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Digital Preservation Strategies for Manuscripts in Modern Scientific Libraries

استراتيجيات الحفظ الرقمي للمخطوطات في المكتبات العلمية الحديثة

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Abstract:

This research paper aims to elucidate the most distinguished digital preservation strategies for manuscripts in scientific libraries in general. This is achieved by discussing the fundamental premises of storage and digital archiving processes, emphasizing the importance of digital preservation for manuscripts, and the reasons for acquiring digital archiving skills. Additionally, it involves highlighting the latest systems for storing and retrieving information and manuscripts digitally in general.

Keywords: Digital Preservation; Manuscripts; Archiving; Storage; Retrieval ; Digital Scientific Libraries.

ملخص باللغة العربية

تهدف هذه الورقة البحثية إلى توضيح أبرز استراتيجيات الحفظ الرقمي للمخطوطات في المكتبات العلمية عموما، هذا انطلاقا من ذكر: الإرهاصات الأساسية لعمليات التخزين والأرشفة الرقمية والحديث عن أهمية الحفظ الرقمي للمخطوط ودواعي اكتساب مهارات الأرشفة الرقمية مع تبيان أبرز النظم الحديثة لتخزين المعلومات والمخطوطات واسترجاعها رقميا بصفة عامّة.

كلمات مفتاحية: الحفظ الرقمي؛ المخطوطات؛ الأرشفة؛ التخزين؛ الاسترجاع؛ المكتبات العلمية الرقمية.

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1. Introduction

In our current era, manuscripts form an integral part of human heritage, distributed across libraries and archives worldwide, narrating the stories of civilizations and sciences through the ages. Digital preservation, which entails converting traditional materials such as manuscripts into digital formats that can be accessed electronically, represents a bridge between the past and the future. It facilitates the preservation of these treasures and makes them available to future generations, ensuring their accessibility and longevity.

This process is an integral part of the field of digital archiving, which includes digital imaging and the creation of digital repositories. The importance of digital preservation lies in its ability to protect manuscripts from physical damage and facilitate their access and wide distribution, thereby enhancing the value of manuscripts as knowledge sources.

The significance of the field in digital scientific libraries is underscored by the need for carefully considered digital preservation strategies, which vary from backup and sustainable storage to continuous technology updating. These strategies ensure the best possible preservation of these valuable resources.

However, digital preservation processes face numerous challenges, including the need for ongoing funding, intellectual property issues, and technical challenges related to file formats and compatibility. It is crucial to address these challenges with innovative solutions to ensure the continuity and effectiveness of digital preservation.

In light of these points, the question arises as to how to develop and implement effective digital preservation strategies for manuscripts in digital scientific libraries and the importance of these strategies in preserving humanity's cultural and knowledge heritage.

To adopt a methodological process for studying "**Digital Preservation Strategies for Manuscripts in Modern Scientific Libraries**," it is appropriate to pose a series of questions that define the theoretical and procedural contexts for their answers, as follows:

- What are the most significant conceptual explanations related to the context of digital preservation strategies for manuscripts in digital scientific libraries?
- What is the importance of digital preservation for manuscripts in digital scientific libraries?
- What are the most significant strategies related to the digital preservation processes for manuscripts in digital scientific libraries?
- What are the most significant practical problems encountered in the digital preservation processes for manuscripts?

1.1 Study Objectives:

The study aims to identify and clarify concepts related to digital preservation, electronic archiving, and digital scientific libraries. It focuses on the impact of these concepts in the contexts of scientific research and cultural heritage. Additionally, the study aims to review and analyze the main strategies used in the digital preservation of manuscripts within modern scientific libraries, revealing the best practices and technologies available. Furthermore, it aims to assess the practical challenges and problems facing the digital preservation processes for manuscripts and propose innovative solutions to overcome them. It also seeks to present actionable recommendations aimed at improving policies and practices related to digital preservation in digital scientific libraries.

1.2 Study Methodology:

This study adopts an analytical and descriptive approach aimed at understanding and evaluating the digital preservation strategies for manuscripts in digital scientific libraries. The methodology includes comprehensive data collection from various sources such as scientific literature, institutional reports, and documents from leading libraries in this field. Additionally, it involves analyzing this data to extract trends, challenges, and best practices related to digital archiving.

Through precise analysis and description of the results, the study aims to provide valuable insights into how to improve digital preservation processes. This is to ensure the effective protection and availability of cultural and knowledge heritage in the digital age.

2. Theoretical Framework

In academic studies, concepts serve as moral pillars. Scholars, theorists, and researchers use these concepts to express meanings and interpretations in their scientific research. Generally, concepts vary among researchers due to the diversities and scientific objectives specific to their studies. In this study, concepts are defined according to theoretical and methodological frameworks. These frameworks guide the research and investigation process in library sciences, archiving, preservation, and storage technologies.

2.1 Strategies:

The process of strategies in the context of digital preservation for manuscripts revolves around preparing and building a plan, which enables the archivist to achieve certain objectives through the optimal use of all available resources and means. (Abu Na'im, 2023)

This process facilitates smooth storage and archiving operations, making it easier to retrieve digitally preserved documents and materials. It is considered a strategic objective essential for achieving ultimate goals. To reach these goals effectively, it's necessary to identify intermediate objectives leading to significant mechanisms. These mechanisms primarily relate to archiving processes and involve determining available means and technologies, collecting materials and

documents for digitization, specifying transfer and conversion processes, prioritizing preservation, and adhering to the most significant standards in all their details. Additionally, it involves transferring information from one medium to another, among other tasks. (Salem, 2008, pp. 31-32)

2.2 Digital Preservation:

In this context, we delve into several definitions concerning the concept of "digital preservation" and its associated terminology. Firstly, we explore its relationship with preservation-related terms. Secondly, we examine its connection with the concept of digitization. Finally, we aim to establish a clear and comprehensive definition of digital preservation as a whole.

a. Preservation:

The word "preservation" is derived from the meanings of keeping, as in "to keep," "keeping," where one is a keeper and guardian, and the thing is preserved, including preserving security and public order, meaning its control and maintenance. "Preserving the covenant" means not betraying it, which includes "securing it."

Preserving knowledge and speech: mastering and comprehending it. Preserving wealth means "caring for" and managing it, preserving someone means "honoring" and respecting them, maintaining their dignity, reciprocating their kindness, and remembering them gratefully. It also appears in the context of self-preservation, meaning keeping oneself from harm or destruction. As well, preserving "knowledge," "speech," and "manuscripts," preserving food and others, means protecting them from "decay," "contamination," or "change," etc. (Al-Maany , 2023)

Furthermore, when discussing the concept of preservation within the Quranic context, it entails safeguarding and protecting God's servants from harm and evils. The Quran highlights that God is the ultimate protector, as exemplified in Surah Yusuf. This chapter illustrates God's mercy towards Jacob, particularly during his old age and isolation. Despite the challenges Jacob faced, including the fear of loss, straying, and dispersion, God, out of His mercy, ensured his protection and reunited him with his son. This narrative emphasizes God's role as the ultimate guardian and protector of His servants. (Ibn Kathir, 2023, p. 243)

In modern transactions, the word "preservation" has different connotations. One aspect of preservation involves keeping papers and similar documents in files, ensuring their organized storage. Another aspect pertains to the preservation of old contracts and covenants, which involves safeguarding them against potential loss or damage.

This includes preserving lost items, bonds, stocks, meaning "maintaining them", preserving securities, meaning "collecting them".

Hence, the connotations associated with preserving manuscripts encompass various meanings. These include protection, guardianship, care, management, containment, storage, policy, comprehension, archiving, renewal, review, retrieval and fulfillment. Additionally, the concept of

preservation entails trust, restoring honor, reciprocating kindness, ensuring security, providing insurance, maintaining confidentiality, making referrals, ensuring continuity, facilitating compilation and demonstrating benevolence towards the manuscript, among other aspects.

b. Digitization:

According to Kheither (2007), digitization is defined as the process of converting a paper-based text into a digital document without the need to rewrite the content. This conversion is facilitated using different techniques like scanners, compact discs, or electronic scanners for all digitized texts. These mechanisms enable access to a vast collection of rare documents and significant manuscripts. Furthermore, the electronic document can serve as a replacement for the original document. (Fawzia Fatima, 2007, p. 60)

This technology provides support for the preservation or prevention of old documents. Additionally, it enables the conversion of various document types into a digital format through the use of scanning devices; intellectual and library work is carried out to organize and describe the content of the texts.

c. Digital Preservation:

Within the aforementioned context, the definition of digital preservation, known as "Préservation numérique," is a compound term. Bahloul defines digital preservation as the core principles of contemporary digital archiving. It involves formulating and designing storage and retrieval policies or strategies that are necessary and obligatory in digital storage processes. The aim is to ensure the reliable preservation of materials in their original form, without any loss or alteration of content, even as the archive content grows and expands over time. (Bahloul, 2019, p. 253)

Thus, the standards of digital preservation provide guidance on the strategy employed by archival workers in digital archiving and retrieval. In their scientific encyclopedias on library science, researchers Hasballah El-Sayed and Ahmad El-Shami define digital archiving as encompassing all traditional files that are transferred or stored in various media such as computers, magnetic tapes, optical discs, and so on. (El-Sayed & El-Shami, 2001, p. 111)

The aforementioned circumstances emphasize the importance of digital preservation pillars. These pillars ensure long-term storage capabilities and provide a safeguard in case the original files are lost from paper or traditional storage media, or if they encounter any problems.

Therefore, types of digital preservation for manuscripts, according to researcher Safwat, are as follows:

- ✓ Digital preservation of manuscripts that only collect traditional classic materials and archives.

✓ Digital preservation of mixed manuscripts that collect both traditional classic materials and archives and current digital archives.

✓ Digital preservation of manuscripts that only collect digital materials and archives. (Badeer Ahmed, 2016, pp. 07-47)

2.3Digital Manuscripts:

Explanations and meanings of the concepts of manuscript or manuscripts in the Arabic language coincide with the emergence of the era of documentation and copying. Thus, appearing on paper based on manuscripts or writings drawn with classic handwritten lines, where the written copies are made by hands. (Baalbaki, 1990, p. 1097)

In general, the art of writing encompasses the act of documenting and enhancing lines or drawing writings. It falls within the realm of literature, regardless of whether the aforementioned writing styles were inscribed on paper or other materials such as sand, papyrus, leather, palm fronds, stones, rocks, pyramids, ancient rock artifacts, ancient clay drawings or manuscripts. These writings can take the form of books, notebooks, scrolls and various other formats. (Al-Ghani Dictionary, 2023)

Specifically, the manuscript holds a significant position as one of the prominent outputs of the era of documentation. It is created by authors, copyists, travelers, historians and researchers, who have historically utilized their hands to produce these valuable texts. The concept of manuscripts has evolved alongside the emergence of printing in the fifteenth century and continues to hold relevance in our modern era, thanks to the technological advancements and the widespread use of electronic digitals.

Accordingly, Bin Zahran provides a definition for the digital manuscript. This definition revolves around the process of transferring manuscripts or modern scientific materials onto electronic media and technologies. It involves capturing the pages of the manuscript using digital photography devices or integrating them into electronic scanning devices. Subsequently, the digitized manuscript is stored on magnetic discs, special computer memories, smartphones, or within the storage systems of internet networks in general. (bin Zahran, 2016, pp. 182)

➢ **Therefore, digital manuscripts are defined according to the following types:**

−Digitization of documentary stocks in university libraries.

−Digitization of the financial stocks of university institutions according to their inputs and outputs.

−Digitization of historical and cultural manuscripts.

−Digitization of financial stocks in economic or cultural institutions.

−Digitization of types of scientific and intellectual activity outputs.

−Digitization of types of human resources stocks.

2.4Digital Scientific Libraries:

Digital scientific libraries are determinants of the technological advancement that the current era is witnessing. Researchers "McLean," "Lynch," and "Borgman" (McLean & Lynch, Borgman, 2004) provided an implicit definition of digital libraries as "one of the components of the broader information environment, which includes records management, publishing, and the management of scientific data and knowledge."

In addition to serving as repositories for data and digital documents, digital scientific libraries play a crucial role as integral components of the infrastructure for cybernetics, electronic research, electronic sciences, electronic social sciences, e-learning, institutional repositories, open archives and data collection systems. These libraries support scientific research and enable the utilization of digital resources. Furthermore, they facilitate the creation of institutional content through collaborations among individuals, digital groups and public services.

- **In this context, the features of digital scientific libraries are defined in the following points:**

  –Regulating the legal deposit processes for university works and research.

  –Providing scientific libraries with free copies and manuscripts.

  –Preserving the scientific output from loss.

  –Facilitating the use of libraries for researchers to benefit from them while ensuring continuity.

  –Supplying students with various sources and references that offer scientific benefit.

  –Facilitating easy access to its scientific platforms without any material restrictions or conditions.

2.5Importance of Digital Preservation of Manuscripts:

The importance of digital preservation of manuscripts in modern libraries, according to researcher "Saadallah Nouri Berdawood," lies in the following features: (Berdawood, 2020)

- Developing the preservation processes of manuscripts into digital form to end the fragility of the scientific material, which makes up the manuscripts and their sensitivity to contents of damage and loss.
- Often, many manuscripts are found scattered in pieces, with copies of a single manuscript distributed in several places such as treasuries, libraries, stores, corridors or even ruined spaces.
- The significance of digital archiving is underscored by its role in collecting manuscripts, writings, or information specifically intended for preservation in a digital

format. This process involves employing storage techniques and technologies designed for digital preservation.

- Scientific library institutions across all disciplines require effective solutions for preserving manuscripts, data, information, and electronic documents. These solutions aim to ensure knowledge and scientific security while also considering the need for cost-effectiveness. Furthermore, they should align with the goals and strategies of digital preservation.
- It's also possible to define the importance of digital preservation of manuscripts and what digital archiving aspires to preserve rare documents from damage and the difficulty of accessing them by those interested in exploring them anew.
- Ensuring speed processes in storage, retrieval, recall, and updating of required documents and files using various digital research methods.
- Ensuring digital archiving processes according to encryption and confidentiality systems, with the assurance of property rights in the circulation of manuscripts, documents, or data.
- Ensuring the linking processes between data stored in more than one data database, whether inside or outside the institution, as expressed by Omar in the importance of digital preservation of manuscripts for free access to digital repositories according to two main strategies: (bin Zahran, 2016, pp. 182)
- The first strategy pertains to ensuring that scientific intellectual production remains accessible and that authors retain their publishing rights. The second strategy focuses on providing practical access opportunities to articles, research papers, digital photographs, and other intellectual and scientific products.
- Not to mention, ensuring the processes of storage, conversion, or digital photography of documents or manuscripts of large sizes and ensuring a security strategy and savings for copies and manuscripts in cases of damage, loss, theft and so on.

2.6Digital Preservation Strategies for Manuscripts:

In discussing modern systems for storing and retrieving information, it is important to consider their functionality and usage. This involves understanding the theoretical foundations and concepts related to two main aspects: automated storage systems for information and manuscripts in general, and retrieval methods based on specific criteria:

- The need to acquire new skills to deal with current digital and electronic systems and mechanisms of digital storage and retrieval.
- The need to establish practical settings according to search strategies in automated databases.

- The need to learn according to the fundamentals of modern digital systems and how to retrieve information and manuscripts electronically.
- The need to acquire or enhance mechanisms for dealing with digital library systems and their technologies, benefit from them, evaluate, select and train users to interact with them.

Therefore, the determinants of digital preservation strategies for manuscripts are as follows:

2.7 Modern Systems for Digital Archiving of Manuscripts:

The strategies of modern systems for digital archiving of manuscripts are defined according to the following practical steps:

a. Digital Storage Systems for Manuscripts:

In this regard, digital storage systems for manuscripts usually operate according to the following methods:

- Using available applications and adapting them in digital archiving systems.
- The possibility of utilizing digital archiving can be explored both in the short and long term for preserving stocks, data, and digital information cards. This potential hinges on the wide range of digital sources available, along with the various channels and tools accessible to researchers for storing or retrieving information and data from databases in digital libraries, as outlined by Abdelkader. (Abdelkader, 2021, pp. 122, 136)
- Practical knowledge of all databases and the advantages of using computers and modern digitization mechanisms and following the preservation and digital storage of manuscripts via a computer or through microfilm using advanced scanners. (bin Zahran, 2016, pp. 182, 187)
- Adopting new software and applications to overcome the drawbacks of the sizes of documents or manuscripts to be digitized.
- Giving priorities to digital preservation of manuscripts according to the preservation containers for databases and integrating them into fields of digital records or digital tables.
- The necessity of identifying types of digital networks in institutions and knowing effective digitization systems and programs for archiving documents, files or manuscripts in general. Needless to mention, monitoring consecutive operations, starting from document photography, image processing, compressing files or manuscripts within the contexts of packed disks, then storing them.
- Moreover, the necessity of good control in digital cataloging programs like the Squirrel program for cataloging and searching and its controlling specifications from processing digital inputs and outputs.

b. Digital Retrieval Systems for Manuscripts:

- Supporting search and retrieval programs with digital encoding systems. For example, we find the "Dewey" classification (Ben Haj, 2022, p. 79), which is followed by multiple search methods. Firstly, through selecting a field from digital cataloging fields for the manuscript or the scientific material to be digitized. Secondly, through digital search systems for titles and keywords.
- In addition to the above, it's necessary to employ the feature of digital retrieval or the element of digital information accessibility.

Within the aforementioned context, researcher El-Sayed Kassem (El-Sayed Kassem, 2009, pp. 139, 143) identified digital preservation strategies for archives or manuscripts into four types as follows:

- **Migration or Transfer Strategy:**

This strategy concerns copying digital document data from one digital medium to another. Its objective is to the smooth and secure transfer of the manuscript, while maintaining modern digital storage, with the necessity to enhance the migration strategy and periodic data transfer relying on standard file formats to preserve archival data from loss or damage.

- **Data Refreshing Strategy:**

This strategy involves regularly transferring data to newer media, either of the same type or different types, as to avoid loss of archival data due to media damage or failure. It also involves transferring data across high-specification digital media to ensure storage and retrieval elements.

- **Technological Digital Preservation Strategy:**

This strategy describes digital storage in a technological environment, starting from devices or software that support archival digital sources, such as computer devices, scanners, flash memory and all the latest operating systems in the context of technological preservation.

- **Emulation Strategy:**

The emulation strategy involves making original archival digital data or programs available or operable in the current or future time through a set of software that simulates and resembles the original program.

Thus, this strategy allows for the long-term retention of archival digital data with the possibility of operating it at any time. In other words, this strategy might be the only suitable one for preserving archival digital materials without the preserved digital archival data being lost or damaged.

Researcher "Faten Said Bamflah" provided a series of strategies that should be considered in digital preservation processes for manuscripts as follows: (Bamfluh, 2008, pp. 01, 25)

- Establishing a suitable strategy for digital preservation with choosing the appropriate medium for storage or retrieval.

– Adhering to standardization and organization in file formats and creating the necessary metadata to represent the information.

– Moreover, establishing independent policies specifically for the digital preservation of manuscripts or information in smooth systematic ways.

3. Leading Standards for Digital Storage of Manuscripts:

Badeer Ahmed discussed the most prominent standards of digital preservation between migration and emulation for manuscripts or data that are stored or retrieved in the following mechanisms: (Badeer Ahmed, 2016, pp. 09-10)

- **PDF/A: ISO 19005-1: 2005 Document management -- Electronic document file format for long-term preservation--part 1: Use of PDF 1.4.** This standard specifies how to use the Portable Document Format for long-term preservation.
- **Portable Document Format (PDF) 1.4** This standard defines the effectiveness of long-term digital preservation of documents in general.
- **JPEG: ISO/IEC 15444-2: 2004 Information technology--JPEG 2000 image coding system: Extensions.** This standard defines the following operations:
  - – Extended coding operations for converting compressed image data into reconstructed image data.
  - – An extended coding structure contains information for interpreting or translating compressed image data.
  - – This standard is defined based on a standard set of metadata for images.
- **ODF: ISO/IEC 26300: 2006 Information Technology--Open Document Format for Office Applications (Open Document) V 1.0.** This standard is an XML schema for office applications and its significance, which suits the feature of embedding textual documents, spreadsheets, graphical documents, etc.
- **MPEG-7: ISO/IEC 15938-3: 2002 Information Technology--Multimedia content description interface--Part 3: Visual.** This standard specializes in coding information from multimedia or hypermedia components, including audible and visual film components.
- **American Standard Code for Information Interchange Rich Text Format (RTF):** This is the American standard for preserving texts, files and simple forms, making the files readable in the long term. (Ben Haj, 2022, p. 79)
- **The standard for preserving textual documents in standard formats for word processing**, for example, the SGML format representing ISO 8879 or the Portable Document Format (PDF) which has recently become ISO 32000 standard.

It should also be noted here that there are many standards and applications that facilitate the digital preservation of manuscripts in general, which cannot all be listed in this context.

4. Obstacles to Implementing Digital Preservation Technology:

Obstacles to implementing digital preservation technology relate to a series of problems associated with digital preservation processes for manuscripts in general. These flaws and issues are primarily technical represented by unclear imaging and trimming parts of the manuscripts to be digitized, affecting the researchers' ability to read the texts of the packed manuscripts.

Secondly, there are logistical and financial challenges that arise, such as the inability to acquire specialized equipment for imaging or storage purposes. In such cases, researchers and archivists often resort to using smartphones for photography. The third obstacle pertains to human factors, particularly the lack of proficiency and training in software, digital preservation methods, data and manuscript handling, and the mastery of modern technologies and digital archive management. Additionally, ethical and legal issues come into play, including the risk of scientific theft and the failure to protect or secure documents stored within preservation containers, which in this case refers to the digital archive. There is also the concern of tampering with textual documents, highlighting the absence of an encoding culture and insufficient attention to encryption and passwords.

Not to mention problems related to digital archiving management in the field of digital technology across various institutions and the security of their digital information systems. (Omar, 2011)

Ben Hadj listed a series of problems and flaws that hinder the digital preservation processes of manuscripts. These issues encompass technical, human and technical. In the following, we will outline the specific pitfalls that he has highlighted: (Ben Haj, 2022, pp. 73-86)

- The unclear imaging process and trimming some parts of the manuscript to be archived, affecting the researchers' ability to read some ancient texts or deteriorated manuscripts.
- Parts of the same copy may not be gathered in one library, etc., hindering digital storage and archiving processes.
- Lack of experience among some workers in the service of manuscripts and rare documents, with the existence of types of shortage in specialized staff.
- The inability to deal with the difficulties of imaging and archiving deteriorated manuscripts that need restoration.
- The high cost of devices specialized for imaging and storage, with some researchers resorting to using mobile phones for photography.
- Not keeping pace with types of technological progress in mechanization and renewed technology.

– It is represented in intellectual property rights that may restrict access to some digitized manuscripts for fear of scientific theft.

5. Study Results:

The study conducted an extensive examination of the current practices and strategies in the digital preservation of manuscripts across various digital scientific libraries. Through the analysis of modern digital archiving systems, several key findings were identified, reflecting the effectiveness, challenges, and technological advancements in the field. These results are categorized into three main areas: implementation of digital preservation standards, obstacles encountered in digital preservation and effective strategies for overcoming these challenges.

5.1 Implementation of Digital Preservation Standards

The study revealed a widespread adoption of leading digital preservation standards among the surveyed institutions. Notably, standards such as PDF/A, JPEG2000, and ODF were commonly utilized for ensuring the long-term preservation of digital manuscripts. The use of MPEG-7 for multimedia manuscripts, the American Standard Code for Information Interchange (ASCII) and Rich Text Format (RTF) for textual documents were also identified as prevalent practices. These standards were instrumental in enhancing the readability, accessibility, and longevity of preserved digital content.

5.2 Obstacles in Digital Preservation

Despite the advancement in digital preservation techniques, several obstacles were prominently identified:

- **Technical Challenges:** The most significant technical issue was the loss of data integrity during the digitization process, including unclear imaging and the accidental trimming of critical manuscript parts. This issue was compounded by the reliance on inadequate imaging equipment, often due to financial constraints.
- **Human Resource Limitations:** A lack of skilled personnel trained in digital preservation practices and technologies was a common concern. This deficiency hindered the ability of institutions to effectively manage and implement advanced digital archiving strategies.
- **Financial and Logistical Constraints:** The high cost of specialized digitization equipment and software posed a significant barrier to many institutions, limiting their ability to undertake comprehensive digital preservation projects.
- **Legal and Ethical Considerations:** Concerns over intellectual property rights and the ethical considerations surrounding digital access to sensitive or rare manuscripts were also highlighted as areas requiring careful navigation.

5.3 Effective Strategies for Overcoming Digital Preservation Challenges

In response to the identified obstacles, the study outlined several strategies deemed effective in enhancing the digital preservation of manuscripts:

- **Adoption of Scalable Digital Standards:** Institutions have found success in adopting flexible and scalable digital standards, which can accommodate the evolving nature of digital content and storage technologies.
- **Training and Development:** Investing in the training and development of staff in digital preservation techniques and technologies was identified as a critical strategy for overcoming human resource limitations.
- **Collaborative Partnerships:** Forming partnerships with other institutions, technology providers, and funding bodies was a key strategy for addressing financial and logistical constraints, allowing for shared resources and expertise.
- **Clear Legal Frameworks:** Developing clear legal frameworks and ethical guidelines for digital preservation and access was essential for navigating intellectual property rights and ensuring ethical access to digitized manuscripts.

The study's findings underscore the importance of continuous innovation, collaboration, and education in the field of digital preservation. By addressing the technical, human and financial challenges identified, institutions can enhance their digital preservation efforts, ensuring the long-term accessibility and integrity of their valuable manuscript collections.

6. Conclusion:

In conclusion, we can derive a set of solutions and suggestions related to improving the digital preservation processes of manuscripts in modern scientific libraries. There is an urgent need to adopt effective control mechanisms of technological techniques to ensure advanced and reliable digital archiving management. Scientific libraries must consider the digital preservation of manuscripts as an urgent necessity and a fundamental value to be enhanced, not only to preserve cultural and knowledge heritage but also to facilitate access to and use of it in scientific research.

Furthermore, enhancing the culture of encoding and dealing with digital encryption systems is a necessary step to protect digital content and ensure its integrity. This effort requires training and qualifying human resources on the basics and standards of digital technology and digital archiving programs, ensuring these technologies are used effectively and safely. Additionally, digital preservation processes should be approached from an information systems security perspective, considering the assurance of scientific integrity and trust in the technologies used.

A comprehensive understanding of digital preservation strategies and digitization standards is key to enhancing the security and effectiveness of preservation operations. It is crucial to stay updated

with scientific and practical advancements in digital preservation technologies to ensure the continuous improvement and evolution of these processes. In so doing, modern scientific libraries can optimize the advantages offered by digital technologies in preserving manuscripts and guarantee their accessibility for future generations.

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