Postprint: Practices and Implications of Long-Term Digital Preservation in Indiana and Montana, USA

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Abstract

[Purpose/Significance] To introduce the practices of long-term digital resource preservation in Indiana and Montana, USA, and provide reference and lessons for digital resource preservation work in Chinese libraries.

[Method/Process] To conduct a comparative analysis of the practices of long-term digital resource preservation in Indiana and Montana, USA, from the perspectives of organizational structure, policy and funding support, technical service platforms, and project characteristics, and to summarize the methods and experiences of digital preservation.

[Results/Conclusion] Implications include: utilizing various levels of the National Working Committee of University Libraries to carry out top-down publicity and education; establishing a sustainable funding mechanism; launching pilot projects on a collaborative basis; assessing the current status of digital preservation in one's own institution and clarifying digital preservation needs; formulating digital preservation policies by referencing established best practices; and selecting appropriate technical platforms and services.

Full Text

Digital Resources Long-term Preservation Practices and Enlightenment from Indiana and Montana, USA

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Abstract

This paper introduces the practices of long-term digital resource preservation in Indiana and Montana, USA, providing reference for digital resource preserva-

tion work in Chinese libraries. The practices are comparatively analyzed from aspects of organizational structure, policy and funding support, technical service platform, and project characteristics, summarizing methods and experiences of digital preservation. Enlightenments obtained include: utilizing national academic library committees at all levels to conduct top-down advocacy and education; establishing sustainable funding mechanisms; launching pilot projects based on cooperation; assessing institutional digital preservation status and clarifying preservation needs; formulating digital preservation policies by referencing mature cases; and selecting appropriate technical platforms and services.

Keywords: Digital preservation; Digital preservation services; Consortium collaboration; Indiana; Montana

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Currently, digital resources are growing at petabyte-level speeds and have become mainstream resources for science, technology, education, and cultural heritage transmission. The long-term preservation of digital resources has increasingly attracted government attention worldwide [1], and research on this topic has gained prominence among scholars both domestically and internationally. Since the late 1980s, with the rapid growth of digital information, academic institutions began to emphasize and undertake research on digital preservation. The U.S. federal government advocated for digital preservation actions through regular reports on federal electronic records preservation and supported the preservation of digital records nationwide through established funds [2]. In 1994, the Association of Research Libraries (ARL) formed a Digital Archiving Working Group responsible for developing guidelines for digital archiving to ensure sustainable, indefinite access to digitally stored records [3]. The working group appealed to the library community, recommending academic research on digital preservation focusing on preservation funds, policy development, and community organizations.

Since then, numerous studies on digital resource preservation have emerged, such as drafting digital preservation plans and policies, developing digital preservation repositories, investigating library digital preservation practices, establishing and implementing metadata preservation, and building and evaluating long-term digital storage systems. The library community has also conducted large-scale digital preservation advocacy and education, including the National Digital Information Infrastructure and Preservation Program led by the Library of Congress. In recent years, domestic scholars have introduced some national engineering projects and consortia for digital resource preservation abroad [5-6], emphasizing that alliance and cooperation represent the best path for long-term digital resource preservation. However, few domestic studies have reported on how university libraries can carry out long-term digital resource preservation through cooperation.

Using the SCI-E and SSCI databases on the Web of Science platform, we retrieved 110 foreign journal papers published since 2000 on libraries participating

in digital preservation alliances or collaborations. The search was limited to the "Topic" field with the English search string: library and digital preservation and (alliance or consortia or consortial or consortium or consortion or coalition or cooperation or collaboration or collaborative). After screening these papers for literature on regional digital preservation practices involving university libraries, we identified practices including the Indiana digital preservation InDiPres project [7], the Montana DuraCloud digital resource preservation project [4], the Massachusetts Pioneer Valley 5-college consortium Archivematica digital preservation project [8], the Texas digital newspaper preservation alliance [9], the Florida dark archive project [10], the North Carolina geospatial data cooperative preservation project [11], the Alabama LOCKSS software-based digital preservation collaborative network [12], and the European Open Preservation Foundation.

Despite extensive research and advocacy, libraries still require certain hardware facilities. In 2014, Bishoff, in collaboration with DuraSpace, surveyed 145 non-ARL libraries on "managing digital collections" [13]. Results showed that digital resource preservation efforts might be hindered by "lack of funds, insufficient expertise and management support, and not knowing where to start." The survey report recommended that the library community address these obstacles through two main strategies: utilizing digital preservation services and collaborative digital preservation.

How to employ these two strategies to implement digital resource preservation practices is a question worth exploring. Compared with digital preservation initiatives in Massachusetts [8], Texas [9], Florida [10], North Carolina [11], and Alabama [12], the Indiana InDiPres project [7] and Montana DuraCloud digital resource preservation project [4] encompass broader digital resource content and better utilize the two main strategies of digital preservation services and collaborative digital preservation for regional work. Particularly noteworthy is that the Indiana InDiPres project, funded by government grants, has over 20 participating units, demonstrating significant scale effects and exemplary practices.

2. Digital Resource Long-term Preservation Practices in Indiana and Montana

2.1 Introduction to the Indiana InDiPres Project [7]

In 2016, the Indiana State Library (ISL) used the Library Services and Technology Act (LSTA) fund as seed money to collaborate with the Cunningham Memorial Library at Indiana State University (CML) to establish the InDiPres project. This project is an affordable, sustainable digital preservation solution based on institutional community collaboration, primarily targeting small and medium-sized cultural heritage institutions in Indiana with insufficient resources. CML and ISL provide a collaborative service framework to facilitate statewide cooperation among institutions, reducing or eliminating technical, fi-

nancial, and personnel barriers to enable participating institutions to conduct appropriate digital preservation work. Under the InDiPres project, each participating institution can achieve optimal digital preservation solutions at low cost, storing seven copies of materials in seven different geographic locations.

2.1.1 Organizational Structure The InDiPres project primarily adopts a hybrid management model combining self-management and leadership organization. The project is led by ISL and CML, establishing an ISL service-oriented working mechanism, with relevant staff from ISL and CML serving as foundation executive fiscal agents and LOCKSS server technical supervisors, respectively. In addition to ISL and CML, 13 member units currently participate (details available at http://indipres.org/institution.html). On February 4, 2016, a working group for the "Preserving Indiana Memory Special Digitization Project" was formed, enabling group user qualification participation in the MetaArchive Cooperative Preservation Network. Working group members come from across Indiana and consist mainly of digital preservation advisors experienced in regional or international network collaboration. The working group brings together experienced experts to provide a secure, geographically dispersed, and economical digital preservation solution that meets the needs of Indiana's cultural memory project.

2.1.2 Policy and Funding Support The InDiPres project working group formulates governance policies, establishes steering and standing committees, clarifies institutional responsibilities and obligations, stipulates quorum and rules of order, nomination and voting procedures, and provides important statements on decision-making authority. Member libraries refer to ARL's SPEC Kit 325 document [14] to formulate digital preservation policies and implement local digital preservation development plans. The working group selects standards, workflows, and ingestion pathways for member libraries and urges them to upload 100% of processed digital content to the MetaArchive digital preservation network.

Between 2007 and 2014, ISL invested over $1,276,000 to establish the LSTA digitization fund, supporting digitization preservation work for libraries and cultural heritage partners in Indiana and incorporating digital collection construction into the Indiana Memory project, resulting in 386,000 digital files. Public or academic libraries could apply for fund projects individually or in partnership with other non-profit organizations.

Under the LSTA fund 2016-2017 project, ISL and CML have implemented community-based management and regularly conduct thematic workshops on writing digital preservation plans and policies. The LSTA fund project also supports the working group in reviewing and selecting appropriate ingestion pathways for member libraries' digital content and documenting workflows. Most funds are used to hire professional metadata experts, who play a key role in digital material preparation and uploading digital content to the collaborative

network. Currently, the LSTA fund project has received a second round of funding. In addition to continuing to hire temporary full-time metadata experts, funds are also used to establish an ingestion working group to ensure and implement workflows for transferring member data to ISU and joining the MetaArchive preservation network. Funds also support the creation of workflow guidance documents for current and future InDiPres members and short-term training programs to help develop local digital preservation policies and plans.

2.1.3 Technical Service Platform The U.S. 2014 Preserving Digital Objects with Restricted Resources (POWRR) white paper describes the digital preservation lifecycle diagram (see Figure 1 [Figure 1: see original paper]) [15], developed by the POWRR team to map the digital preservation lifecycle to familiar digital curation and preservation practices for cultural heritage professionals. The digital preservation process generally includes ingestion, processing, access, storage, and maintenance of digital resources.

Digital preservation services are generally divided into three categories (see Figure 2 [Figure 2: see original paper]) [15]: The first category comprises toolsets that can handle the complete digital preservation workflow (ingestion, processing, access, storage, and maintenance of digital materials), such as Rosetta, Preservica, and ArchivesDirect platforms. The second category focuses primarily on ingestion and processing services, such as Archivematica, Curator's Workbench, and Data Accessioner platforms. The third category focuses mainly on preservation and storage services, such as DuraCloud, Amazon S3, Glacier, and MetaArchive.

The InDiPres project selected the MetaArchive Alliance as its digital service technology platform, joining the MetaArchive Cooperative Preservation Network as a group user. MetaArchive primarily provides preservation and storage services for digital materials, with its role in the digital preservation lifecycle shown in Figure 3 [Figure 3: see original paper]. Functions it cannot perform are shown with gray backgrounds in Figure 3.

Established in 2004 with funding from the National Digital Information Infrastructure and Preservation Program (NDIIPP), the MetaArchive Alliance is committed to cost transparency among members, collectively sharing expertise and experience, and providing community-managed digital preservation solutions suitable for all types and sizes of institutions. Each MetaArchive member is responsible for creating their own digital files, while unified organizational management can make distributed digital preservation more economical. The MetaArchive Alliance primarily targets small and medium-sized institutions and provides members with various opportunities to participate in digital preservation research or join digital preservation working groups.

ISL encourages small and medium-sized institutions to join the InDiPres project while also accepting other organizational participants. Currently, over 20 institutions have applied to join the InDiPres project, which participates in the

MetaArchive Alliance as a group user, with each institution bearing an annual cost of $325 and storage priced at $0.59/GB.

2.1.4 Main Project Characteristics Through years of exploration, ISL and CML have established a community-based, cost-effective, open-resource digital preservation solution. The project's success hinges on education and investment.

First, the InDiPres project has emphasized digital preservation education from the outset. In March-April 2016, ISL and CML held eight digital preservation open forums, training 125 staff members from libraries, museums, local government offices, and community organizations. Based on the DPOE project's training workshops focusing on identification, selection, and storage modules [16], content centered on collection development activities, attempting to align digital preservation tasks with existing group development policies and practices of all participating units. The forums provided PowerPoint slides, digital preservation literature, thematic bibliographies, and distributed membership application forms to attendees. The open forums also provided venues for staff from libraries, archives, museums, and local governments, as well as interested individuals, to join InDiPres.

Many organizations apply for funds to scan rare and fragile original items, often equating this act with digital preservation. Therefore, open forums discussed the long-term nature, accessibility, and framework concepts of digital content preservation, and provided reference suggestions on how to secure institutional administrative support and establish and maintain basic digital preservation workflows.

Second, all participants have invested significant effort in the InDiPres project. The project's successful implementation demonstrates that creating a grassroots digital preservation solution from scratch is arduous work requiring leadership, dedication, determination, flexibility, support, and time. Success requires vision and the compelling ability to share knowledge, as well as stakeholder recognition of the cooperative approach to digital preservation. Each institution is controlled by its own governing body, and joining a fee-based organization requires approval from local boards and/or administrative departments in most cases. Management strategies may occasionally need revision to accommodate member organizations' regulations or legal issues. Participating units can better achieve digital preservation goals through complementary advantages.

2.1.5 InDiPres Project Effectiveness Due to continuous government funding, the InDiPres project currently has over 20 participating institutions, demonstrating significant scale effects. Even small libraries can launch digital preservation projects by joining the alliance and maximize the use of joint resources to achieve digital preservation goals through partnership building and collective knowledge management. The InDiPres project is currently being implemented, with the LSTA fund project receiving a second round of funding. InDiPres plans to achieve self-sufficiency in membership fees by 2020.

2.2 Montana DuraCloud Digital Resource Preservation Project [4]

In April 2016, four Montana libraries launched a one-year DuraCloud digital resource preservation cooperative pilot project to evaluate the feasibility and practicality of multi-institutional purchase of DuraCloud services for digital preservation work, and to explore how to purchase long-term, affordable digital storage services as group users through economies of scale and price advantages. This project provides a reference model for institutions seeking digital preservation cooperation. Through implementing cooperative preservation plans, institutions can establish and maintain long-term partnerships, positioning themselves to ensure successful digital preservation implementation.

2.2.1 Organizational Structure The DuraCloud digital resource preservation project primarily adopts a self-management model under working group guidance. Four participating institutions are involved: Montana State University, University of Montana, Montana Tech, and the Montana Historical Society. In 2015, under the leadership of S. Meister, a digital archives administrator at the University of Montana, the four institutions jointly established the Digital Preservation Working Group (DPWG) to support statewide digital preservation work through cooperation. Shared responsibilities of member institutions include: raising funds, developing project-based preservation plans, and regular communication with the digital preservation working group.

Each member institution has dedicated digital preservation staff who can conduct their own digital preservation work while understanding and supporting each other's efforts. Additionally, relevant personnel in the same working group can learn from each other, build collective knowledge, and achieve resource sharing. In addition to cost savings from sharing the same digital preservation service, institutions also benefit from sharing knowledge and skills in cooperation, with the DPWG serving as a support system to solve difficult problems when challenges arise.

2.2.2 Policy and Funding Support Compared with the InDiPres project, the DuraCloud digital resource preservation project has not formulated management policies. Instead, DPWG initially developed collective recommendations on digital preservation best practices through compiling a shared digital preservation literature repository. Based on assessment results and preservation needs, DPWG formulated shared digital preservation solutions and coordinated digital preservation work across Montana. Because the four institutions' digital preservation work is at different stages, each implements different digital preservation policies.

Each DPWG member in the project received financial support from their respective institution for participating in the one-year DuraCloud cooperative pilot project. DPWG is currently implementing a shared preservation system, identifying shared preservation content, and integrating it into existing workflows. DPWG will evaluate whether to continue this partnership after the pilot

project concludes. The four institutions signed a memorandum of understanding requiring each to purchase at least 1TB of storage space. The DuraCloud annual service fee is shared equally among the four institutions, with the annual fee including 1TB of storage space, allowing each institution to obtain an additional 1/4TB of storage space. Each institution selects, uploads, manages, and maintains its own content.

2.2.3 Technical Service Platform DPWG selected DuraCloud as its digital service technology platform. DuraCloud focuses primarily on preservation and storage of digital materials, with its role in the digital preservation lifecycle shown in Figure 4 [Figure 4: see original paper].

Before launching the DuraCloud digital resource preservation project, DPWG conducted a comparative analysis of four service platforms—Preservica, Rosetta, DuraCloud, and MetaArchive—regarding cost, applicability, and preservation processes. DuraCloud and MetaArchive primarily provide archival storage services with redundancy and distributed storage for regular fixity checks, while Preservica and Rosetta can provide archival storage and ingestion services with additional functions such as ingesting, processing, and publishing digital content.

DPWG determined that its key objective was to ensure digital archival storage beyond existing basic storage and backup systems, with archival storage being the fundamental need. Therefore, DPWG considered selecting either DuraCloud or MetaArchive. However, MetaArchive requires at least a three-year contract, while DPWG was still in the assessment stage and could not sign multi-year contracts with service providers. Consequently, DPWG recommended implementing a multi-institutional, one-year DuraCloud pilot project, reducing costs for each unit through group purchase of services.

2.2.4 Main Project Characteristics The project's main characteristics include creating a shared digital resource content description template to facilitate the working group's understanding of each institution's digital collection status and developing a five-point plan for successful digital preservation cooperation.

(1) **Shared Digital Resource Content Description Template.** Content description is an important task undertaken before implementing digital preservation projects, aiming to record basic information about digital resources. The British Library notes that creating preservation plan content descriptions provides opportunities to establish dialogue with managers and content experts regarding special preservation needs, thus benefiting institutions [17].

The University of Montana created and shared a content description template with other DPWG members. The content description profile records basic information about each institution's collection, including content type, description, size, complexity, current management/storage, rights, value, and preservation

priority. The template requires each institution to consider collections relative to each other, including their relative complexity (e.g., diversity of file formats), value, and preservation priority. It also documents creation, acquisition, rights management, and current storage practices for each collection. Content description allows the working group to determine the scale of institutional digital resource collections and identify the most critical content for digital preservation.

Through using this shared template process, DPWG can better compare each institution's collection and digital preservation status. As a useful reference, content description continues to provide DPWG with an overall "snapshot" of the digital content it manages. The content description template is shown in Table 1 .

(2) **Five-Point Plan for Successful Cooperation.** The four institutions established cooperative partnerships and gained practical experience in digital preservation work by sharing the DuraCloud service platform. The working group attended training as a whole, identified problems together, developed shareable institutional workflows, and thereby improved each institution's workflows. This work also promoted and enhanced statewide digital content collaboration and preservation awareness. DPWG proposed a five-point plan for successful cooperation, shown in Figure 5 [Figure 5: see original paper].

As shown in Figure 5, the five-point plan for successful cooperation mainly includes: cultivating a knowledge base and determining a common vision; assessing each institution's current digital preservation status; advocating the value of digital preservation activities; implementing shared digital preservation services; and sustaining group activities and establishing continuous support frameworks.

2.2.5 DuraCloud Digital Resource Preservation Project Effectiveness

The Montana DuraCloud digital resource preservation project is a one-year cooperative pilot project. Through the pilot project, institutions implement best practices for long-term digital resource preservation, understand and support each other's work, and ultimately achieve digital sharing services to fill gaps in existing digital preservation work. The organization establishes partnerships, builds shared knowledge, maximizes resource integration, and helps resource-limited libraries achieve digital preservation goals. The four institutions save costs by sharing a digital preservation service platform while also benefiting from sharing knowledge and skills. After project completion, each institution will conduct self-assessment to reflect on the impact of cooperation on digital preservation practices. Whether cooperation will continue depends on whether respective institutions continue to provide financial support.

3. Comparative Analysis of Digital Resource Long-term Preservation Practices in Indiana and Montana

3.1 Common Points

3.1.1 Emphasis on Advocacy and Training. Both projects attach great importance to advocating digital preservation work and have conducted various forms of thematic training. The InDiPres project utilized eight digital preservation open forums to train 125 digital preservation staff members. By inviting digital preservation experts and staff for on-site guidance, issuing press releases or utilizing other publications, thematic introductions, and workshops, the project conducted digital preservation education and provided digital preservation solutions for institutions interested in joining InDiPres. The DuraCloud digital resource preservation project also 特别强调倡导与培育的重要性 (particularly emphasizes the importance of advocacy and cultivation). In the early stages of digital preservation solution creation, to ensure most institutional staff understand and recognize digital preservation work, the project introduces the main information and key points of the solution to library managers, IT professionals, and library colleagues.

3.1.2 Establishment of Working Groups and Cooperative Digital Preservation Goals. The InDiPres project established the Preserving Indiana Memory Special Digitization Project working group. Members come from across Indiana and consist mainly of digital preservation advisors experienced in regional or international network collaboration. The four Montana libraries formed the Montana Digital Preservation Working Group to support statewide digital preservation work through cooperation. Working groups can coordinate institutional digital preservation work, build partnerships and shared knowledge, maximize resource integration, and help resource-limited small and medium-sized libraries achieve digital preservation goals.

3.2 Different Points

3.2.1 Different Cooperation Foundations. In the InDiPres project, CML and ISL have a profound cooperation foundation. In 2003-2004, CML and ISL jointly hosted the Indiana Digital Library Summit and cooperated to establish a statewide digital library, subsequently serving as leaders in statewide digital library construction. In 2008, the two units jointly released "Indiana Memory," and both subsequently led the organization of Indiana Digital Preservation Summits and statewide digital preservation seminars. This multi-year cooperation foundation and leadership role enabled the InDiPres project to gain responses from many units across Indiana, with statewide digital preservation work proceeding smoothly. The four Montana libraries cooperate to support statewide digital preservation work based primarily on traditional business cooperation (such as interlibrary loan and revised union catalogs), with less influence and scale effect than the InDiPres project.

3.2.2 Different Organizational Structures. The InDiPres project primarily

adopts a hybrid management model combining self-management and leadership organization. ISL and CML serve as leading organizations, establishing an ISL service-oriented working mechanism with foundation executive fiscal agents and LOCKSS server technical supervisors positioned at ISL and CML respectively. The four Montana libraries adopt a self-management model under working group guidance. The InDiPres project organizational structure model is more suitable for digital preservation projects with multiple library participants, led by resource-rich and technologically strong libraries that can support InDiPres entity operations. However, personnel issues disrupted plans, and the website (http://indipres.org) remains under construction.

3.2.3 Different Technical Service Platforms. The InDiPres project selected MetaArchive as its digital service technology platform, joining the MetaArchive cooperative preservation network as a group user. MetaArchive requires at least a three-year contract, while Montana DPWG was still in the assessment stage and could not sign multi-year contracts with service providers. Therefore, DPWG ultimately recommended implementing a multi-institutional, one-year DuraCloud pilot project.

3.2.4 Different Funding Mechanisms and Sustainability. Under LSTA digitization fund support, the InDiPres project focuses on small and medium-sized libraries and Indiana cultural heritage organizations, establishing cooperative groups to implement affordable, sustainable digital preservation solutions. With government funding, the InDiPres project has strong sustainability. The four Montana libraries' digital preservation funds are borne by each respective unit, making sustainability relatively weaker due to each institution's policy influences.

3.3 Project Applicability Conditions

The InDiPres project is an affordable, sustainable digital preservation solution based on institutional community collaboration under the leadership of ISL and CML as leading organizations. Through statewide digital preservation cooperation, it reduces or eliminates technical, financial, and personnel barriers, enabling resource-limited small and medium-sized cultural heritage institutions in Indiana to conduct appropriate digital preservation work. This model is suitable for larger-scale multi-institutional digitization cooperation and digital preservation practices within a province or city, led by libraries with strong resources and technical capabilities to drive other resource-limited small and medium-sized cultural heritage institutions in implementing digital preservation work.

Although the Montana DuraCloud digital resource preservation project is a statewide digital preservation pilot project, it is implemented within a smaller scope and is suitable for small-scale multi-institutional cooperative digital preservation practices within a regional area (such as certain university towns). Through cooperation, institutions can implement their own best practices in digital preservation and conduct personalized digital preservation work while

sharing the same digital service platform.

3.4 Project Advantages and Disadvantages Analysis

The InDiPres project, with its continuous government funding support and organizational management and coordination by leading units, involves many participating units, demonstrates significant scale effects, and has strong sustainability. The project has enabled 75% of InDiPres members to implement local digital preservation policies and plans, and to select digital standards, workflows, and ingestion pathways for InDiPres members. However, the project's self-management and leadership organization hybrid model means some units' personalized digital preservation needs cannot be met. Most project funds are used to hire temporary full-time metadata experts, and personnel issues can disrupt overall project plans, affecting many aspects. For example, the originally planned website development was disrupted by personnel issues, and the website (http://indipres.org) remains under construction.

Compared with the InDiPres project, the DuraCloud digital preservation project's greatest weakness is the lack of continuous funding input, resulting in relatively weaker sustainability. However, the project involves fewer participating units, offers flexible organization and implementation, utilizes each institution's own funds, and can implement each institution's best practices in digital preservation under the support of the same digital preservation working group. It can also conduct personalized digital preservation work while sharing the same digital service platform.

4. Implications and Enlightenment

The U.S. National Agenda for Digital Stewardship 2015 [18] emphasizes the importance of developing an evidence base, providing education and training opportunities, and promoting cooperation and communication. Chinese university libraries can learn from U.S. digital preservation practices: on one hand, establishing national or provincial digital resource preservation alliances under the organization of national or provincial academic library committees to advocate the value of long-term digital resource preservation and provide policy guidance and digital preservation practice guidance for grassroots units; on the other hand, each university library can join digital preservation alliances or conduct digital preservation practices through cooperation. Institutions can reference mature foreign cases, conduct digital preservation practices through pilot projects, identify problems in practice, and summarize and share digital preservation experiences.

4.1 Utilize National Academic Library Committees at All Levels for Advocacy and Education

National academic library committees at all levels play important roles in promoting various library businesses and can utilize their strong organizational

capabilities and influence to advocate and educate on long-term digital resource preservation. Additionally, referencing the InDiPres project, leading units can be designated. Beyond advocating the value of digital preservation activities at national and provincial levels, staff implementing digital preservation must also recognize the importance of advocacy in preparing digital preservation services. In the early stages of digital preservation solution creation, to ensure most institutional staff understand and recognize digital preservation work, the main information and key points of the solution can be introduced to library managers, IT professionals, and library colleagues. Additionally, persuading stakeholders to recognize the value of digital preservation and approve cooperative solutions is also crucial.

4.2 Establish Sustainable Funding Mechanisms

Indiana's establishment of special funds for digital preservation, led by ISL and CML organizing over 20 statewide units to jointly implement economical and sustainable digital preservation solutions, is worthy of emulation. National academic library committees at all levels can apply for continuous digital preservation funds from governments at all levels, 面向所有会员 (for all members), to jointly implement affordable, sustainable digital preservation solutions based on institutional community collaboration.

4.3 Conduct Pilot Projects Based on Cooperation

Integrating resources, professional knowledge, and developing collective knowledge can promote digital preservation practices. Even small libraries can meet basic digital preservation needs by participating in cooperative projects. Both cases above are built upon cooperation, reducing economic costs, sharing knowledge and skills, and jointly facing difficulties and challenges. The InDiPres project was established after years of dialogue among institutions, built upon the foundation of the Indiana Digital Library, Indiana Digital Preservation Summit, and Indiana Memory project. With this existing cooperation foundation, various tasks have proceeded smoothly.

Through pilot cooperative projects, institutions can assess their digital preservation status, identify existing problems, and explore the feasibility of digital shared preservation. During project implementation, institutions can communicate with each other and jointly address difficulties and challenges encountered in work, accumulating experience for future cooperation.

4.4 Assess Digital Preservation Status and Clarify Preservation Needs

Before formulating digital preservation plans, university libraries should first assess their digital preservation status and clarify digital preservation needs. Libraries can reference the content description template created by the University of Montana and shared with other DPWG members to evaluate and inventory their digital collection content and scale from multiple aspects: content type,

description, acquisition, size, complexity, current management/storage, rights, value, and priority. They should review existing policies and workflows to determine key content for digital preservation. Using common evaluation indicators, they can conduct comparative analysis of advantages and disadvantages of single-institution versus multi-institutional cooperative digital preservation work, determine team common needs, and list priority requirement inventories.

4.5 Reference Mature Digital Resource Preservation Models for Policy Development

Domestic university libraries can reference mature foreign digital resource preservation models to formulate relevant digital preservation policies. In 2016, V.A. Dressler [19] surveyed digital preservation policies at 124 ARL member libraries and recommended typical digital preservation policy items including: financial and staff accountability; intellectual property issues; distributed services; metadata; standards; reformatting objects; implementation; storage and media strategies; review and certification; audit and risk assessment; stakeholders; and terminology.

4.6 Select Appropriate Technical Platforms and Services

Both fee-based and open-source digital preservation service platforms enable resource-limited libraries to implement institutional digital preservation work without developing complex digital preservation systems. The two cases above selected MetaArchive and DuraCloud technology platforms respectively, primarily for digital material preservation and storage. If funding permits, libraries can select toolsets that handle the complete digital preservation workflow, such as Rosetta, Preservica, and ArchivesDirect platforms. If funding is insufficient, they can select service platforms focusing on extraction and processing, such as Archivematica, Curator's Workbench, and Data Accessioner.

Long-term preservation of digital resources is increasingly becoming a strategic focus of international concern, with research flourishing. However, many libraries and archives often do not fully understand its essence and, due to lacking necessary resources for conducting digital preservation work independently—including funds, policies, technology, and personnel—have no plans to implement digital preservation work. Multi-institutional cooperation for long-term digital resource preservation is a direction worth exploring and developing further. By referencing successful domestic and international digital preservation cases, Chinese university libraries can conduct digital preservation through collective work, sharing resources, knowledge, and support under different cooperation models according to their respective statuses, creating long-term sustainable digital preservation solutions and contributing to the development of China's digital preservation cause.

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Note: Figure translations are in progress. See original paper for figures.