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Technology of Creating Archive Document Collections Related to Scientific Heritage

Abstract

This article explores the main principles and methods of creating archive document collections for the preservation of scientific heritage. The application of modern digital technologies makes it easier to store archive documents and integrate them into databases. The article analyzes the methods used in creating collections, the applied problems, and potential directions for development. The research results show that effective archive management systems play a significant role in the preservation and restoration of scientific data.

Keywords: Archive Document Collections, Scientific Heritage, Digitization, Data Management, Conservation Technologies

Bilimsel Mirasla İlgili Arşiv Belge Koleksiyonları Oluşturma Teknolojisi

Öz

Bu makale, bilimsel mirasın korunması için arşiv belge koleksiyonları oluşturmanın temel ilkelerini ve yöntemlerini araştırmaktadır. Modern dijital teknolojilerin uygulanması, arşiv belgelerinin saklanmasını ve veri tabanlarına entegre edilmesini kolaylaştırmaktadır. Makale, koleksiyon oluşturmada kullanılan yöntemleri, uygulanan sorunları ve gelişim için potansiyel yönleri analiz etmektedir. Araştırma sonuçları,

etkili arşiv yönetim sistemlerinin bilimsel verilerin korunması ve restorasyonunda önemli bir rol oynadığını göstermektedir.

Anahtar Kelimeler: Arşiv Belge Koleksiyonları, Bilimsel Miras, Sayısallaştırma, Veri Yönetimi, Koruma Teknolojileri

Introduction

The preservation of scientific heritage and its transmission to future generations plays a crucial role in the cultural development of humanity. This heritage serves as an invaluable database for research and development across various fields, ranging from historical knowledge to technological innovations. However, the rapidly changing technological environment, the increasing volume of information, and the challenges related to document preservation demand new approaches to maintaining scientific heritage. In the modern era, the creation of archive document collections stands as one of the primary tools in addressing this issue. The application of digital technologies has revolutionized the classification, management, and preservation of archive documents, leading to significant changes in this field. Through electronic archives, the study and use of scientific heritage have become more accessible, ensuring the continuity of both scientific and cultural heritage. This article focuses specifically on the technology of creating archive document collections related to scientific heritage. The aim is to examine the main features of these technologies, their applied methods, and their compliance with modern standards, while also discussing the challenges and future development prospects. In this context, the need for the development and implementation of effective archive management systems for the preservation of scientific heritage is emphasized.

1. Problem Statement

In research on the preservation of scientific heritage and the creation of archive document collections, it is essential to apply both scientific-theoretical and practical approaches. The methodology of this article is based on both theoretical justification and the analysis of practical examples. The following methods were used within the framework of the research:

2. Analytical-descriptive method

*Systematic collection and classification of existing data on the creation and management of archive document collections;

*Analysis of the theoretical basis of the topic based on scientific literature, international standards, and best practices.

3. Comparative method

*Comparison of archive management systems applied in different countries and organizations to identify advantages and shortcomings;

*Analysis of different approaches to the integration of international standards and technologies in archive management.

4. Practical-applied method:

*Investigation of real examples of the application of digitization technologies (e.g., UNESCO's digital archive projects);

*Observation of the practical use of electronic document management systems and cloud-based platforms.

5. Systemic approach

*Development of a systematic model for the structuring and classification of archive collections; (Kazimi & Mahammadli, 2021).

*Use of metadata structures and classification principles according to international standards in the research (e.g., ISO 15489, ISAD (G).

6.Source and document research

*Analysis of traditional and modern approaches to the preservation of historical documents and scientific heritage materials;

*Use of primary sources obtained from national and international archives in the research.

7. Statistical analysis

*Analysis of the spread and effectiveness of technologies used in archive management;

*The research results show an increase in the effectiveness of document preservation and use with the application of digital technologies.

8. Empirical approach

*Identification of existing difficulties and needs in the creation and management of archive document collections based on practical observations and experiences;

*Study and analysis of user experiences in digitized archives.

These methods enable more accurate results in the application of modern technologies for the preservation of scientific heritage and archive management (Ismayilov, Mahammadli &

Gasimli, 2023b). The methodology serves both to justify theoretical approaches and to develop practical recommendations:

a. Preservation of Cultural and Scientific Memory

Through archive collections, unique scientific data and historical documents are passed down from generation to generation, preserving humanity's cultural and scientific memory.

b. Resource Base for Research and Education

The archiving of scientific heritage creates a reliable and systematic source of information for researchers and educational institutions. This is especially important in fields such as history, technology, and other disciplines (Kenzhebayeva, Urmurzina & Mahammadli, 2018).

c. Systematic Classification and Management

Archives make data flow more efficient by using modern technologies for classification, storage, and management. This ensures quick and easy access to information (Mammadov, 2022a).

d. National and International Cooperation

Archiving scientific heritage promotes international research collaborations and supports global knowledge exchange. This is particularly reflected in initiatives by UNESCO and other international organizations.

e. Creating a Foundation for Innovation

The preservation of past scientific achievements fosters the creation of new innovations. This is particularly facilitated by the digitization of scientific heritage.

In addition, there are several issues related to the development of archive collections. These include the damage to physical documents, the high financial costs of digitization processes, and legal limitations (Mahammadi, 2024b). The application of modern technologies and the use of international standards are crucial for solving these problems. Overall, scientific heritage and archive collections play a bridging role between culture and science, and their preservation ensures the continuity of humanity's intellectual heritage.

The application of modern technologies has led to revolutionary changes in the preservation of scientific heritage and the management of archive document collections. These technologies encompass various processes, ranging from the digitization of documents to the automated management of data, enhancing the efficiency of archives (Mahamadli, 2018). Specifically, modern technologies are applied in the preservation of scientific heritage in the following directions:

*Digitization

a) The conversion of physical documents into digital format ensures their long-term preservation;

b) Documents stored in digital format require less space and reduce the risk of physical damage; (Ismayilov, 2022).

c) Texts of documents are digitized using Optical Character Recognition (OCR) technology, making them searchable.

*Electronic Archive Management

a) Electronic Document Management Systems (EDMS) facilitate the management of documents;

b) These systems provide automated management at all stages, from document creation to archival submission; (Oqlu, 2021).

c) Document classification and quick search are ensured through the use of metadata structures.

*Cloud Technologies:

a) Cloud services provide storage for documents and ensure access from anywhere; (İsmayılov & Məhəmmədli, 2024).

b) Secure data storage and recovery options are provided;

c) Shared platforms support international collaboration and data exchange.

*Artificial Intelligence and Machine Learning:

-Artificial intelligence technologies are widely used for automatic classification and analysis of data;

-Machine learning models analyze document content to quickly find relevant information; (Ismayilov & Khalafova, 2023).

-AI is also used to predict the risks of damage in the preservation process of archive documents.

*Blockchain Technologies:

-Blockchain technologies ensure the immutability and authentication of documents; (İsmayılov, Mahammadli & Gasimli, 2023a).

-Through these technologies, the source and history of documents can be traced;

-Data security and transparency are enhanced.

*Interactive Platforms and Mobile Applications:

-Interactive archive platforms allow users to explore documents; (Mahammadli, 2018).

-Mobile applications allow users to access archival data from anywhere;

-QR codes and other tools facilitate quick access to information.

*Virtual Reality (VR) and 3D Modeling:

-3D models of historical documents and artifacts are created to enable interactive learning of scientific heritage; (Ismayilov, Mahammadli & Khudiyeva, 2022).

-Virtual reality is used to organize digital tours of ancient libraries and archives.

*Application of International Standards

-International standards like ISO 15489, MoReq (Model Requirements for Electronic Records Management) ensure integration with modern technologies; (Nadir, I. & Oruj, 2022).

-Standardized approaches make document management and exchange more efficient.

The application of modern technologies ensures the development of archive collections and makes scientific heritage more accessible. (Ismayilov, Ismayilov, & Mammadova, 2019). However, there are still some challenges, such as high costs, the establishment of technological infrastructure, and data security issues. Nevertheless, the continuous development of technologies provides the opportunity to overcome these challenges.

UNESCO's Memory of the World Program. Under this program, documents of historical and scientific significance have been digitized and made openly accessible. For example, ancient manuscripts, maps, and archival documents have been digitized (Kazimi & Agamirzaev, 2021).

*Europeana (European Culture Portal)

Created by the European Union, this platform brings together digital content from thousands of libraries, museums, and archives; digitized documents are accessible for interactive searching and research.

*National Electronic Archive Projects

For example, the "e-Archive" project in Estonia ensures the electronic management of state archives. (Tofiq, Oqlu, & Kazimi, 2022). The system facilitates the classification, preservation, and presentation of documents to users; Digitized documents are accessible online from anywhere.

*Qatar's National Electronic Archive System

This system utilizes artificial intelligence and automated search technologies to ensure the fast retrieval and preservation of data (Kushzhanov, & Dashqin, 2019c).

*Google Arts and Culture

Through this platform, historical and cultural documents, photographs, and digital collections are stored and made available to users via cloud technologies; The platform is aimed at both scientific and cultural heritage preservation. (Ismayilov & Aliyeva, 2023).

*World Digital Library

Supported by UNESCO and the U.S. Library of Congress, this platform provides a vast resource base for the preservation and use of scientific and historical documents (Oqlu, Nadir, & Tofiq, 2023).

*British Library Digital Scholarship

The British National Library uses artificial intelligence algorithms for the automatic classification and transcription of historical documents; Thanks to AI, thousands of documents are analyzed and made accessible in a short period (Kushzhanov, & Mahammadli, 2019b).

*National Archives and Records Administration (NARA)

Operating in the U.S., NARA analyzes digital documents through automated systems and machine learning technologies to ensure their correct classification. (Kazimi, Abdullayeva & Ismayilov, 2020).

*Blockchain in Estonian Archives

Blockchain technology is used to ensure the immutability of documents. This approach helps track the source and history of documents (Məhəmmədli, 2024).

*Vatican Archives Digital Tour

Virtual reality technology has created a digital access point to the closed archives of the Vatican. Researchers can study rare documents and manuscripts using VR (Mammadov, 2022b).

*3D Modeling in International Historical Archives

3D models of ancient documents and archival materials have been created and made available to users for the preservation of cultural heritage.

*ISAD(G) (General International Standard for Archival Description)

This standard is applied in many national and international archives. For example, the National Archives of Canada has optimized document classification and search by working according to the ISAD (G) standard.

*ISO 15489 (Document Management Standard)

This is used in the development of modern document management systems and provides guidelines for the management of digital archives (Muhammadli, 2023).

*National Archives of Azerbaijan

The National Archives of Azerbaijan has implemented various projects for the digitization and preservation of historical documents. In these projects, both traditional documents and digital materials have been classified, and an online database has been created. The application of modern technologies in the preservation of scientific heritage and the creation of archival document collections offers numerous advantages, yet there are challenges and issues in this field. However, developing technologies and innovative approaches present promising solutions to address these problems.

We can show the following for the problems:

a) Financial and Resource Limitations:

-The implementation of modern technologies requires significant financial resources. Digitization equipment, cloud technologies, and modern software incur high costs;

-The lack of qualified personnel and the additional financial needs for their training.

b) Technological Infrastructure Deficiency:

-The absence of modern technological infrastructure in many countries or small organizations limits the digitization and management of archive documents;

-In regions with poor internet connectivity, access to digital archives is problematic.

c) Data Security:

-The protection of digital documents is accompanied by cybersecurity risks. The theft, loss, or modification of data can cause serious problems; (Heydar, 2023).

-Due to the limited use of blockchain technologies, document authentication becomes difficult.

d) Legal and Ethical Issues:

-There are problems in ensuring the privacy of digital documents and protecting intellectual property rights; (Kushzhanov & Dashgin, 2019a).

-Legal compliance issues arise in international data exchange.

e) Rapid Obsolescence of Technologies:

-The rapid advancement of technologies causes the technical equipment and software being used to become obsolete quickly. This leads to additional financial costs and workloads; (Mammadov, 2013).

-There is a risk that the formats used for long-term archiving may no longer be supported.

f) User Experience Problems:

-The lack of user-friendliness in digital archives makes the efficient search and use of documents difficult; (Ismayilov & Khalafova, 2022a).

-The complexity of metadata structures and classification systems creates additional barriers for users.

*Artificial Intelligence and Machine Learning

Offers new opportunities in automatic classification, transcription, and content analysis of documents;

*Blockchain Technologies

 Can solve security issues by ensuring the immutability and authentication of documents. The use of cloud services can reduce the costs of storing and managing documents. Cloud platforms allow access to documents anytime and anywhere. Shared resources can further develop international collaboration.

International standards (e.g., ISO 15489, ISAD (G) can be widely applied to optimize the structuring and management of archives. Standardization facilitates document exchange and integration (Balginova, Maydangalieva, Satygalieva & Mahammadli, 2018). The development of cybersecurity technologies can prevent data loss and security risks. The widespread use of encryption and other security measures will strengthen the protection of digital documents.

User-friendly interfaces for digital archives can be developed, making access to documents easier and more accessible. Improved search systems and interactive platforms will make users' work easier. Regional and global collaboration projects in the field of archive preservation can help solve financial and technological issues. Larger-scale projects can be implemented with the support of international organizations (e.g., UNESCO, IFLA). (Qasımlı & Məhəmmədli, 2024b). The

digitization of paper documents can reduce the demand for ecological resources. Promoting recycling through electronic management systems will contribute to environmental sustainability.

The development of new educational programs to support digital archive technologies can strengthen personnel training. Scientific research and innovative approaches will expand the knowledge base in this field (Oqlu, 2021; Nadir, & Sevda, 2022).

Conclusion

The preservation of scientific heritage and the creation of archival document collections are of particular importance in the modern era, both in terms of ensuring the continuity of scientific and cultural heritage. While modern technologies have brought revolutionary changes in this field, the existing problems require systematic and strategic approaches.

Archival document collections form the collective memory of society and play a crucial role in the development of humanity (Qasımlı & Məhəmmədli, 2024a). The preservation of these documents ensures the transmission of cultural and scientific heritage to future generations. Innovations such as digitization, artificial intelligence, cloud technologies, and blockchain make the preservation and use of archival documents more efficient. Issues such as a lack of financial resources, limited technological infrastructure, and cybersecurity risks are key factors that hinder progress in this field (Ismayılov & Khudiyeva, 2023).

The application of international standards, regional collaboration, and the expansion of innovative technologies stand out as key directions for addressing these problems. Government institutions and international organizations (e.g., UNESCO, IFLA) should provide specific financial support for the digitization of archival documents (Ismayilov& Khalafova, 2022b). Grant programs and special funds should be established for the preservation of scientific heritage. Expanding the use of artificial intelligence, automation, and blockchain technologies will make document preservation more effective. Global access to documents should be ensured through cloud-based storage and management systems. Universities should create relevant educational programs for the training of specialists in digital archive management. Modern technology training should be organized for current archivists. The preservation of scientific heritage and the creation of archival collections is an important task that can be achieved not only through technology but also through strategic approaches, international collaboration, and public involvement. If continuous efforts are made in this direction, the transmission of scientific and cultural heritage to future generations will be ensured.

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