillset allow for streamlining process development.

University of California San Diego created a "Cross-functional" workflow and "Metadata Flow" digital life-cycle models to manage digital content within a multiple department [Workflow Model 1].[18] Though the models' approaches are fundamentally effective, they are complicated with numerous, multifactorial steps that require continuous handling of archival materials.

Workflow Model 1 depicts processes that travel to and from multiple personnel, which in turn creates additional "handling" of objects, digital or analog, followed by implementing changes and returning the materials back into a portion of the workflow to then travel to another station or module. Increased human participation in a workflow inevitability increases error.[19] The effect of error causes inefficient application of information and preventable mishandling of rare or archival items. Development of

17. Chan. 2009.
18. Pryse, "1954 Dejur Grundig Steno-Cassette Digitization: Carl Albert Center Archives A/V. Congressional Archives Carl Albert Center YouTube Channel," 2020, available at: https://www.youtube.com/watch?v=Da1mlCzKsQ0&list=PLf4g93KWAK-GS5g6sfovcdsKk9-5HefYt.
19. Shaw et al., "Finding the Balance: Modelling Successful Workflows for Digital Library Collections," *Journal of Digital Media Management*, 6, no 3 (2017): 295–311.



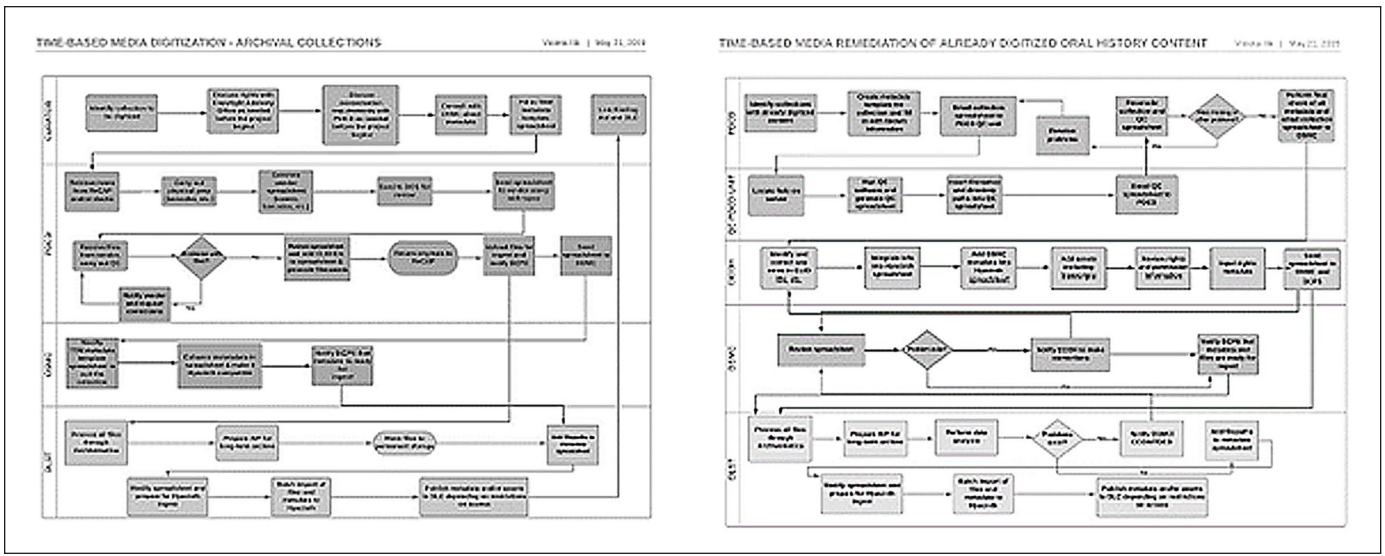
Workflow Model 2. Indiana University digitization workflow model.

information systems facilitates the flow of information from ingestion to end-user or for future migratory practices in an archival setting. When information is corrupted or requires correction, the productivity cycle is rendered ineffective, thus, having to repeat steps or delivering invalid information.

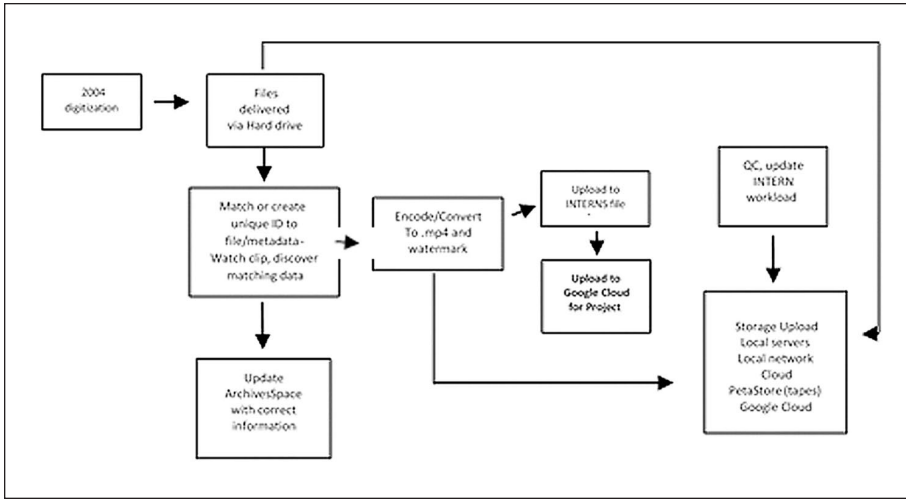
In evaluating the Collection and solidifying workflow program methods, the Center has found it is more efficient to complete the entirety of preservation and digitization work in-house, as outsourcing can cost millions of dollars and create excessive delays. A large-scale project created in 2013 by Indiana University discovered the cost to outsource digitization and preservation of 25,000 film reels was $12 million with an additional $15 million for 325,000 audio and video recordings.[20] The project predicted an eight-year completion date. In 2017, the film digitization phase began with 30,000 reels of at risk film, which involved complex workflow measures [Workflow Model 2] including vendor delivery, post vendor processing and re-scanning activities.[21]

Columbia University, similarly, embarked on a project to preserve and provide access to their audio visual collections, funded by the Mellon Foundation at $750,000 to

20. McKenzie, "A Race Against Time to Preserve University Media Collections: Irreplaceable Audio and Video Recordings from the 20th Century are Languishing in University Collections, Deteriorating. Can They be Saved?: Inside Higher Ed," 2018, available at: https://www.insidehighered.com/news/2018/06/29/universities-urged-save-media-collections-it%E2%80%99s-too-late.
21. Arton, "Media Digitization & Preservation Initiative Blog: Digitizing Film Guide," 2018, available at: https://blogs.iu.edu/mdpi/2018/11/19/digitizing-film-guide/.



Workflow Model 3. Columbia University project workflow.



Workflow Model 4. prior to development of the current linear reciprocity workflow model.

outsource 21,000 media items over a five-year period[22]. Columbia University's project workflow describes a multi-department, multifaceted infrastructure [Workflow Model 3] to include vendor relations, and complex external and internal administration[23]

Comparable to the evaluated complex workflow models, the Center's initial multi-sectional workflow created a great probability for error or barrier-ridden processes that resulted in inconsistency and unreliability. This pre-center workflow process involved receiving the Collection's materials on various, obsolete formats: CD, DVD, or external hard drives, in a single, access format, without embedded or encrypted metadata or any additional data accompanying the materials. In order to create a cohesive ingestion of materials, the initial workflow model [Workflow Model 4] was implemented to provide essential modification, uniformity, and reliability standards.

Like Columbia and Indiana, the Center faces an opportunity to improve accessibility and to apply an efficient workflow model into information systems. Since the Collection was last digitized in 2004, the digital preservation master files are due for a refresh or migration to meet modern best practices for long-term preservation (the duplication, copy, and migration of analog and digital film to a new support format) or conservation (safeguarding and protection of original materials from damage, decay, and loss). Acknowledging the advancement of metadata requirements and the Senior Archivist's extensive work with development of a robust metadata schema (Table 3),

22. Columbia University Libraries. 2019.
23. Mendenhall, et al. "Unhiding the Audiovisual Past at Columbia University Libraries. With Assistance of Mendenhall, Timothy, Dina Sokolova, Melanie Wacker, and Alexander Whelan. ALA Annual 2019: ALCTS TSWEIG." American Library Association. June 24, 2019 (ALA Annual 2019: ALCTS TSWEIG)," 2019.

Table 2. Current Digitization Standards Versus 2004 Digitization Standards.

	2004 Standard	Current best practices
Access file size	60.78 MB	100 GB/h
Format	MPEG	Uncompressed: MXF, MOV, AVI
Access format	N/A	.mp4, .m4v, m4p, .3gpp, .3gp, .3gpp2, .3g2, .k3g, .jpm, .jpx, .mqv, .ismv, .f4v
Bit depth	8 bit	10 bit
Compression	Lossy	Lossless
Average dimension	720 × 480 pixels	PAL-720 × 576 pixels, NTSC-720 × 486 pixels
Metadata	Basic, non-specific, missing technical	EIDR or ISAN standard specific: (MODS, METS, PREMIS, PBCORE)
Frame rate	29.97 fps	29.97 fps
Chroma format	N/A	4:2:2
Color space	N/A	YUV
Audio stream	N/A	BEF 48kHz, 26-bit PCm encoding
Audio channel	N/A	2 (L,R)

the Center was uniquely positioned to apply preservation actions from the beginning (analog or physical items) through long-term storing.[24, 25]

Metadata Enhancement

The importance of migration and digital progression is vital to the preservation and protection of digital (and analog) materials and to maintain integrity of the accessibility of the archival holdings. Table 2 lists a basic summary of 2004 digital standards compared to current best practices. Technological advances provided software and hardware capable of extending the amount of data visible to the public as well as the Archivist. Moreover, technology provides enhanced mechanisms to allow for various access methods to enhance user experience, such as the ability to stream on multiple devices, access metadata while viewing, and interactivity or interoperability between devices or programs.

Through acquisition and ingestion of the Collection, the Center observed the absence of supplementary information attached or encased with the physical item, such as written descriptions on containers, documents found with the physical materials, playback equipment, storage, and other data. This lack of data was not the inexperience of past curators and archivists, it was due to natu ral evolution of technology and advancement

24. Pryse's research with metadata structure, metadata enhancement, and created several highly functional schemas to provide accuracy and integrity for long-term migration tasks, for over seven years. Pryse's metadata schema utilized at the Center's archive provides imperative controls to allow for future archivists to determine program ming, playback equipment, and operating systems (in full) to migrate and recreate an accurate depiction of the intended file(s).
25. Pryse, "1954 Dejur Grundig Steno-Cassette Digitization: Carl Albert Center Archives A/V. Congressional Archives Carl Albert Center YouTube Channel," 2020, available at: https://www.youtube.com/watch?v=Da1mlCzKsQ0&list=PLf4g93KWAK-GS5g6sfovcdsKk9-5HefYt.

Table 3. Existing Political Science Coded elements.

Physical information	Production information	Political information	Postproduction information
Network ID#	Last name	Nation	YouTube title
Primary Copy ID#	First name	Party	Edited YouTube length
Original ID#	Role	State	Edited time begin
Slate ID#	Production agency	Office	
Date ad created	Political action committee	Gender	
Communication type	Ad title	Summary of ad	
Program type	Length	Full transcript	
Election year	Ad begin	Subject #1	
Format		Subject #2	
License		Subject #3	
Donor			
Tags			

of metadata creation in the field of archive science. The Center, as a leading repository in long-term digital content management, implements current practices in the field of information science, and applies all "up-to-date" practices as standard collection policy. It is the sole responsibility of the Center, as custodians of rare and historical materials, to actively promote the future usability of all collection holdings.

The Center has developed enhanced data collection methods to incorporate existing data with advanced data as well as integrating current Political Science coded elements included in Table 3.

Advanced metadata collection and creation includes a unique schema developed by the Center's Archive staff to effectively collect structural, technical, and preservation elements referred to in Table 4. This extensive list of archival metadata was initially created by the Center to address oral histories but has been modified to incorporate additional moving image formats.

As senior archive personnel has extensive experience in audio/video preservation and long-term digital life-cycle methodologies and manages project workflow, the Center is uniquely qualified to improve productivity and provide remote access and handling of complex digital components throughout the COVID-19 pandemic[26]. Whereas an archive might fall behind on internal task and infrastructure, the Center has been able to grow all digital collections through enhanced workflow adaptation.

Solution: Linear Reciprocity Workflow

While global challenges plagued professional infrastructure throughout 2020, many challenges existed in the archival field before COVID-19, as mentioned in the previous section. Archival work has increasingly witnessed budget reductions, staffing

26. Curator and Senior Archive personnel has worked, extensively, with rare and obsolete media formats, playback equipment, and conserving unique materials. Curator and Senior Archive personnel has worked, extensively, with rare and obsolete media formats, playback equipment, and conserving unique materials.

Table 4. CAC Video Metadata Elements Created by the Center.

Descriptive	Preservation	Embeded technical	Technical	Rights access
Title	Format	VidFormat	CommManufact	Rights declaration
Creator	Gauge	VidCodecID	CommModel	Rights holder
Item ID	Length	VidBitRate	CommVersion	Rights holder designation
Collection	Stock brand	VidWidth	CommBuild	Rights holder contact
Date creation	Stock duration	VidHeight	OS	
Language	Signal encoding	VidStandard	OSVersion	
Publisher	Orig labels	VidColorSpace	VidReproDevType	
Description	Orig copies	VidFrameRate	AudioReproModel	
Subjects	Migration series	AudioFormat	VidDevSerial	
Coverage		AudioBitRate	VidReproDevSerial	
Date		AudioBitRate	VidCaptureDev1	
		AudioBitDepth	VCD1Manufactuer	
		AudiosampRate	VCD1Name	
		Audiores	VCD1ModelVerssion	
		FormatExtesion	VCD1Serial	
		MIMEtype	VidCapture1Softwate	
		FormatVersion	VCD1Driver	
		FileSize	VCD1Software	
		Duration	VCD1SoftVersion	
		FifeMigrateDate	TransferNotes	
		EncodeDate	TechTransferNotes	

shortfalls, and mounting costs of maintaining digital or analog materials throughout their life cycles. Maintaining collections such as the Political Communication Collection (PCC), with resounding limited resources, is impractical if not impossible without enhanced analysis of existing workflows. The Center, accordingly, has developed successful activities and information process management through proven control measures to facilitate continuity throughout the information flow system. These controls can be defined by a series of management actions, processes, and policies from one module to the next.

The Center has found existing archival information system models provide a guide for information flow, but leave a problematic gap with methodology and standardization, which in turn causes loss of data throughout the system and over time. These long-range theoretical models lack practicality, fail to capitalize on evolving technology, or conspire to highlight barriers within the flow that now can be surmounted.

Gaps in existing research and workflow models include ineffective reliance on inundated or archaic processes in the archival information system due to system familiarity or institutional paralysis that prevent integrating new methodologies. Further gaps are illustrated by archival information systems based on outdated practices that modern processes cannot interpret.[27] A similar example would be attempting to open today's software from a decade-old computer operating system. The application can interpret the data but cannot replicate the intended information, leaving a viewer with a symbolic rendition of the actual program. Archival processes continually improve

27. Rasche, "The Paradoxical Foundation of Strategic Management. Hamburg, Germany: Physica-Verlag A Springer Company," 2008, available at: https://link.springer.com/book/10.1007% 2F978-3-7908-1976-2#authorsandaffiliationsbook.

and change, stagnant archival process development in a repository leaves one unable to "catch-up" with innovations.[28]

Finally, the prevalent gap in existing models such as Indiana and Columbia University's digitization workflows is the extent of personnel, departments, equipment, funding, and multifaceted processes involved. Many smaller institutions operate on significantly reduced structural support systems. Often, the paralysis in the smaller organizations is due to the lack of adaptable, practical models available. The "Linear Reciprocity Model" offers a systematic approach to multifunctional paradigms.

The information system process not only should focus on the flow of information but also the processes in which the system has evolved to integrate human dimensions and technical develop ments. Analysis of current modalities offer a deep look into the existing structure of the archival information system and the transformative changes that have created the modern digital archive system.[29] With organizational systems, the decisive output or goal is the quantitative rate at which it can ingest, process, and define data . To reach this output goal a significant process of information must flow freely from one system component to the next. Organizational systems with extensive barriers not only increase entropic results, but also prevent synchronization to support consistent and efficient flow of data.[30] Eventually, as barriers increase and systemic processes collapse, the structure crumbles, ultimately creating more damage to organizational design and development as well as the repeated handling of analog or digital items within a collection.

Currently, there are no profession-wide standardized digitization processing guidelines for addressing functional components of digital audiovisual material. Without defined, structured, systematic workflow measures, there is a greater chance of information entropy due to the repeated handling, duplicate digitization, or lack of preservation mechanisms to facilitate future migration schedules. The Center has designed simple approaches to address the complexity of the archival information system from ingestion to end-user. The "Linear Reciprocity Model" simplifies structural breakdown by defining levels of complex activities and defining measurable outcomes throughout the information system. The multi-process functionalities of an information system determine productivity as it concerns digital archives. The relationship between data creation and data output is measured by:

- **Items digitized (ingested)**: At first ingestion or "creation" of knowledge, the micro and macro processes must be defined to create a standardized and balanced flow of information through the system.

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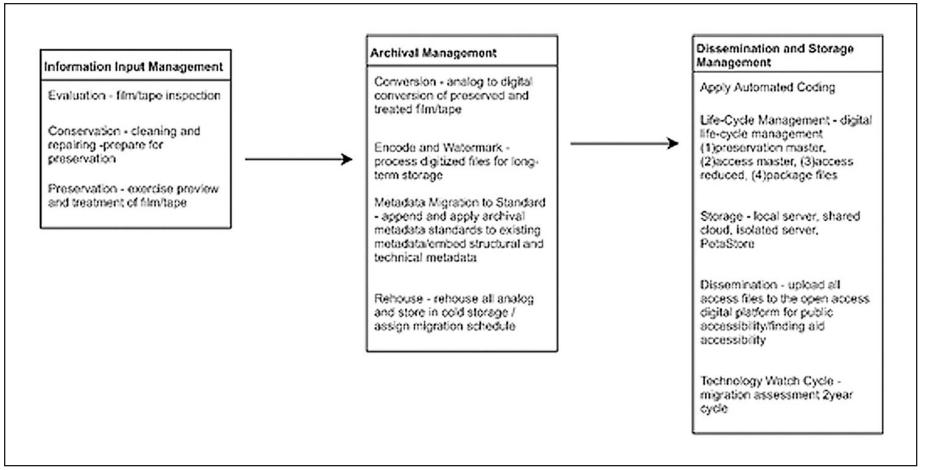
28. It is imperative to collect obsolete playback equipment and bulk to repair or change heads/belts/transistors, etc. Collection of software and computer units built for obsolete operating systems are also imperative to collect. Without resource management, the inability to transfer analog materials will result in loss or preventable degradation.
29. Pryse, "Developing a Model for Information and Knowledge Flow Within the Networked Digital Archival Information System. University of North Texas," 2020, available at: https://rb.gy/eet11l.
30. Rasche, "The Paradoxical Foundation of Strategic Management. Hamburg, Germany: Physica- Verlag A Springer Company," 2008, available at: https://link.springer.com/book/10.1007% 2F978-3-7908-1976-2#authorsandaffiliationsbook.



Workflow Model 5. Three module system for simplified process stability.

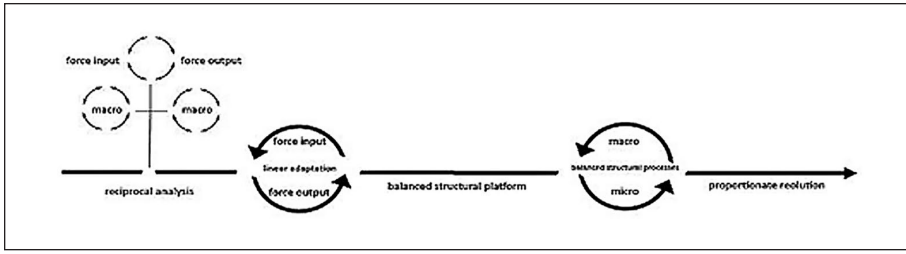
- **Accuracy of digital metadata creation**: Incomplete or inaccurate metadata creation prevents accessibility and longevity of collected materials.
- **Time ratios for processing (physical and digital combine)**: Efficiency of defined processes and the quality of the finished product. Defined control measure to effectively direct reliability.
- **Sustainability over a defined time period**: Prevention of fragmented or unreliable data relies on the ability of the Archive to maintain data over an extended (defined) period of time. Migration and technology analysis schedules are defined in the preservation metadata.

Workflow Model 5 represents clustered sequences of activities into three basic modules. One flows into the next without significant deviation from the linear path. Simply, the linear flow facilitates continuity and interoperability with personnel turnover.[31]

Sustainability and Cross-Format Application

The political communication project represents the specificity of film and video format methods; however, the Linear Workflow approach has been implemented in all digital media workflow at the Center.[32] Standardization of all processes depends on the

31. As a University entity student will change positions on a semester basis. The continuous cycle represents challenges for many University archives. The Center's workflow has addressed the in-boarding process of new student groups. Since the 2020 pandemic the student internship program at the Center has more than doubled/per semester. Research proves employee turnover is a significant factor in organizational success (Ahmed, Z., et al. 2016).
32. The Center has digitized and migrated materials for multiple grant funded projects which includes over 1 million digital images, audio, video, text, and e-books. For more information visit the Carl Albert Center Website.



Workflow Model 6. Linear reciprocity model (proposed, 2020).

continued analysis and adaption of cur rent standards and digital technologies. Limiting factors should not exist across digital platforms. The simplicity of the Linear Workflow Model allows for cross-application of defined controls to be effortlessly applied to any information system platform indefinitely. Relying on platform specific capabilities severely limits continuity of data and long-term preservation challenges.

The "Linear Reciprocity Model" [Workflow Model 6] is exemplified by the ability to maintain cohesive structure throughout the information system. Automating batch processes and identifying each barrier on multi-dimensional levels, result in consistency, interoperability, and longterm alignment to all archival environments.[33] With balance of micro and macro controls in each mod ule the model establishes defined measures to achieve a successive balanced structural information flow [Workflow Model 3].

Adaptation of media format and genre then dictates the micro and macro controls, but the force of the processes continue to move reciprocally without disconnection from the linear flow. As a result, developing a workflow template for any digital project can be controlled before input or ingestion of initial data and adapted to end-user requirements.

An additional measure defined by the Linear Reciprocity Model [Workflow Model 6] is the ideology of a "one-touch" method of processing collections. Intrinsically focused on collection welfare, the center has adapted the guidance of handling the original object at a minimum and only for "refresh" purposes. Identifying the micro processes and the subsequent tasks involved within each module lends to the goals of the Center's archive. The Center has found that a workflow structured with efficient, exclusive processes should only be handled on singular dates assigned migration schedule. Repeatedly handing or accessing preserved materials will always result in increased degradation or absolute loss of data.

Workflow activities, defined by the Linear Reciprocity Model [Workflow Model 6], directs training to the role of the personnel, not the individual education or skillset working with the information. Simplicity of process within each module secures barrier-free flow of information. Deviation from the outlined processes can result in flow disruption thereby creating openings for error or misaligned data. The key factor of

33. Pryse, "Developing a Model for Information and Knowledge Flow Within the Networked Digital Archival Information System. University of North Texas," 2020, available at: https://rb.gy/eet11l.

success is the role of leadership with defining the workflow model. The Center's template developed for all digital projects is not contingent on individual educational background of those working on a project.

The Collection represents over 100,000 complex files that are exclusively reliant on specialized software and hardware control. Historically, numerous archives and museums had become incapable of handling such materials without hiring specialized staff exclusively assigned to a special collection . According to a report by a leading authority in the digital archival field, Online Com puter Library Center, Inc. (OCLC), the most common impediments recorded when addressing audio and visual media were:[34]

1. 83% lack of training
2. 69% reported lack of funding
3. 54% reported lack of time for planning
4. 52% reported lack of expertise

The model developed by the Center addresses all potential issues with its comprehensive workflow design. The Workflow Model assigned to the Collection project has a three-module configuration to simplify the process and address specialized training before launching the project [Workflow Model 6]. Within the three-module workflow, the standard storage structure facilitates the continuity of information from one module to the next. Module efficiency cycles forward along the linear path with no regressive steps that cause repeated handling or misuse of files.

Productivity metrics for this project are based on clustering both serial and randomized files using productivity, cycle time, and flow efficiency models.[35,36] Process analysis and design methodology used for both human and automated processes allow for reciprocal interaction between task, process, and module, with focus on standardization throughout the workflow. Long-term preserva tion and end-user accessibility of massive digital data collections rely on efficient methodologies that demonstrate both stability and continuous adaptability so as to reduce deterioration. Using standardized processes removes barrier formation, duplication, data entropy, and redundancy.

The Center has found using automated batch file scripting and batch enabled processes integrates defined commands to expedite activities throughout the workflow [Workflow Model 7]. The homogeneous automation of activities allows limited personnel to sort substantial amounts of complex file structures, creates the ability to embed, append, and import/export data, and to monitor potential errors. Batch file processes, once written, are easily communicated to personnel through training materials that can be copied and pasted into command line interfaces [Workflow Model 8]. This automation allows for large scale data analysis on a micro level to support cyclical flow throughout the linear system.

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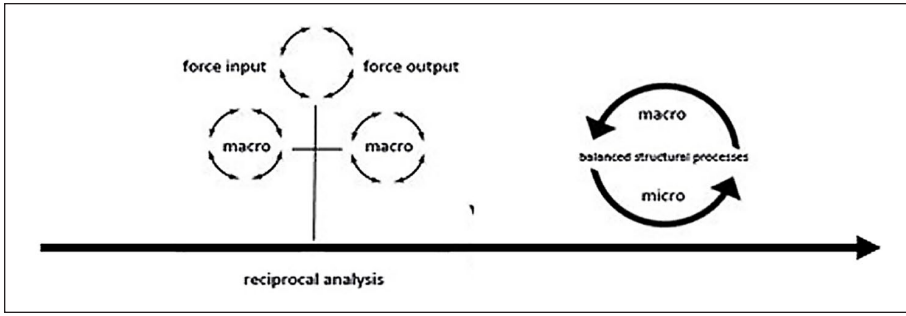
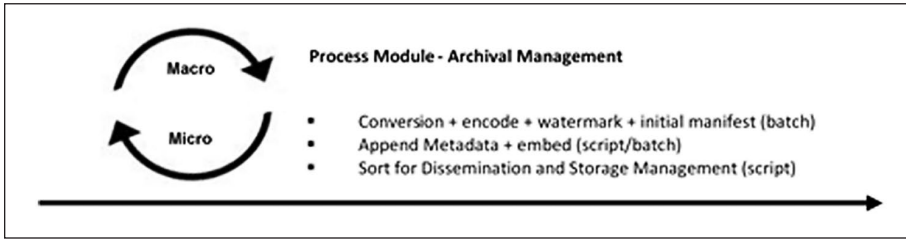
34. Dooley and Luce, *Taking Our Pulse: The OCLC Research Survey of Special Collections and Archives* (Dublin, OH, 2010).
35. Lin et al. "A Generic Structure for Business Process Modeling," *Business Process Management Journal*, 8 no 2 (2002): 19–41.
36. Tsalgatidou and Junginger, "Modelling in the Re-Engineering Process," *ACM SIGOIS Bulletin*, 16 no 1 (1995): 17–24.



Workflow Model 7. Modules within the linear reciprocity model.



Workflow Model 8. Macro levels and micro process reciprocation.

The continuous generation of flow force creates a constant production throughout the information system, without depending on personnel subject to turnover or student programming changes. Un-like barrier-ridden workflow systems, the Center's workflow provides sustainability. Experiential research by the Center through process measurement found information entropy occurs when de fined or varied controls, or lack of controls, are present.[37,38] Workflow connectivity and simplified processes benefit personnel, whether remote or in-house, independent of experience in the field, or education. Predictability throughout the information system reduces entropy by creating cohesive reciprocation of workflow activities. Reciprocal cohesion of flow isolates potential data anomalies by factoring the probability of network or personnel changes, as well as format migration for future preservation.

Preservation and migration planning are often outsourced or handled in-house as independent activities separate from linear workflows, and then re-introduced to the

37. Losee, "An Information Theory Calculator for Understanding Information and Library Science Applications," *Information*, 8 no. 3 (2017): 98.
38. Utilizing the theory of information and Shannon entropy formulas, the Center was able to predict or find prob-ability of relationships between variables; or in the case of this project: processes. The averaging of complex processes throughout the information system provided data which assisted in focusing micro processes to design efficient input and output through each module. [Average(X) = E(X) = i Pr(xi) Xi. Whereas Entropy for the average variable is H(X) = i Pr(xi) log(1/Pr(xi)),].

information system when complete. Resource variables present a higher probability of information entropy through displacement or alternative standardization unique to the entity in control of the data.

Conclusion

Through continuous analysis of workflow processes, the Center has effectively produced quality assets with robust metadata, error-free file structure and quantifiable control methods, which effect long-term preservation goals as well as end-user accessibility. Though the "Linear Reciprocity Model" is based on business efficient work-production processes, the Center has found that quanti fying actions in relation to productivity outcome provides decreased cycle time and data reliability. The overall impact of simplified linear workflow implementation has grown opportunities for col laboration with multiple universities, provided means of funding large-scale digital projects, and has advanced the Center's remote workflow capabilities.

Pandemics or other causes of interruption of funding for any organization results in potential failure of systems by immobilizing the organization's ability to produce, or in the case of archival repositories, preserve items that are expiring and degrading on a minute-to-minute basis. This paper provides a practical approach to addressing critical concerns in archival information systems. Technological evolution dictates usability of information and the organization provides the accessibility to that information. Pragmatic transformation in the information system requires simplification rather than complicated processes with multi-level activities that directly harm the materials an archive holds. Providing a structured, defined workflow before initiating any project guides the process in a manner that guarantees a fail safe outcome. In the archival field this outcome is the basis for future funding, collaboration, and opportunities to provide the public information for generations to come.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

J.A. Pryse https://orcid.org/0000-0001-5243-4079

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Author Biography

J.A. Pryse as a dedicated educator and archive specialist, works with large-scale, complex collections which requires attention to workflow efficiency and the ability to implement defined standardized processes within multifaceted information systems. Pryse's research and professional development is focused on continuity and reliability of all collected materials and to advocate for continuous process efficiency strategy creation.