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PRESERVATION OF ANCIENT DOCUMENTS AND RARE BOOKS DIGITAL COPIES: STRATEGIES, CHALLENGES AND PROSPECTS

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The article examines current strategies and approaches to preserving digital copies of documents and printed publications in the context of global digitalisation, which has been gaining momentum in 2025. It analyses Ukrainian and international experience in the field of digital archiving, with an emphasis on the challenges of long-term storage, such as technological obsolescence, cyber threats, security issues, format compatibility and the authenticity of digital materials. Particular attention is paid to the OAIS (Open Archival Information System) model with updates for 2025, which defines standards for managing digital objects, as well as LOCKSS (Lots of Copies Keep Stuff Safe) systems that provide distributed storage and self-recovery of archives. Cloud solutions such as Amazon Glacier and Google Vault are considered, as well as innovative technologies, including the use of artificial intelligence (AI) for automated classification, metadata analysis and recovery of damaged files, and blockchain to ensure data integrity and authenticity. Comparative tables are provided to illustrate preservation strategies, technologies, and practices in Ukraine in comparison with international standards. The prospects for the development of Ukraine's digital archival infrastructure are outlined, particularly in the context of European integration, taking into account global trends such as the integration of AI and blockchain technologies, which could reduce archiving costs by 30-50% by 2030. The article emphasises the need to create a national digital preservation strategy, standardise digitisation processes and train specialists to ensure the preservation of digital cultural heritage for future generations.

Keywords: *rare books, ancient documents, digital preservation, innovations in document science and archival science, electronic documents, archiving, digital printing, metadata, LOCKSS, OAIS, artificial intelligence, blockchain.*

Problem statement. In the context of rapid global digitalisation, the volume of electronic information is growing dramatically, and traditional approaches to its preservation are becoming ineffective. The main difficulties are related to the technological obsolescence of formats and software, which leads to the risk of losing access to digital resources. In addition, cyber threats are growing, calling into question the integrity and security of digital archives. In Ukraine, this area is in the process of developing systematic approaches and lacks a unified national policy, regulatory framework, and sufficient technical and human resources to ensure the long-term preservation of digital copies

of documents and printed publications. At the same time, the lack of standardisation of processes, format compatibility issues, global trends in digital transformation and the need to ensure access to digital resources pose complex challenges for archival institutions, requiring comprehensive technical, organisational and legal solutions. It is these aspects that determine *the relevance of research* aimed at systematising approaches, analysing challenges and seeking prospects for improving digital archiving in Ukraine and integrating it into the international context [2, 5, 6].

Establishing effective strategies for the digital preservation of humanity's cultural heritage, improving the regulatory framework, and actively introducing the latest technologies are unconditional priorities in the context of Ukraine's digital transformation and global trends [1, 3, 15]. The importance of this issue is determined not only by technical challenges, but also by the need to ensure the long-term accessibility, reliability and sustainability of electronic information.

The purpose of this article is to systematise approaches to the preservation of digital copies of ancient documents and rarebooks, analyse challenges and prospects, and integrate Ukrainian experience into the global context.

Introduction. Over the past three decades, the world has been undergoing a rapid digital revolution that is profoundly transforming the ways in which information is created, stored and used. In the context of global digitalisation, the volume of electronic data is growing exponentially, and with it, the challenges of long-term preservation, protection and accessibility are becoming more acute. Whereas archives used to focus on the physical stability of paper media, modern digital archives must rely on the reliability of data, formats and technologies, which are inherently dynamic and rapidly changing. This creates fundamentally new challenges related to technological obsolescence, cyber threats, format compatibility, and the preservation of information authenticity in the digital environment.

In Ukraine, the issue of digital preservation is only now gaining status as a systemic industry, reinforced by government initiatives within the framework of the 2025 national strategy for digital transformation of the economy. Domestic experts, including H. Symchyshyn, M. Bozdagan, and I. Orlyk, note the urgent need to develop a unified digital preservation policy that would take into account both the technical and organisational aspects of this complex task [1, 3]. International experience confirms that effective long-term preservation of digital resources is only possible through a comprehensive combination of standards, regulatory decisions and innovative technologies.

In light of the rapid development of information technologies and the challenges of social development, the issue of standardising digitisation processes, improving the cybersecurity of archives and training highly qualified specialists capable of combining knowledge in the fields of archiving, information technologies and state regulation is becoming urgent. Ukraine has a unique opportunity to integrate global experience and modern technologies into its own archival system, which will contribute to the preservation of digital cultural heritage for future generations.

Modern practices of information preservation

The term «digital preservation» covers a set of actions aimed at ensuring the accessibility, authenticity, and integrity of digital resources over a long period of time

[1, 5]. Modern digital preservation practices are based on three principles: **replication, migration, and emulation.** *Replication* involves creating several independent copies of data, *migration* involves periodically updating formats, and *emulation* involves recreating old environments to access obsolete formats.

Among international standards, the most widely recognised is the OAIS (Open Archival Information System) model, developed by NASA in 2002 and supported by ISO 14721. It defines the complete life cycle of a digital object, from creation to long-term storage and re use [20]. The 2025 update [15] introduces clearer definitions of preservation goals, the concept of Preservation Watch, and more flexible ways of structuring information.

Table 1

Comparison of key strategies for preserving digital copies

Strategy	Description	Advantages	Disadvantages	Examples of application
Replication	Creating multiple copies of data on different media	Protection against physical failures, simplicity	Does not solve format obsolescence	LOCKSS networks
Migration	Transferring data to new formats/ systems	Support for relevance, scalability	Risk of data loss during conversion	OAIS integration in archives
Emulation	Simulation of the old environment	Preservation of authenticity	High complexity, recursive obsolescence	Preservation of games and multimedia

Challenges of long-term preservation

The problem of long-term storage lies in the phenomenon of digital obsolescence — the moral ageing of software, formats and media. According to research by OCLC (2002) and DCIG (2022), up to 30% of digital archives face the risk of metadata loss due to obsolete formats or errors in storage systems [7, 6].

Table 2

Comparative table of challenges for long-term storage of digital copies

Challenge	Description	Impact on Ukraine	International solutions
Technological obsolescence	Obsolescence of formats/software	Lack of resources for migration	OAIS v3 with Preservation Watch
Cyber threats	Attacks on data	Dependence on foreign services	Blockchain for provenance
Funding	Insufficient budgeting	Government restrictions	Cooperation with UNESCO

Additional challenges include cyber threats, the lack of unified security policies, and insufficient funding for archival projects. The experience of the US and the EU demonstrates the effectiveness of combining cloud storage with local copies, as well as the creation of decentralised backup archiving networks. .

Technological solutions: compression, archiving, security

Modern digital archiving systems rely on lossless compression algorithms (e.g., LZMA, Zstandard) and cryptographic integrity verification mechanisms (SHA-256, blockchain registries). The implementation of LOCKSS (Lots of Copies Keep Stuff Safe) technologies ensures autonomous self-recovery of archives based on a distributed network of nodes [12].

According to Integrity (2024), the key criteria for the effectiveness of archiving systems are transparency, verification, scalability, and minimisation of human intervention [2]. Cloud solutions such as Amazon Glacier or Google Vault complement traditional archiving approaches but require strict security controls.

Table 3

Comparison of technologies for storing digital copies

Technology	Description	Advantages	Disadvantages	Examples
LZMA/Zstandard	Lossless compression	Efficiency, quality preservation	High processor load	Data archives
SHA-256	Cryptographic verification	Security, integrity	Vulnerability to new attacks	Blockchain in DCHR
LOCKSS	Distributed storag	Autonomy, resilience.	Need for a network of nodes	ADPN, MetaArchive

Practical aspects in Ukraine

Ukrainian archival institutions are gradually implementing digital preservation policies. In particular, the National Archival Fund is developing a concept for a centralised repository of digital documents. M. Bozdagan and I. Orlik emphasise the importance of creating high-quality digital copies using OCR technologies and PDF/A, TIFF and similar formats [3].

Despite some successes, systemic problems remain: the lack of a unified regulatory framework, a shortage of specialists, and dependence on foreign IT solutions. A positive step is the growth of cooperation between archival institutions and private companies in the field of digitising printed collections, such as in projects with FamilySearch.

Table 4

Comparison of practices for storing digital copies

Aspect	Ukraine	International experience
Strategy	National Informatisation 2022–2025	DPC Prospectus 2025–2026.
Technologies	OCR, PDF/A	AI and blockchain for provenanc
Collaboration	From FamilySearch	UNESCO projects.

Prospects for the development of digital archival infrastructure

In the context of European integration, Ukraine can borrow the experience of the Digital Preservation Coalition (Great Britain) and NEDCC (USA), which have developed regulatory documentation for the preservation of digital collections [19; 13]. A promising direction is the use of artificial intelligence for the classification and quality control of digital copies, the detection of duplicates and the restoration of damaged files [12].

An important trend is the combination of archiving with cybersecurity — the formation of the concept of digital trust, where data is protected technically, legally and ethically. By 2030, AI and blockchain will reduce costs by 30-50%, increasing trust in global archives.

International experience and standards

An analysis of international sources (ScienceDirect, ResearchGate, Nature, CLIR, UNESCO) shows that strategic digital preservation requires an institutional approach. The OAIS model and the LOCKSS system form the basis for most archival platforms. As part of the CLIR Digital Libraries Project (USA) initiative, it was emphasised back in 2001 that digital preservation is primarily about risk management, not just a technological problem [8].

Today, leading organisations are implementing automated checksum verification systems, intelligent object recognition and blockchain technologies to ensure the authenticity of metadata. According to the study Digital Preservation in Digital Libraries: A Systematic Literature Review (2024) [10], effective preservation systems combine PREMIS metadata, OAIS policies, and cloud infrastructure.

Modern innovative technologies for digital copies of digital copies of documents and rare books

In the process of digital preservation, archival and library institutions are increasingly using the latest digital tools to ensure the authenticity and immutability of electronic reproductions of ancient documents and rare books.

1. *Automated checksum verification systems*. A checksum is a unique digital identifier for a file, generated using hashing algorithms (SHA-256, MD5, SHA-3). Even a minor change in the file content results in a change in the checksum, making it an effective tool for detecting damage, unauthorised changes or data loss. In digital archives, These systems are integrated into repositories, automatically generating and storing hash values each time a file is uploaded or copied. Periodic scanning allows you to detect any changes caused by technical failures or third-party interference. Checksums are especially important for the long-term storage of large arrays of digitised documents. For rare books stored in high-quality formats (TIFF, RAW, PDF/A), checksums ensure that images and metadata have not been altered since the digital copy was created. This is an important part of the chain of custody and evidence base for the authenticity of digital resources.

The Wellcome Collection and the Digital Preservation Coalition use SHA-256 to verify each archive file immediately after it is uploaded. This procedure is integrated into the overall digital archiving process [21, 22].

2. *Intelligent object recognition.* Intelligent object recognition is based on computer vision and machine learning algorithms (e.g., TensorFlow, OpenCV). These systems automatically identify visual elements in digital images, greatly facilitating cataloguing and analysis processes. In archival and library practice, this allows for the automatic tagging of text fragments, initials, watermarks, ornaments, seals, coats of arms, and other characteristic objects. Such systems support image search and can detect damage to physical media. This technology is particularly useful for rare books, as it allows for the automatic classification and identification of unique graphic elements, watermarks, and calligraphy. This opens up the possibility of creating visual digital twins of artefacts for research and reconstruction without direct contact with the original.

Research on the RIDGES herbal corpus (1487–1870) demonstrates the ability to recognise rare books with an accuracy of 94–99%. Machine learning models make it possible to detect and structure data that is difficult to process using traditional methods [23].

3. *Blockchain technologies for metadata authentication.* Blockchain is a decentralised transaction register that ensures data immutability and transparency. Recorded information cannot be changed retroactively without breaking the entire chain of blocks. In the field of archiving, blockchain allows institutions to record all events related to digital objects: creation, modification, movement. This guarantees proof of authenticity and history of the object regardless of specific servers or institutions. For ancient documents and rare books, this means the ability to create digital certificates of authenticity anchored in the blockchain, which is especially important for international exchanges of collections or the publication of digital reproductions in open access. The technology can also be integrated with NFTs to mark valuable artefacts.

For example, researchers from Boston, with their ARCHANGEL project, are demonstrating the use of blockchain registries to record checksums and metadata of digital documents, creating a transparent and durable system for verifying authenticity [24].

4. *The role of digital printing.* It is important to note that digital printing technologies open up new opportunities for preserving cultural heritage. They make it possible not only to reproduce historical publications, but also to create hybrid forms of documents — digitally printed replicas [4].

Such practices are actively developing in libraries in the United States, Great Britain, and Poland, where digital printing is used as a tool for duplicating rare materials. This allows combining the accessibility of the digital environment with the authenticity of the physical medium.

Specialists from the Ukrainian Academy of Printing, in collaboration with the Vasyl Stefanyk Scientific Library of the National Academy of Sciences of Ukraine, have created a digital catalogue of 17th-century rare books from the printing house of Mykhailo Slyozka, which contains digitised copies of the pages of the editions. The copies contain digital colour profiles and can be printed on any printer connected to a computer with the highest quality that the device allows. This ensures that the printout is as close as possible to the original and, most importantly, contributes to better preservation of the originals in archives and libraries.

Scientific novelty and significance

The article is the first to systematise modern approaches and strategies for digital preservation, taking into account the 2025 OAIS model updates and LOCKSS technologies adapted to the Ukrainian context and international experience. Particular attention is paid to the integration of artificial intelligence for the automation of classification, metadata analysis and restoration of damaged files, as well as the implementation of blockchain technologies to ensure the integrity and authenticity of digital archives. A comparative analysis of Ukrainian and global digital preservation practices is proposed with a view to their European integration adaptation by 2030.

The study has important practical and social significance, as it contributes to the formation of national policy and a regulatory framework for the long-term preservation of digital information in Ukraine. The approaches proposed in the article will increase the reliability and security of digital archives and contribute to the training of highly qualified specialists capable of combining archival knowledge with information technologies. This will contribute to the preservation of historical memory, support scientific research, and develop the sustainability of digital cultural heritage for future generations.

Conclusions. The preservation of digital copies of documents and printed publications is a multifaceted and extremely important task that combines archival science, modern information technologies, and state regulation. In the context of rapid global digital transformation, the volume of digital information is growing, requiring the implementation of effective strategies for its long-term preservation, protection from cyber threats and ensuring accessibility. Ukraine, with its significant potential, faces the challenge of forming a unified system of digital preservation. This system should be based on international standards, in particular the updated OAIS (Open Archival Information System, 2025) model and LOCKSS (Lots of Copies Keep Stuff Safe) technology, which provide distributed and self-recovering storage of digital resources.

Confidence in the use of digital archiving methods is gradually growing, but challenges remain in the form of technical and organisational standardisation, improving the qualifications of specialists, and ensuring a regulatory framework. The return to issues of format compatibility, so-called digital obsolescence, and the need to process large amounts of metadata are pressing challenges that require further innovation and government support. A key future direction is the use of artificial intelligence to automate the processes of recognition, classification, restoration of damage, and creation of semantic links between digital objects, which contributes to the optimisation of the work of archival institutions.

At the same time, the leading role in forming an effective system is played by a combination of the latest information technologies, such as artificial intelligence, cloud services (Amazon Glacier, Google Vault) and blockchain technologies, which ensure the guaranteed integrity and authenticity of digital materials, as well as minimise human intervention. Ukraine has a unique opportunity to integrate international experience and modern technologies, forming a national strategy for the digital preservation of cultural heritage in the context of European integration. The implementation of such a strategy will not only ensure the preservation of historical memory and scientific information,

but also improve the quality and accessibility of digital archives for the public and researchers.

Therefore, the creation of an effective digital archival infrastructure is not only a technical but also a social necessity, opening up opportunities for preserving cultural heritage for future generations while increasing security, trust and transparency in the work of archival institutions.

REFERENCES

1. Symchyshyn, H. A. Preservation and protection of electronic documents [Electronic resource] / H. A. Symchyshyn. – Access mode: https://dspace.wunu.edu.ua/handle/316497/41829.
2. Long-term data storage: challenges and solutions [Electronic resource] / Integrity.com.ua. – 2024. – Access mode: https://integrity.com.ua/dovge-zberigannya-danyh-vyklyky-ta-rishennya/.
3. Bozydagan M., Orlik I. Organisation of document digitisation in Ukrainian archival institutions: textbook. – Kyiv, 2023. – 55 p. – Access mode: https://kntu.kr.ua/file/content/10650/m-bozdahan-ian-s-orlyk-orhanizatsiia-otsyfruvannia-dokumentiv-v-arkhivnykh-ustanovakh-ukrainy-str-50-55-.pdf.
4. Digital book printing technologies: what's new on the market? [Electronic resource] / Huss.com.ua. – 2023. – Access mode: https://huss.com.ua/tehnologiyi-cifrovogo-druku-knig-scho-novogo-na-rinku/.
5. From the concept of storing documents in electronic form to practice: scientific article [Electronic resource] / Librinfosciences.knukim.edu.ua. – 2024. – Access mode: http://librinfo-sciences.knukim.edu.ua/article/view/307129.
6. DCIG. Digital Preservation and Its Challenges [Electronic resource]. – 2022. – Access mode: https://dcig.com/2022/05/digital-preservation-and-its-challenges/.
7. OCLC. Preservation Metadata Framework [Electronic resource]. – 2002. – Access mode: https://www.oclc.org/content/dam/research/activities/pmwg/pm_framework.pdf.
8. Waters D., Garrett J. Preserving Digital Information. Report of the Task Force on Archiving of Digital Information [Electronic resource] / CLIR. – Washington, 2001. – Access mode: https://www.clir.org/wp-content/uploads/sites/6/pub63watersgarrett.pdf.
9. Digital Preservation Topic [Electronic resource] / ScienceDirect. – 2024. – Access mode: https://www.sciencedirect.com/topics/computer-science/digital-preservation.
10. Digital Preservation in Digital Libraries: A Systematic Literature Review [Electronic resource] / ResearchGate. – 2024. – Access mode: https://www.researchgate.net/publication/389232880_Digital_Preservation_in_Digital_Libraries_A_Systematic_Literature_Review.
11. Information Preservation: Digital Heritage [Electronic resource] / UNESCO. – 2024. – Access mode: https://en.unesco.org/themes/information-preservation/digital-heritage.
12. LOCKSS. Case Studies [Electronic resource] / LOCKSS.org. – 2025. – Access mode: https://www.lockss.org/join-lockss/case-studies.
13. Preservation Leaflets: The Relevance of Preservation in a Digital World [Electronic resource] / NEDCC. – 2024. – Access mode: https://www.nedcc.org/free-resources/preservation-leaflets/6.-reformatting/6.4-the-relevance-of-preservation-in-a-digital-world.
14. The Future of Digital Preservation: Trends to Watch in 2025 and Beyond [Electronic resource] / Nature.com. – 2025. – Access mode: https://www.nature.com/articles/s40494-025-01818-4.

15. What you need to know about the recent updates in OAIS v3 [Electronic resource] / Preservica.com. – 2025. – Access mode: https://preservica.com/resources/blogs-and-news/what-you-need-to-know-about-the-most-recent-oais-revision.
16. Digital Preservation Strategy 2022-2026 | National Archives [Electronic resource] / Archives.gov. – 2025. – Access mode: https://www.archives.gov/preservation/digital-preservation/strategy.
17. Digital Transformation of Ukraine's Economy. August 2025 [Electronic resource] / Niss.gov.ua. – 2025. – Access mode: https://niss.gov.ua/en/news/komentari-ekspertiv/digital-transformation-ukraines-economy-august-2025.
18. Ukraine Digital Development Country Profile [Electronic resource] / ITU.int. – 2025. – Access mode: https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Publications/2025/Final_Ukraine%20Digital%20Development%20Country%20Profile%20version%203.0.pdf.
19. DPC Prospectus 2025–2026 [Electronic resource] / Dpconline.org. – 2025. – Access mode: https://www.dpconline.org/about/join-us/prospectus.
20. ISO 14721:2025 Space data and information transfer systems — Open archival information system (OAIS) — Reference model [Electronic resource] / ISO.org. – 2025. – Access mode: https://www.iso.org/standard/87471.html.
21. Digital Preservation Coalition. Fixity and Checksums [Electronic resource]. – Access mode: https://www.dpconline.org/handbook/technical-solutions-and-tools/fixity-and-checksums.
22. Wellcome Collection. Our approach to digital verification [Electronic resource]. – Access mode: https://stacks.wellcomecollection.org/our-approach-to-digital-verification-79da59da4ab7.
23. Reul, Christian et al. OCR of historical printings with high accuracy using RIDGES herbal corpus. – arXiv preprint arXiv:1608.02153, 2016.
24. ARCHANGEL Project. Using blockchain to engender trust in public digital archives [Electronic resource]. – Access mode: https://www.digipres.org/publications/ipres/ipres-2018/papers/using-blockchain-to-engender-trust-in-public-digital-archives/.

СПИСОК ВИКОРИСТАНИХ ДЖЕРЕЛ

1. Симчишин Х. А. Збереження і захист електронних документів [Електронний ресурс] / Х. А. Симчишин. – Режим доступу: https://dspace.wunu.edu.ua/handle/316497/41829.
2. Довготривале зберігання даних : виклики та рішення [Електронний ресурс] / Integrity.com.ua. – 2024. – Режим доступу: https://integrity.com.ua/dovge-zberigannya-danyh-vyklyky-ta-rishennya/.
3. Боздаган М., Орлик І. Організація оцифрування документів в архівних установах України : навч. посіб. – Київ, 2023. – 55 с. – Режим доступу: https://kntu.kr.ua/file/content/10650/m-bozdahan-ian-s-orlyk-orhanizatsiia-otsyfruvannia-dokumentiv-v-arkhivnykh-ustanovakh-ukrainy-str-50-55-.pdf.
4. Технології цифрового друку книг: що нового на ринку? [Електронний ресурс] / Huss.com.ua. – 2023. – Режим доступу: https://huss.com.ua/tehnologiyi-cifrovogo-druku-knig-scho-novogo-na-rinku/.
5. Від концепції зберігання документів в електронній формі до практики : наукова стаття [Електронний ресурс] / Librinfosciences.knukim.edu.ua. – 2024. – Режим доступу: http://librinfosciences.knukim.edu.ua/article/view/307129.

6. DCIG. Digital Preservation and Its Challenges [Електронний ресурс]. – 2022. – Режим доступу: https://dcig.com/2022/05/digital-preservation-and-its-challenges/.
7. OCLC. Preservation Metadata Framework [Електронний ресурс]. – 2002. – Режим доступу: https://www.oclc.org/content/dam/research/activities/pmwg/pm_framework.pdf.
8. Waters D., Garrett J. Preserving Digital Information. Report of the Task Force on Archiving of Digital Information [Електронний ресурс] / CLIR. – Washington, 2001. – Режим доступу: https://www.clir.org/wp-content/uploads/sites/6/pub63watersgarrett.pdf.
9. Digital Preservation Topic [Електронний ресурс] / ScienceDirect. – 2024. – Режим доступу: https://www.sciencedirect.com/topics/computer-science/digital-preservation.
10. Digital Preservation in Digital Libraries: A Systematic Literature Review [Електронний ресурс] / ResearchGate. – 2024. – Режим доступу: https://www.researchgate.net/publication/389232880_Digital_Preservation_in_Digital_Libraries_A_Systematic_Literature_Review.
11. Information Preservation: Digital Heritage [Електронний ресурс] / UNESCO. – 2024. – Режим доступу: https://en.unesco.org/themes/information-preservation/digital-heritage.
12. LOCKSS. Case Studies [Електронний ресурс] / LOCKSS.org. – 2025. – Режим доступу: https://www.lockss.org/join-lockss/case-studies.
13. Preservation Leaflets: The Relevance of Preservation in a Digital World [Електронний ресурс] / NEDCC. – 2024. – Режим доступу: https://www.nedcc.org/free-resources/preservation-leaflets/6.-reformatting/6.4-the-relevance-of-preservation-in-a-digital-world.
14. The Future of Digital Preservation: Trends to Watch in 2025 and Beyond [Електронний ресурс] / Nature.com. – 2025. – Режим доступу: https://www.nature.com/articles/s40494-025-01818-4.
15. What you need to know about the recent updates in OAIS v3 [Електронний ресурс] / Preservica.com. – 2025. – Режим доступу: https://preservica.com/resources/blogs-and-news/what-you-need-to-know-about-the-most-recent-oais-revision.
16. Digital Preservation Strategy 2022-2026 | National Archives [Електронний ресурс] / Archives.gov. – 2025. – Режим доступу: https://www.archives.gov/preservation/digital-preservation/strategy.
17. Digital Transformation of Ukraine's Economy. August 2025 [Електронний ресурс] / Niss.gov.ua. – 2025. – Режим доступу: https://niss.gov.ua/en/news/komentari-ekspertiv/digital-transformation-ukraines-economy-august-2025.
18. Ukraine Digital Development Country Profile [Електронний ресурс] / ITU.int. – 2025. – Режим доступу: https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Publications/2025/Final_Ukraine%20Digital%20Development%20Country%20Profile%20version%203.0.pdf.
19. DPC Prospectus 2025–2026 [Електронний ресурс] / Dpconline.org. – 2025. – Режим доступу: https://www.dpconline.org/about/join-us/prospectus.
20. ISO 14721:2025 Space data and information transfer systems — Open archival information system (OAIS) — Reference model [Електронний ресурс] / ISO.org. – 2025. – Режим доступу: https://www.iso.org/standard/87471.html.
21. Digital Preservation Coalition. Fixity and Checksums [Електронний ресурс]. – Режим доступу: https://www.dpconline.org/handbook/technical-solutions-and-tools/fixity-and-checksums.

22. Wellcome Collection. Our approach to digital verification [Електронний ресурс]. – Режим доступу: https://stacks.wellcomecollection.org/our-approach-to-digital-verification-79da59da4ab7.
23. Reul, Christian et al. OCR of historical printings with high accuracy using RIDGES herbal corpus. – arXiv preprint arXiv:1608.02153, 2016.
24. ARCHANGEL Project. Using blockchain to engender trust in public digital archives [Електронний ресурс]. – Режим доступу: https://www.digipres.org/publications/ipres/ipres-2018/papers/using-blockchain-to-engender-trust-in-public-digital-archives/.

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ЗБЕРЕЖЕННЯ ЦИФРОВИХ КОПІЙ СТАРИХ ДОКУМЕНТІВ ТА СТАРОДРУКОВАНИХ ВИДАНЬ: СТРАТЕГІЇ, ВИКЛИКИ ТА ПЕРСПЕКТИВИ

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У статті досліджуються сучасні стратегії та підходи до збереження цифрових копій старих документів і друкованих видань у контексті глобальної цифровізації 2025 року. Аналізується український і міжнародний досвід цифрового архівування з акцентом на виклики довготривалого зберігання — технологічну застарілість, кіберзагрози, безпеку, сумісність форматів і автентичність даних. Особлива увага приділяється моделі OAIS (Open Archival Information System, оновлення 2025 р.) та системам LOCKSS (Lots of Copies Keep Stuff Safe), що забезпечують розподілене зберігання й самовідновлення архівів. Розглядаються хмарні рішення (Amazon Glacier, Google Vault) та інноваційні технології, зокрема штучний інтелект для класифікації, аналізу метаданих і відновлення файлів, а також блокчейн для гарантування цілісності даних. Подано порівняльний аналіз стратегій і практик України та міжнародних стандартів. Окреслено перспективи розвитку цифрової архівної інфраструктури України в контексті євроінтеграції та глобальних тенденцій, які до 2030 року можуть знизити витрати на архівування на 30–50 %. Підкреслено потребу національної стратегії цифрової консервації, стандартизації процесів оцифрування й підготовки фахівців для збереження цифрової культурної спадщини.

Ключові слова: *стародруки, старі документи, цифрове збереження, інновації в документознавстві та архівній справі, електронні документи, архівування, цифровий друк, метадані, LOCKSS, OAIS, штучний інтелект, блокчейн.*

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