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IMPROVING DIGITAL PRESERVATION IN NIGERIAN ACADEMIC LIBRARIES: STRATEGIES AND CHALLENGES IN THE AGE OF BIG DATA

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Abstract

Digital preservation in Nigerian academic libraries faces significant challenges, including inadequate funding, lack of technical expertise, and the absence of standardised policies. This study explores the critical factors affecting digital preservation efforts and examines potential strategies for ensuring long-term accessibility to digital content. Drawing on existing literature, the research highlights the importance of metadata standards, format migration, cloud computing, and institutional policy frameworks in enhancing digital preservation practices. It also underscores the need for capacity-building initiatives to equip librarians with essential digital preservation skills. Additionally, the study recommends sustainable funding mechanisms, such as government grants, private-sector collaborations, and international partnerships, to support technological advancements and training programs. By addressing these key challenges, Nigerian academic libraries can strengthen their digital preservation efforts, ensuring the longevity and integrity of scholarly resources in an increasingly digitalized academic environment.

***Keywords*:** Digital preservation, Institutional repositories, metadata standards, Nigerian Digital academic libraries**.**

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Introduction

Digital preservation is increasingly becoming a major concern for academic libraries in Nigeria as they struggle to manage and safeguard large volumes of digital content. Digital preservation in Nigerian academic libraries remains a critical concern, particularly as institutions strive to safeguard long-term access to scholarly resources in the face of rapid technological change. While prior studies have extensively documented challenges such as hardware and software obsolescence, limited funding, and insufficient technical expertise (Sambo et al., 2017; Kari & Baro, 2016), this research moves beyond mere problem identification. It evaluates how institutional policy frameworks, staff capacity-building, and technological adoption influence the sustainability of digital preservation efforts in Nigerian university libraries. In particular, the study adopts a systems-oriented perspective that considers infrastructural constraints, administrative priorities, and user engagement. Although previous literature, including Samba et al. (2014), highlights the need for national policies and structured training programs, this study contributes by critically assessing the effectiveness of such interventions in practice, identifying existing gaps, and proposing a model for policy-to-practice translation within the Nigerian context. Thus, rather than reiterating existing challenges, the research seeks to illuminate practical and context-specific solutions that align with institutional realities. Olubiyo and Olubiyo (2023) are of the opinion that adopting digital preservation techniques such as migration can help maintain access to digital resources over time. By implementing these measures, academic libraries in Nigeria can strengthen their ability to preserve and provide long-term access to valuable digital information.

Digital preservation in academic libraries is essential for ensuring long-term access to information resources and supporting research activities of its parent institutions. According to Awamleh and Hamad (2022), the ability to maintain digital records over time is fundamental to sustaining scholarly communication and knowledge dissemination. Saini (2020) pointed out that institutional repositories play a critical role in showcasing research output and enhancing collaboration among scholars. However, Gerrard et al. (2018) further noted that the sheer

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volume of digital content presents significant challenges, necessitating the adoption of advanced system architectures capable of handling Big Data efficiently. Pasqui (2024) is of the opinion that libraries must continuously adapt their preservation strategies in response to the evolving publishing industry and the emergence of Open Science. Key considerations in this process include the development of comprehensive preservation policies, encouraging faculty participation, and addressing financial constraints (Saini, 2020). Additionally, Pasqui (2024) emphasized that integrating digital curation and preservation is crucial to ensuring the long-term usability and accessibility of digital resources. To address these challenges, libraries should explore cloud services to minimize infrastructure costs and incorporate "digital preservation by design" into all academic and cultural heritage initiatives (Pasqui, 2024).

This study seeks to assess the current state of digital preservation in Nigerian academic libraries from existing literature, identifying key challenges and proposing strategies for improving long-term access to digital resources. Specifically, it aims to evaluate existing digital preservation infrastructure and policies, examine major obstacles that hinder effective preservation, and explore best practices suited for the Big Data era. Without effective digital preservation measures, Nigerian academic libraries risk knowledge loss, increased academic dishonesty, and inefficiencies in research. Therefore, it is imperative for these institutions to adopt proactive preservation strategies that safeguard digital collections from obsolescence, cyber threats, and inadequate infrastructure. By analyzing current approaches and aligning them with global best practices, this research will contribute to the development of sustainable digital preservation frameworks that support academic excellence and knowledge retention in Nigeria.

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Overview of Digital Preservation in Academic Libraries

Digital preservation in academic libraries is essential for ensuring the long-term accessibility and usability of digital resources. According to Masenya and Ngulube (2020), common preservation strategies include migration, bit preservation, and replication, which help maintain the integrity of digital collections. However, as these collections expand to the scale of Big Data, Gerrard et al. (2018) pointed out that preservation systems must evolve to support large-scale processing and analysis. They further stated that achieving this requires parallel processing capabilities and efficient collection subdivision to manage vast amounts of information effectively. Pasqui (2024) is of the opinion that digital curation and preservation are becoming more interconnected, especially with the rise of dynamic content and Open Science, which introduce new complexities for academic libraries. He further suggested that cloud services offer a cost-effective solution for preservation infrastructure, reducing financial burdens on institutions. To address these evolving challenges, Pasqui (2024), along with Masenya and Ngulube (2020), stated that libraries should adopt a "digital preservation by design" approach, ensuring that preservation strategies are integrated into digital library systems from the outset.

Academic libraries in Nigeria face considerable challenges in digital preservation, primarily due to inadequate infrastructure, limited technical expertise, and insufficient funding. According to Sambo et al. (2017) and Samba et al. (2014), many institutions struggle with outdated technologies and a lack of formal digital preservation policies. Kari and Baro (2016) further pointed out that the absence of clear guidelines leaves libraries vulnerable to data loss and inefficiencies in managing digital resources. Additionally, Samba et al. (2014) stated that many librarians have low awareness and knowledge of digital preservation strategies, highlighting the need for specialized training and capacity-building initiatives. Sambo et al. (2017) noted that key preservation challenges include hardware and software obsolescence,

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inadequate backup systems, and the absence of standardized policies, all of which threaten the long-term accessibility of digital collections. In response to these issues, Oguche and Aliyu (2021) suggested the development of a national framework for digital preservation in Nigeria, incorporating strategies such as emulation, migration, and encapsulation. Furthermore, Sambo et al. (2017) and Samba et al. (2014) emphasized the need to develop standardized policies, provide comprehensive training programs for librarians, secure increased funding, and establish long-term preservation strategies to ensure that digital collections remain accessible for future generations.

The Impact of Big Data on Digital Preservation in Nigeria

Big Data presents both opportunities and challenges for libraries, particularly in digital preservation and service enhancement. According to Gerrard et al. (2018), the exponential growth of digital content demands innovative solutions for storage, organization, and retrieval. Libraries must adapt to managing vast datasets efficiently by integrating technologies such as cloud storage and AI-driven metadata management, as suggested by Ball (2019). Kaladhar et al. (2018) pointed out that Big Data analytics can extract valuable insights from library data, improving user services and information accessibility. However, scaling preservation systems to handle Big Data volumes is a significant challenge, requiring parallel processing capabilities and effective collection subdivision, as noted by Gerrard et al. (2018). Additionally, Garoufallou and Gaitanou (2021) stated that librarians must develop new skills to handle Big Data technologies and derive value from complex datasets. While Big Data offers great potential for enhancing library services, Ball (2019) is of the opinion that libraries must balance accuracy requirements with the benefits of data correlation and analysis.

In the Nigerian context, digital preservation faces severe challenges, including hardware and software obsolescence, lack of training, inadequate funding, and the absence of standardized

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policies. According to Sambo et al. (2017), these issues are further complicated by the increasing complexity of Big Data, which requires more sophisticated preservation systems and expertise. Tella (2019) pointed out that although librarians recognize the potential of Big Data to improve patron experiences and streamline operations, they often struggle with poor infrastructure, unreliable internet connectivity, and a shortage of data experts. Samba et al. (2014) stated that many libraries lack formal digital preservation policies, and librarians often have limited knowledge of effective preservation strategies. To address these challenges, Samba et al. (2014) and Sambo et al. (2017) suggested developing national preservation policies, updating library and information science curricula, and investing in training and infrastructure. Furthermore, Gerrard et al. (2018) emphasized the need for evolving preservation system architectures that can handle Big Data while maintaining usability and efficiency.

Existing Digital Preservation Strategies

Digital preservation strategies in academic libraries are essential for maintaining long-term access to digital resources. According to Masenya and Ngulube (2020) and Adjei et al. (2019), common approaches include digital repositories, migration, bit preservation, replication, and risk management. Gbaje and Mohammed (2017) pointed out that the Open Archival Information System (OAIS) reference model is widely used as a framework for digital preservation, outlining key components such as ingest, storage, management, and access. However, Adjei et al. (2019) stated that some institutions still struggle with inadequate preservation standards and practices, which can compromise the longevity of digital collections. To address these challenges, Adjei et al. (2019) suggested that academic libraries should develop comprehensive digital preservation policies, establish disaster recovery plans, secure adequate funding, and invest in staff development. Chandra and Gokhale (2012) further pointed out that implementing OAIS-compliant systems can enhance interoperability and

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provide a structured approach to digital preservation, as demonstrated by the Indian Institute of Geomagnetism's pilot institutional repository.

Ensuring long-term access to electronic resources requires a combination of strategies that address technological obsolescence and data security. According to Olubiyo and Olubiyo (2023) and Beskaravainaya and Mitroshin (2024), regular data migration is critical for transferring digital content to newer formats and systems, preventing loss due to outdated technology. Beskaravainaya and Mitroshin (2024) also stated that libraries rely on redundant storage solutions and cloud storage to safeguard data against hardware failures and corruption. Maxymuk (2005) is of the opinion that metadata management plays a vital role in digital preservation by providing descriptive, technical, and administrative information, which aids in discovery and long-term usability. Barve (2007) pointed out that file format selection is another crucial factor, as libraries must consider format characteristics, specifications, and long-term sustainability. Furthermore, Barve (2007) noted that international initiatives like PRONOM and the Global Digital Format Registry (GDFR) assist in managing file format information, helping institutions navigate the challenges of preserving digital resources in an ever-evolving technological landscape.

Current State of Digital Preservation in Nigerian Academic Libraries

The state of digital preservation in Nigerian academic libraries presents significant challenges, primarily due to inadequate infrastructure and outdated systems. According to Sambo et al. (2017) and Samba et al. (2014), many institutions lack the necessary hardware and software to support effective digital preservation. Saka et al. (2021) further pointed out that limited access to advanced technologies and obsolete systems hinder large-scale data storage and management. Additionally, Sambo et al. (2017) and Saka et al. (2021) stated that insufficient funding, unreliable internet services, and inconsistent power supply further impede

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preservation efforts. Kari and Baro (2016) are of the opinion that the absence of digital preservation policies and a lack of trained staff increase the risk of data loss. However, some progress has been made, as Kari and Baro (2016) pointed out that some Nigerian university libraries have developed institutional repositories using DSpace software. Despite this, most institutions still struggle with inadequate long-term funding and technical expertise, making sustainable digital preservation a continuing challenge. Addressing these issues requires strategic investments in infrastructure, training, policy development, and sustainable funding to strengthen digital preservation practices in Nigerian academic libraries.

While there is increasing awareness of digital preservation among librarians, many academic libraries in Nigeria still lack structured policies and the technical expertise required for effective implementation. According to Sambo et al. (2017) and Samba et al. (2014), although some librarians understand the importance of preservation strategies, institutions often struggle with hardware and software obsolescence, insufficient funding, and a shortage of trained personnel. Kari and Baro (2016) and Sambo et al. (2017) pointed out that while some universities have adopted institutional repositories such as DSpace, many still lack long-term policies and sustainable funding for digital preservation. Gbaje (2011) is of the opinion that migration remains the most used preservation strategy, but there is a need for more structured approaches and a national framework to guide institutions. To address these gaps, Samba et al. (2014) and Gbaje (2011) suggested the development of standardized preservation policies, the provision of specialized training for librarians, and securing adequate financial support. Additionally, they recommended the establishment of a National Centre for Digital Preservation to coordinate and monitor digital preservation activities across the country, ensuring that Nigerian academic libraries can effectively safeguard digital resources for future generations.

Challenges of Digital Preservation in Nigerian Academic Libraries

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Technological Obsolescence: Nigerian academic libraries face considerable challenges in the digital preservation of resources. According to Sambo et al. (2017) and Samba et al. (2014), key issues include outdated hardware and software implementation. Samba et al. (2014) further pointed out that many librarians are not well-informed about digital preservation strategies, which significantly hinders effective implementation. Additionally, Sambo et al. (2017) stated that the technological gap and frequent power outages further complicate efforts to maintain digital resources. Ifijeh et al. (2015) are of the opinion that while traditional binding methods are still used for newspaper preservation, they are no longer adequate, and digitization is a more effective solution. However, Ifijeh et al. (2015) also pointed out that digitization efforts face significant barriers, including the digital divide, poor infrastructure, and copyright restrictions. To address these challenges, there must be a need for modern preservation technologies and stronger institutional policies. According to Samba et al. (2014) and Olubiyo and Olubiyo (2023), libraries should prioritize training programs for librarians and advocate for national policies on digital preservation. Additionally, Olubiyo and Olubiyo (2023) stated that migration strategies can be an effective solution for maintaining access to digital information, particularly in mitigating the risks of technological obsolescence.

Limited Funding and Resources: Nigerian academic libraries encounter significant challenges in the digital preservation of their collections. Financial constraints remain a major obstacle, limiting the acquisition of essential technology and infrastructure necessary for the long-term storage and protection of digital content. Limited funding and resources significantly hinder Big Data preservation in Nigeria by restricting the acquisition of essential infrastructure, technology, and expertise. Many institutions in Nigeria lack the financial capacity to invest in high-capacity storage systems, cloud services, and data backup solutions necessary for long-term preservation. Additionally, inadequate funding leads to outdated hardware and software, making it difficult to manage and protect large volumes of digital content effectively. The

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shortage of financial resources also affects human capital development, as there are limited opportunities for training librarians and IT personnel in advanced data management and preservation techniques. Without skilled professionals, libraries struggle to implement efficient data preservation strategies Sambo et al. (2017) and Olatokun (2008).

Skills and Training Gaps: Nigerian academic libraries face significant hurdles in digital preservation, with the lack of specialized skills and training among library staff being a primary concern. According to Sambo et al. (2017) and Samba et al. (2014), many librarians do not possess the technical expertise necessary for effective digital preservation, making it difficult to manage and safeguard digital collections. The situation is further complicated by the absence of formal digital preservation policies, insufficient funding, and minimal institutional support, all of which hinder the development of sustainable preservation strategies (Sambo et al., 2017; Samba et al., 2014). Additionally, Njeze and James (2013) pointed out that many institutions rely on paraprofessionals rather than trained specialists to oversee preservation efforts, which affects the efficiency and longevity of digital resources. While librarians in Nigeria generally exhibit strong management and interpersonal skills, their proficiency in information technology remains inadequate, preventing them from fully adapting to the demands of digital libraries (Ezema & Ugwu, 2014). Without proper IT knowledge, librarians struggle to implement modern preservation techniques, leaving digital collections vulnerable to degradation and loss. To address these issues, the provision of targeted training programs for librarians, and the revision of library and information science curricula to incorporate digital preservation methodologies are some of the measures that can be explored (Samba et al., 2014; Ezema & Ugwu, 2014).

Policy and Institutional Barriers: There is a lack of comprehensive and standardized policies or institutional frameworks for digital preservation in Nigerian academic libraries. The absence of clear guidelines and regulations makes it difficult to implement consistent and effective

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preservation practices across institutions. This policy gap also results in fragmented efforts and a lack of coordinated strategy, hindering the overall progress of digital preservation in the academic sector Gbaje and Mohammed (2013).

Strategies for Enhancing Digital Preservation in the Era of Big Data

In the era of big data, academic institutions and libraries face the growing need to preserve vast volumes of digital content in formats that ensure long-term accessibility, authenticity, and usability. As data generation accelerates across research, education, and administration, effective digital preservation strategies have become essential to safeguard intellectual assets and institutional memory. This section explores practical and forward-looking strategy for enhancing digital preservation in academic libraries, with particular attention to the technological, policy, and human resource dimensions required to meet the demands of a data-intensive environment.

Adoption of Cloud-Based and Distributed Storage Systems

Cloud computing has emerged as a transformative solution for digital preservation in academic libraries, providing scalability, flexibility, and cost-effectiveness. According to Masenya (2020) and Karthika et al. (2024), libraries are increasingly adopting cloud-based services for storage, digital asset management, and collaborative research. These services offer advantages such as cost-effectiveness, ease of use, and the ability to scale resources as needed (Karthika et al., 2024). However, Asim et al. (2024) pointed out that challenges such as security concerns and slow internet connectivity continue to hinder widespread adoption. Additionally, Rosenthal and Vargas (2013) argued that while cloud storage provides convenience, it may not always be the most cost-effective option compared to local hardware for long-term storage. As cloud computing continues to evolve, Karthika et al. (2024) stated that it presents significant

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opportunities for optimizing library services and enhancing scholarly collaboration in the digital era.

Implementation of Metadata Standards and Format Migration

Metadata standards and format migration play a vital role in ensuring the long-term preservation of digital resources in academic libraries. According to Formenton et al. (2018) and Maxymuk (2005), metadata schemas such as Dublin Core, MODS, and METS provide structured frameworks for describing and organizing digital content, making it easier to manage and retrieve. These standards not only enhance discoverability but also support interoperability between different digital systems, ensuring seamless access across platforms. Formenton et al. (2018) further emphasized that metadata standards help preserve the authenticity, integrity, and reliability of digital objects over time, which is essential for maintaining the credibility of academic resources.

Format migration is equally critical in addressing technological obsolescence, ensuring that digital materials remain accessible despite changing software and hardware environments. Olubiyo and Olubiyo (2023) pointed out that as file formats evolve, libraries must implement proactive migration strategies to prevent data loss and maintain usability. Sambo et al. (2017) stressed the importance of establishing comprehensive preservation policies that incorporate both metadata standardization and format migration as key components of digital resource management. By adopting these strategies, academic libraries can safeguard scholarly content for future generations while effectively managing the challenges posed by big data in the digital era (Maxymuk, 2005).

Strengthening Institutional Policies and Regulations

Strengthening institutional policies and regulations is essential for the effective implementation of digital preservation strategies in academic libraries. According to Adjei et al. (2019), well-

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defined policies provide clear guidelines for managing digital content, covering crucial aspects such as data security, intellectual property rights, and long-term access to digital resources. These policies ensure that digital preservation aligns with institutional goals while also adhering to legal and ethical standards. Additionally, strong regulations create consistency in the management of digital collections, helping libraries standardize their preservation practices across departments. By making digital preservation a core component of library operations, institutions can demonstrate their commitment to protecting valuable academic resources and ensuring their longevity.

Furthermore, establishing robust institutional policies fosters collaboration among key stakeholders, including librarians, researchers, IT personnel, and external partners. Gbaje and Mohammed (2013) pointed out that clear policies support better resource allocation and encourage continuous investment in preservation technologies, training programs, and research initiatives. These policies also help mitigate challenges such as technological obsolescence and funding constraints by embedding digital preservation into an institution's strategic priorities. According to Oguche and Aliyu (2021), Nigerian academic libraries, in particular, require strong institutional policies to address local challenges and promote a culture of digital preservation. By integrating these policies into institutional frameworks, libraries can secure their collections, enhance accessibility, and remain relevant in an increasingly digital academic environment.

Capacity Building and Skill Development

Capacity building and skill development play a critical role in ensuring effective digital preservation in Nigerian academic libraries. According to Samba et al. (2014), many libraries struggle with the absence of digital preservation policies and a lack of trained personnel to manage digital collections. Njeze and James (2013) pointed out that the absence of specialized

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professionals in preservation sections highlights the need for continuous staff training and development. Additionally, Ezema and Ugwu (2014) stated that librarians require a combination of interpersonal, leadership, management, and information technology skills to function effectively in the digital library environment. However, limited funding remains a significant obstacle to updating these skills and adopting modern preservation techniques.

To bridge this gap, professional associations such as the Nigerian Library Association (N.L.A) and the Librarians' Registration Council of Nigeria (L.R.C.N) have taken steps to equip librarians with essential digital skills. Edewor (2020) noted that workshops and training sessions organized by these bodies have contributed to improved librarian competencies and the introduction of new services aligned with sustainable development goals. However, for digital preservation efforts to be truly effective and sustainable, academic libraries must invest in continuous learning initiatives, foster collaborations with institutions for specialized training, and address persistent challenges such as technological obsolescence and a shortage of skilled professionals.

Conclusion

Enhancing digital preservation in Nigerian academic libraries is a critical step toward ensuring the long-term accessibility and integrity of academic resources in the digital age. As the volume of digital content continues to grow, especially with the increasing impact of big data, academic libraries must adopt robust strategies that include cloud-based storage solutions, the implementation of metadata standards, and format migration techniques. While challenges such as limited funding, technological obsolescence, and a lack of trained personnel persist, addressing these issues through targeted capacity building and strategic policy development can significantly improve digital preservation efforts. Strengthening institutional frameworks, promoting awareness, and investing in skill development will ensure that libraries remain

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equipped to manage and safeguard digital content effectively. Ultimately, these measures will help Nigerian academic libraries maintain their role as critical centres of learning and knowledge preservation in an increasingly digital world.

Recommendations for Nigerian Academic Libraries

Adopt Cloud-Based and Distributed Storage Solutions

To enhance digital preservation, Nigerian academic libraries should prioritise transitioning from traditional local storage to secure cloud-based and distributed storage systems. This will improve data redundancy, scalability, and access to digital resources. Libraries are encouraged to explore Library Services Platforms (LSPS) to manage digital content more efficiently. To reduce adoption barriers, institutions should utilise existing research consortia like the Nigerian Research and Education Network (Ngren) to share infrastructure and costs. Collaboration with international partners can also provide technical support and funding. Strong partnerships between librarians and ICT professionals should be frosted to ensure seamless cloud integration.

Implement Metadata Standards and Format Migration Strategies

Libraries should adopt internationally recognised metadata standards to enhance discoverability, preservation, and long-term access to digital resources. Developing clear institutional metadata policies and offering regular training on metadata application will improve cataloguing consistency and resource integrity. Additionally, format migration strategies must be employed to address technological obsolescence. Institutions should proactively monitor and update digital file formats, using global tools such as PRONOM and the Global Digital Format Registry (GDFR) to ensure long-term compatibility and preservation.

Develop Comprehensive Institutional Policies on Digital Preservation

Academic libraries should collaborate with their university administrations to create well-defined policies that govern digital preservation practices. These policies must address data ownership, content management, security standards, and access control. Embedding digital preservation responsibilities

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into institutional frameworks will promote accountability and structured management. The policies should also include enforcement mechanisms, regular review processes, and alignment with national and international data governance standards.

Strengthen Staff Capacity and Professional Development

There is a critical need for ongoing capacity-building initiatives to equip library staff with the skills required for practical digital preservation. Institutions should conduct training needs assessments and design targeted training programmes focusing on digital curation, metadata management, digital rights, and emerging technologies. Furthermore, universities should revise library and information science curricula to include comprehensive modules on digital preservation. Providing librarians consistent access to modern tools and technologies will also ensure sustainable preservation practices.

Secure Sustainable Funding for Digital Preservation Projects

Sustainable financing is essential to support infrastructure upgrades, acquire digital tools, and maintain skilled personnel. Libraries should actively pursue government grants, institutional budget allocations, and strategic partnerships with international donors and development organisations. Collaborations with the private sector through sponsorships, corporate social responsibility schemes, and public-private partnerships should also be explored. Advocacy efforts should highlight digital preservation's long-term academic and institutional value to justify increased investment from parent institutions.

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