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Development of archival practice in the context of digitalisation and the implementation of electronic document management in the Republic of Poland

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Abstract. The relevance of the study lies in the need to enhance the efficiency, transparency, and long-term preservation of archival collections through digitalisation. The purpose of the study was to evaluate electronic document management and digitalisation of archival resources of the Republic of Poland to identify their advantages, challenges, and development prospects. The study adopted a descriptive and analytical approach and employed documentary, comparative, and case-study methods, thereby enabling a comprehensive evaluation of the regulatory and practical dimensions of the digitalisation of archives in the Republic of Poland and the identification of prospects for the development of the national digital infrastructure. The study demonstrated that the archival system of the Republic of Poland was undergoing a systemic digital transformation, with the implementation of electronic document management forming its key component, which ensured the automation of the document-processing cycle and compliance with international standards such as the Open Archival Information System, Encoded Archival Description, Metadata Encoding and Transmission Standard, and Electronic Identification, Authentication and Trust Services. The findings indicated a considerable increase in the efficiency of archival operations: the time required for document registration was reduced from three days to four hours, losses of files decreased by 92%, and a complete electronic cycle of the development and transfer of archival packages was ensured. Comparative analysis showed that the central infrastructural projects are the Search the Archives portal and the National Digital Archives, which form a national digital ecosystem and are integrated with international platforms such as Europeana and Archives Portal Europe. Content analysis demonstrated dynamic growth in the digitalisation of archival collections: the number of digitised documents increased from 8.2 million to 70.3 million, and the share of collections in digital format rose from 11.3% to 77.6%. However, key constraints were identified: uneven technical capacity among regional archives, issues concerning the long-term preservation of digital copies, the safeguarding of metadata integrity, insufficient staff qualifications, and cybersecurity challenges. The findings are of academic value for researchers, specialists in archival digitalisation, staff of archival institutions, and public administrators interested in the modernisation of archival practice and the integration of national archival resources into the international digital space

Keywords: digitisation; metadata; digital repository; electronic archival systems; digital transformation; archival infrastructure

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Introduction

Archival practice in the period 2020-2025 underwent intensive transformation under the influence of digitalisation and the implementation of electronic document management. The Republic of Poland, a state with a developed network of national and regional archives, actively integrates digital technologies to ensure access to archival collections, their long-term preservation, and greater efficiency in document processing. These processes, however, are accompanied by challenges: the scale of digitising collections, shortages of financial and human resources, the need for metadata standardisation, the safeguarding of digital objects, and the legal regulation of access. The examination of the current state of the archival system of the Republic of Poland, the evaluation of implemented projects, and the analysis of challenges and development prospects are relevant for identifying effective strategies for digitalisation, the modernisation of archival practice, and increased accessibility of historical and cultural heritage for scholars and the wider public.

The review of the literature on the development of archival practice and digitalisation indicates strong academic interest among Polish researchers in the issues of implementing electronic document management and digitising archival collections. In the study by A. Rosa (2025), emphasis is placed on the historical dimension of archival digitalisation, covering the period from the initial computerisation initiatives of the 1990s to the establishment of the National Digital Archive (NDA) and the Search the Archives portal. The author traced the evolution of the technological infrastructure of the archival system, arguing that digitalisation is not a single technical step but the result of a consistent modernisation policy combining metadata standards, centralised management of collections, and state-level support. The study by D. Drzewiecka (2024) adopted a socio-legal approach and examined the issue of access to archival materials in the post-communist period. The researcher demonstrated that the democratisation of the archival sphere after 1989 was accompanied by structural constraints, including the slow pace of digitisation, varied levels of technical capacity across regional archives, and complex procedures for granting access to documents. The study also highlighted that digitalisation in the Republic of Poland has not only a technical but also a value-based dimension since ensuring openness of collections is linked with the development of public trust in state institutions and the maintenance of democratic memory practices. In contrast, M. Kawczyńska (2024) examined archival digitalisation within the broader context of European open-data policy, focusing on the legal aspects of the re-use of public sector information. The author analysed the impact of EU directives on data openness, interoperability, and electronic identification on the transformation of Polish archives into a component of the integrated European digital space.

Other studies confirm the importance of a comprehensive approach to archival digitalisation, the implementation of electronic document management, and the preservation of electronic documents. N. Korzhyk *et al.* (2023) examined the state of state archives of Ukraine during Russian aggression, outlining major challenges and achievements in the preservation and accessibility of documents. The researcher emphasised the need for an integration of technological solutions and adaptive management of archival processes even under crisis conditions. The study by R. Nurbatyrova *et al.* (2024) investigated the digital transformation of archives in Kazakhstan in the context of the introduction of an electronic document-management system. The authors demonstrated that the comprehensive implementation of electronic services increases efficiency in processing and accessing archival materials, while requiring metadata standardisation and adequate staff training. In turn, L. Žaja (2021) focused on regulatory frameworks, legislation, and standards for controlling and preserving electronic documents in northern European countries, emphasising that clear legal and methodological regulation of electronic archival processes is a necessary condition for their long-term reliability and accessibility. The analysis of these studies confirms that contemporary archival practice requires the integration of technological, regulatory, and organisational approaches that ensure the effective functioning of digital archives and the resilience of electronic document management.

In turn, G. Colavizza *et al.* (2021) examined the role of artificial intelligence in archives, analysing current debates and the prospects for employing artificial intelligence to automate cataloguing, classification, and the retrieval of archival materials. The authors emphasised that the introduction of intelligent algorithms may substantially increase the efficiency of processing large volumes of data, but requires careful regulation and the safeguarding of system reliability. A. Hawkins (2022) explored the use of linked data in digital archives and the humanities, demonstrating how the application of semantic web technology enhances the accessibility of both digitised and born-digital collections. The author drew attention to the standardisation of metadata and the integration of archival systems to ensure convenient and reliable information retrieval. G. Zaagsma (2023) analysed the political and cultural context of digital history, investigating how digitisation processes influence the representation of historical narratives and access to digital historical sources. The study showed that the digitalisation of archives requires not only technical modernisation, but also an understanding of the sociocultural and political dimensions of access and interpretation.

The analysis of previous studies indicates substantial progress in the field of archival digitalisation, the introduction of electronic document management, and the use of contemporary technologies to improve the

accessibility of archival materials. However, most studies concentrate on technical or regulatory aspects, such as the standardisation of metadata, the implementation of electronic document-management systems, and the use of artificial intelligence to automate document processing. A comprehensive analysis that simultaneously encompasses regulatory, organisational, and technological contexts of archival digitalisation in Poland has not been conducted, nor has the effectiveness of specific projects for digitising collections and providing online access to them been assessed. The purpose of the study was a comprehensive analysis of the current state of the archival system of Poland in the context of digitalisation and the introduction of electronic document management, including an evaluation of implemented digitisation projects and the provision of online access to archival collections, as well as the identification of existing challenges and prospects for further development. Two objectives were set within the study: identifying and systematising the existing regulatory, organisational, and technological frameworks underpinning the digitalisation of archival work in Poland; examining specific projects for the digitisation of archival collections and online platforms, assessing their effectiveness, accessibility, and problematic aspects that influence the further development of electronic archival document management.

Materials and Methods

The study adopted a descriptive and analytical approach with elements of case study and comparative analysis. The timeframe covered the period 2015-2024, which included the most recent legislative amendments, updates to methodological standards, and the implementation of the principal digital initiatives of voivodeship archives. The methodology entailed a combination of several analytical methods. First, a documentary and comparative analysis was conducted, which enabled the systematisation of provisions of laws, secondary legislation, and methodological standards, and the identification of key aspects of digitalisation: the creation, transfer, preservation, description, and access to electronic documents. The main sources of information comprised regulations, secondary regulatory documents, and strategic plans of state archives dedicated to archival digitalisation. The principal regulations examined included the Act "On National Archival Resources and Archives" (1983), which defines the structure of the archival system, the State Archives (n.d.), and approaches to the preservation and transfer of electronic documents. The analysis also covered the Regulation of the Minister of Culture and National Heritage No. 1743 (2015), which sets the rules for classifying and transferring digital documents to archives, and the Regulation of the Prime Minister No. 67 (2011), which introduces the Electronic Document Management system (EDM) in state institutions. The Strategy for the developed by the author based on of archival resources for 2021-2030 (State Archives, 2021) and the Standards for the digitisation of archival materials (Grochowski, 2017) served as the strategic documents for analysis, detailing directions for digital transformation and technical standards for the digitisation of collections. The methodological foundation was the Open Archival Information System (OAIS) (2022), which adapts the OAIS reference model – ISO 14721:2025 (2025) – to national conditions. Key digital platforms and infrastructural solutions were analysed to evaluate practical aspects of digitalisation: the Search the Archives (n.d.), which aggregates descriptions and scans of archival materials; the National Digital Archives (NDA) (n.d.), which provides the preservation of and access to large volumes of digital copies; and the local systems of voivodeship archives, which support regional digitalisation initiatives. Second, the case-study method was employed to evaluate the practical implementation of digital projects. Specific projects of NDA and voivodeship archives were analysed with regard to the scale of digitisation, technical solutions (file formats, preservation levels, back-up procedures), and the accessibility of resources for users via the Search the Archives (n.d.). Therefore, the combination of documentary, comparative, and case-study methods enabled a comprehensive examination of both regulatory and practical aspects of the digitalisation of the archives of Poland, an evaluation of the effectiveness of implemented projects, and the identification of promising areas for the development of digital archival infrastructure.

Results

Overview of the current state of the archival system of Poland

The archival system of Poland is structured as a multi-level state network that integrates three central archives in Warsaw with regional (voivodeship) archives and their branches. The central institutions include the Central Archive of Historical Records (CAHR), the Archives of Modern Records, and the National Digital Archives (n.d.). The legal framework is defined by the Act "On National Archival Resources and Archives" (1983), which specifies the competences of the General Director of the State Archives (State Archives, n.d.), the procedures for establishing and administering archival holdings, the conditions for transferring materials, their preservation, and the provision of access. The act and its related regulations also establish the principles governing digitisation, the conditions for the transfer of electronic documents to archives, and the responsibilities for preservation and access. NDA serves as the central coordinator of digitisation in the archival sector. Its work is guided by two strategic documents: the Strategy for the digitisation of archival resources for 2021-2030 (State Archives, 2021), approved by the General Director of the State Archives, which sets out the principles of large-scale digitisation, open data, and continuity of access; and the Standards for the digitisation of archival materials (Grochowski, 2017), methodological guidelines

that specify scanning parameters, storage formats, metadata structures, and requirements for systems describing digital copies. NDA performs both technical and methodological functions: it develops protocols for digitisation, storage, and checksum verification, together with standards for long-term digital preservation. Within its structure, the National Digital Archives operates a multi-layered preservation system comprising an Access Layer that provides public metadata and digital copies through the Search the Archives portal, an Archival Layer that holds primary high-resolution copies, and a Backup Layer that maintains duplicates in remote data centres.

The key instrument for accessing digitised materials is the Search the Archives (n.d.), a centralised aggregator that merges descriptions and scans from state and selected non-state archival institutions across the country. The portal enables metadata searching, browsing of scans, ordering of copies, and the creation of personal collections, thereby significantly enhancing the accessibility of archival resources for researchers and the wider public. The functions and services of archives encompass conventional operations such as acquisition, storage, conservation, inventorying, and reading room access, together with an expanded range of digital services including digitisation on request, systematic large-scale digitisation of priority collections, provision of metadata in open formats, electronic ordering, remote access, and user-oriented educational and informational projects. Many archives combine physical conservation with digital copies as part of a broader strategy to ensure both accessibility and preservation. The principal institutions of the archival system of Poland are presented in Table 1.

Table 1. Key institutions of the archival system in Poland

Institution	Role / Main functions	Examples of digital initiatives
Central Archive of Historical Records	Preservation of historical documents, reference and information services	Digitisation of metric books, Search the Archives
Archive of Contemporary Records	Archives of central institutions, state registries	Electronic fonds descriptions, collaboration with NDA
National Digital Archives	Coordination of digital projects, preservation of audiovisual materials, development of digitisation standards	Mass scanning, National Digital Archives
Voivodeship archives	Collection of local fonds, local digitisation	Regional projects, integration of descriptions into Search the Archives
Search the Archives	Aggregation of descriptions and scans, search and access tool	Metadata search, copy ordering, personalised user accounts

Source: developed by the author based on research by L. Harc (2021)

Table 1 reflects the structural organisation and functional role of the key institutions within the archival system of Poland, with a focus on digitisation and resource accessibility. It shows how the different levels of the archival network interact and what contribution each makes to digital preservation and access provision. The central archives, such as the CAHR and the Archives of Modern Records, perform classical functions of storage and reference services, while integrating digital tools, for example, digitisation of parish registers and the creation of electronic descriptions of collections. This illustrates the combination of conventional archival procedures with contemporary digital services. NDA occupies a central position in coordinating digital projects, defining digitisation standards and protocols, conducting large-scale scanning, and maintaining its own digital repository. Its role is essential for ensuring the unification of digitisation processes, methodological consistency, and open access to resources. The voivodeship archives focus on local collections and the integration of digitised outputs into national systems, which highlights the importance of the multi-level structure and the coordination between central and regional institutions. The Search the Archives (n.d.) functions as an aggregator, providing centralised access to metadata and scans, which significantly increases the accessibility of archival resources for researchers and the public, while supporting personalised user experiences through accounts and copy requests. Overall, Table 1 demonstrates the effective integration of organisational structure, functional responsibilities, and digital tools that together shape the contemporary digital archival ecosystem of Poland.

Figure 1 illustrates the logical structure of the archival system of Poland and the flows of digital resources, showing the interaction between state administration, central and regional archives, and users. It presents how the multi-level organisational model ensures the preservation of archival holdings, coordination of digitisation, and access to materials through centralised platforms. This visual representation allows both vertical and horizontal connections between system components to be assessed, emphasising the integrative character of the contemporary digital archival infrastructure.

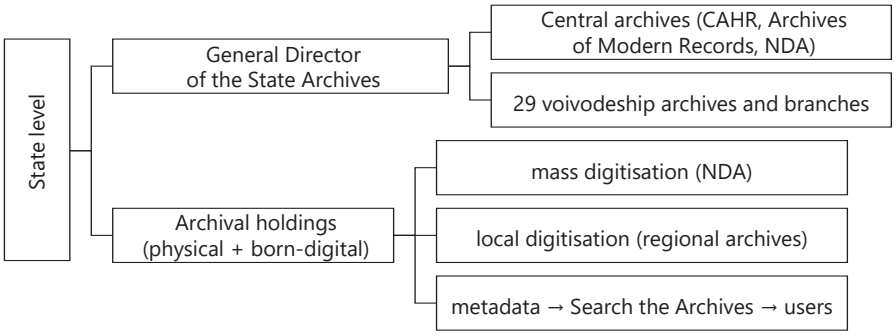

Figure 1. Structure of archival system of Poland and flows of digital resources
Source: developed by the author based on the study by D. Magier & S. Posokhov (2022)

At the national level, the coordinating role is performed by the State Archives (n.d.), who supervises the central archives and regional units. The central archives, which include CAHR, the Archives of Modern Records, and NDA, concentrate key functions of preservation, standardisation, and large-scale digitisation of holdings. The regional voivodeship archives implement local digitisation projects and integrate their results into national systems. Archival holdings, represented by both physical and born-digital documents, follow two parallel digital trajectories: large-scale digitisation conducted by NDA ensures standardised high-quality copies of key collections, whereas local digitisation in the regional archives enables the processing of specific holdings and the preservation of local cultural features. Metadata and digital copies are transmitted centrally to the Search the Archives (n.d.), which serves as the single interface for end users, providing accessibility, search, and document ordering. The diagram highlights the efficiency of the multi-level structure, which combines centralised management, process standardisation, and regional flexibility. It demonstrates how the archival system of Poland maintains sustainability, accessibility, and consistency of digital resources, while supporting the integration of physical and digital holdings into a unified information ecosystem.

The key document that defines the framework of digital archival policy is the Act "On National Archival Resources and Archives" (1983). The Act sets out the concept of the national archival resource, establishes the responsibility of state bodies for the transfer of electronic documents to archives, and delegates the competences of the State Archives (n.d.) in the field of standardising digital processes. In its recent versions (following the amendments of 2018 and 2020), the Act for the first time provided a clear definition of documents in digital form and the procedures for their preservation in state repositories. The legislative framework is complemented by the Regulation of the Minister of Culture and National Heritage No. 1743 (2015) on the classification and transfer of materials to archives. It defines the rules for receiving electronic documents, the requirements for formats, metadata structures, signatures, and authentication systems. The document stipulates the mandatory use of long-term formats (TIFF, PDF/A, XML) and the implementation of digital preservation policies. Another important instrument is the Government of the UK (2011), which introduced electronic document circulation in public institutions. It obliges state authorities to use Electronic Document Management (EDM) systems compatible with archival requirements and mechanisms for transfer to state archives. Table 2 presents the key regulatory and methodological documents that define the legal and technical landscape of digitisation in the archival domain in Poland.

The general overview of the documents shows that digitisation in the archival system of Poland is founded on a comprehensive approach that combines legislative requirements, technical standards for digitisation, and methodological guidelines for managing digital data. Regulations establish the legal foundation for electronic document circulation and define the roles of key institutions. Strategic documents outline the development pathways of the digital archival infrastructure and open access to materials, whereas standards and national adaptations of international models guarantee compatibility and long-term preservation of digital resources.

Table 2. Key regulations and methodological documents on digitisation

Document	Year	Content / Significance
Act "On National Archival Resources and Archives"	1983 (amended 2020)	Establishes the principles of archival practice, defines the concept of electronic documents, and outlines the competencies of the General Director of the State Archives
Regulation of the Minister of Culture and National Heritage No. 1743	2015	Regulates digitisation, sets standards for formats, description, and transmission of electronic documents
Regulation of the Prime Minister	2011	Implements the EDM system in the public sector
Archival Resources Digitisation Strategy 2021-2030	2021	Defines areas of digitisation policy and infrastructure development

Continued Table 2.

Document	Year	Content / Significance
Archival Materials Digitisation Standards	2022	Provides methodological guidelines on technical parameters and formats of digital copies
Polish OAIS Model	2022	National adaptation of the model for long-term digital preservation

Source: developed by the author based on the study by K. Kowalczyk (2021)

Figure 2 illustrates the structure of governance of digitisation within the archival sector of Poland at the state level and the hierarchical links between the central bodies responsible for policy development, methodological standards, and the direct implementation of digital initiatives. The diagram shows how the Ministry of Culture and National Heritage delegates authority to the General Director of the State Archives for coordinating archives and approving standards, while ensuring technical and methodological implementation through NDA.

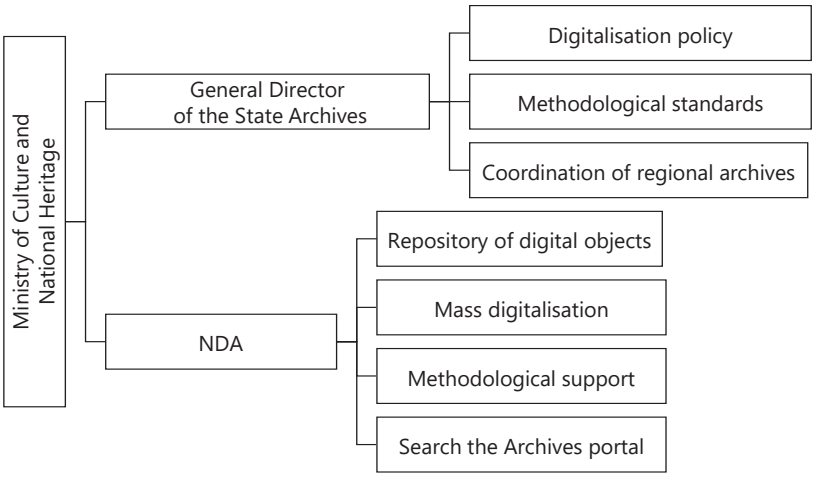

Figure 2. Text-based scheme of digitalisation management in the archival sector
Source: developed by the author based on the study by M. Sobęcka (2025)

The diagram highlights the separation of strategic and executive functions in the governance of digitisation within the archival system. The General Director of the State Archives is responsible for policy development, approval of methodological standards, and coordination of the activities of the 29 voivodeship archives, which ensures consistency of approaches throughout the country. NDA implements direct digitisation measures, including large-scale scanning of archival collections, management of the digital object repository, and methodological support of processes, and offers user access through the Search the Archives portal. This structure ensures effective integration of regulatory requirements, technical solutions, and open access, while supporting standardisation and long-term preservation of digital resources. The legislative framework of Poland therefore provides a comprehensive regulatory basis for digital archival activity, combining legal guarantees of authenticity, durability, and accessibility of documents. The central role of NDA extends beyond the preservation of digital resources to the development of unified standards for state archives, which ensures an integrated archival policy in line with European principles of digital continuity and open access.

Analysis of the implementation of electronic document circulation in archival practice

The contemporary archival system of Poland is undergoing a profound digital transformation, with the introduction of electronic document circulation (Electronic Document Management System) forming its core element. This process encompasses not only the replacement of paper-based administrative practices with digital workflows but also the development of a coherent ecosystem for managing information flows, where documents are created, processed, signed, transmitted, and archived in digital form. Two interlinked platforms play a key role in state archives in Poland: Electronic Documentation Management in the EZD RP system (EDM EZD PR) (n.d.) and European Pressure Ulcer Advisory Panel (EPUAP) (n.d.), which support the functioning of e-government and create the normative and technological foundation for digital archival practice. The system of electronic document circulation in the state sector of Poland is based on the principle of a single information chain that includes the stages of creation, approval, validation, registration, and transfer of a document to the archive. This process may be summarised in the form of a diagram (Fig. 3).

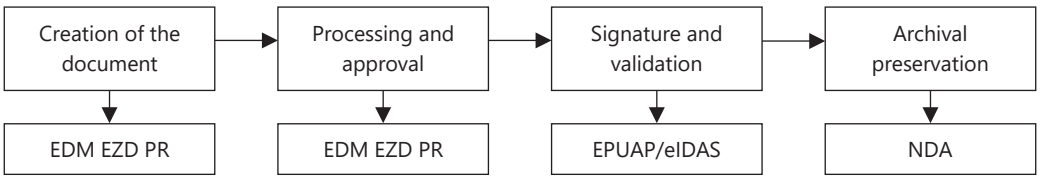

Figure 3. Electronic document management system based on a unified information chain
Source: author's development

In this framework, the Electronic Documentation Management in the EZD RP system (n.d.) serves as the primary tool for electronic record management, whereas EPUAP provides the infrastructure for electronic identification, digital signatures, and inter-agency interaction. EDM EZD PR system, developed by the Podlaskie Voivodeship Office, had become the standard for the majority of Polish state institutions, including archives. It supports the full lifecycle of document management, from creation to transfer to the archive. The main functional modules of EDM EZD PR include registration and classification of documents according to the national file classification scheme, electronic circulation between departments and institutions, digital signatures and authenticity verification through integration with EPUAP (n.d.) and Electronic Identification, Authentication and Trust Services (eIDAS) (n.d.), automated generation of archival packages for transfer to state archives, and an embedded module for retention schedule control in compliance with JRWA (Uniform Material List of Files) standards. According to the State Archives (n.d.), by 2024, the EDM EZD PR system was used by over 1,200 state institutions, including most regional archives. Its advantages include open-source architecture and state support, ensuring adaptability to regulatory and technological changes. Table 3 presents a comparative overview of the two key systems forming the technological basis of electronic record management in Polish archival practice – EDM EZD PR and EPUAP.

Table 3. Comparative characteristics of electronic document management systems in the archival practice of Poland

Characteristic	EDM EZD PR	EPUAP
System type	Electronic document management system	Electronic administrative services platform
Main function	Creation, processing, and archiving of electronic documents	User identification, digital signature, inter-agency exchange
Use in archives	Preparation and transmission of archival packages	Receipt, authentication, and transfer between institutions
Interaction with NDA	Automatic creation of archival copies	Transmission of authenticated electronic documents
Compliance with standards	OAIS, EAD, METS, JRWA	eIDAS, ISO/IEC 27001:2022
Level of integration	High (API and REST support)	Medium (via GOV.pl gateway)

Note: EAD – Encoded Archival Description; METS – Metadata Encoding and Transmission Standard
Source: developed by the author based on the study by D. Drzewiecka (2024)

The Table 3 demonstrates that the EDM EZD PR system plays a leading role in the digitalisation of internal documentation processes, as it covers the complete cycle of electronic document processing, from creation to the transfer of archival packages to state archives. High levels of integration with other information systems are supported through open APIs and adherence to international archival standards (OAIS, EAD, METS, JRWA). Conversely, EPUAP functions as an overarching system that provides electronic identification, signatures, inter-agency exchange, and document authenticity verification in accordance with eIDAS (n.d.) requirements and ISO/IEC 27001:2022 (2022) security standards. The EPUAP platform constitutes a central element of the e-government framework of Poland, through which official communication is conducted between citizens, institutions, and state archives. Users can submit official requests, receive documents, and sign them using a qualified electronic signature with legal validity. Through integration with the EDM EZD PR system, documents created and approved via EPUAP automatically acquire official status and may be transferred to the archive without printing. This substantially reduces processing time and the risk of data loss. Within archival practice, EPUAP also functions as a virtual gateway for electronic archive transfer, ensuring compatibility across different departmental record management systems (Drzewiecka, 2024).

Evaluation of the efficiency of electronic record management in Polish state archives indicates a positive impact on productivity, transparency, and archival quality. According to the Digital Decade Country Report (2023), implementation of EDM EZD PR reduced the average document registration time from three days to four hours, while the number of lost cases decreased by 92%. Electronic interaction via EPUAP reduced administrative burden, providing remote access to documents

and enabling a fully electronic approval cycle. Certain challenges remain, including the migration of legacy documents, ensuring metadata authenticity, and standardising archival package formats, which are not yet fully harmonised across all voivodeships.

The implementation of electronic record management is a key aspect of the digital transformation of the archival sector in Poland, closely linked to the need to enhance documentation efficiency, ensure authenticity, and guarantee long-term preservation. This process began in the 2010s with the introduction of the national e-government programme and the transition of public sector institutions to digital recordkeeping formats. The Polish archival system, as a vital component of the national information infrastructure, integrated its procedures with state platforms, primarily the EDM EZD PR system and the EPUAP platform. This integration established a unified electronic document lifecycle, from creation within departmental systems to archival preservation at the NDA. The structural-functional diagram below illustrates the flow of electronic documents between the principal elements of the archival-information ecosystem (Fig. 4).

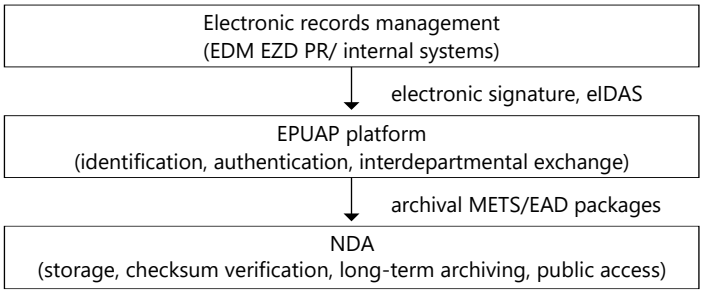

Figure 4. Model of electronic document management in the archival system of Poland
Source: developed by the author based on the study by S. Kotyla (2021)

At the first level, electronic record management (EDM EZD PR) operates, overseeing the creation, processing, and registration of electronic documents within institutions. This stage generates the primary data set, with each document signed using a qualified electronic signature in accordance with eIDAS (n.d.) standards, thereby ensuring the legal validity of digital records. The second level is represented by the EPUAP (n.d.), which functions as an intermediary between institutions and state archives. It provides electronic user identification, document authentication, and the transfer of records between various administrative structures. EPUAP effectively establishes a unified information exchange space in formats compatible with archival standards, including METS and EAD. The third level comprises the NDA, which constitutes the terminal point for the preservation of electronic archival packages. This stage involves checksum verification, compliance with long-term archival standards (Open Archival Information System, 2022), and public access provision through the repository and the Search the Archives (n.d.). Collectively, the framework illustrates an integrated ecosystem of digital archival infrastructure of Poland, with each level performing a clearly defined function: EDM EZD PR – document creation, EPUAP – authentication and transfer, NDA – preservation and access (Kotyla, 2021). This approach guarantees not only technological integrity but also the legal reliability of all electronic document circulation processes. The implementation of electronic record management in Polish archival practice thus proceeds systematically and methodically. Its foundation lies in the integration of EDM EZD PR and EPUAP, which together form a unified digital chain of document circulation from creation to archival preservation. This arrangement enhances archival efficiency, fosters transparency, strengthens cyber-resilience, and ensures the long-term preservation of the state's digital heritage.

Evaluation of implemented digitisation projects of archival collections and online access

The digitisation of archival collections in Poland represents one of the most successful examples of systemic modernisation of the archival sector in Central and Eastern Europe. Between 2015 and 2025, the state archives of Poland undertook a series of large-scale initiatives aimed at providing open access to historical sources, optimising search capabilities, and preserving cultural heritage in digital format. Among the most significant projects are the Search the Archives (n.d.), the National Digital Archives (n.d.), and inter-archival digitisation programmes within European initiatives, including Europeana (n.d.) and Archives Portal Europe (APE) (2025).

The Search the Archives (n.d.) constitutes a key infrastructural platform, developed by the National Archives of Poland in collaboration with the Ministry of Culture and National Heritage. Launched in 2009, the portal became the central access point for digital copies of documents produced through mass digitisation. Its current version, updated in 2021, supports integration with the EDM EZD PR system, the NDA, and European databases. By early 2025, the Search the Archives database contained over 70 million scanned archival documents, encompassing more than 45 terabytes of data. The portal holds materials from 33 state archives in Poland, including parish registers,

cadastral plans, court cases, and documents from state institutions of the nineteenth and twentieth centuries.

The system interface is constructed on a REST API model, enabling integration with other archival databases, academic repositories, and libraries. Portal architecture adheres to the OAIS model and descriptive standards EAD and Dublin Core, ensuring full interoperability with international metadata systems. The dynamics of Polish archival collection digitisation through the Search the Archives portal are presented in Table 4.

Table 4. Dynamics of the digitisation of Polish archival collections via the Search of the Archives portal

Year	Number of digitised documents (million)	Data volume (TB)	Share of archival collections (%)
2015	8.2	4.6	11.3
2018	24.5	14.2	28.7
2021	48.0	29.8	53.1
2024	70.3	45.1	77.6

Source: developed by the author based on the study by K. Kowalczyk (2024)

As shown in Table 4, between 2015 and 2024, the digitisation of archival collections in Poland demonstrated consistent and rapid growth. The number of digitised documents increased from 8.2 million to 70.3 million, representing more than an eightfold rise. Concurrently, the volume of digital data expanded from 4.6 TB to 45.1 TB, while the proportion of archival holdings available in electronic format rose from 11.3% to 77.6%. This trend reflects the systematic deployment of digital transformation processes, encompassing both national and regional archives. Significant growth occurred during the period 2018-2021, when large-scale mass digitisation programmes were implemented under the Strategy for the digitisation of archival resources for 2021-2030 (State Archives, 2021). This enabled the integration of millions of pages from parish registers, civil status acts, notarial documents, and cartographic materials into the portal. The system is now approaching full digital representation of archival holdings, establishing a foundation for further automation of metadata description, intelligent search, and the application of artificial intelligence technologies for document identification.

Polish archives actively integrate into international digital cultural heritage networks. Through the use of standardised metadata (EAD, EDM), over 2.3 million digital objects from Search the Archives (n.d.) are already accessible via the Europeana (n.d.), positioning Poland as a regional leader in the volume of represented archival resources. Furthermore, Poland participates in the APE project, encompassing 33 European countries. This facilitates the integration of Polish archival metadata into a shared search system, enhancing international visibility and accessibility of Polish collections (Rosa, 2025). Figure 5 illustrates the multi-tiered structure of the digital archival ecosystem of Poland, linking national electronic record management platforms, centralised search systems, and European integration initiatives.

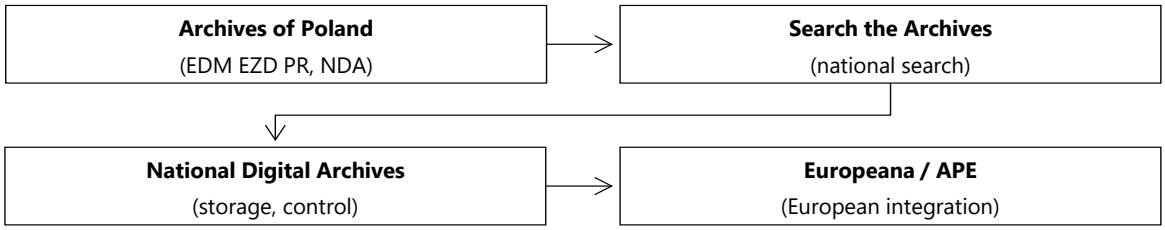

Figure 5. Information interaction of Polish archives in the context of the digital ecosystem
Source: developed by the author based on the study by A. Rosa (2025)

The Polish model of archival digitisation is built upon a clear vertical hierarchy of interconnected elements. The central role is occupied by the Search the Archives (n.d.), which functions as the national tool for archival material discovery, providing open access to millions of digitised documents. Its effectiveness is supported by EDM EZD PR, the electronic record management system that automates processes of document creation, storage, and transfer within the public sector. In parallel, the National Digital Archives (n.d.) operates to provide centralised storage of digital copies, version control, and metadata standardisation, ensuring the reliability and authenticity of archival objects. An essential component of the strategy is integration with the Europeana (n.d.) and Archives Portal Europe (2025) platforms, which incorporates Polish archives into the shared European digital cultural heritage space. The framework therefore demonstrates not only technical interaction between systems but also an institutionally coordinated approach to managing archival resources, from the national to the international level. This enables Poland not only to preserve its documentary heritage

effectively but also to promote global accessibility of historical data within the European information space.

Consequently, the implemented digitisation projects of Polish archival holdings represent a defining stage in the modernisation of the archival system. The Search the Archives (n.d.) and the National Digital Archives (n.d.) have established a national digital infrastructure that ensures openness, standardisation, and long-term preservation of documentary heritage. International integration through Europeana (n.d.) and Archives Portal Europe (2025) has enhanced the visibility of Polish archives and created conditions for data exchange, academic collaboration, and the development of shared European standards in digital archiving. The Polish experience in archival digitisation demonstrates an effective model combining technological innovation, state policy, and methodological support, which may serve as an example for other Central and Eastern European countries.

The state of Polish digital archival infrastructure demonstrates substantial progress in the creation of databases, the development of electronic services, and the integration of archival resources into national information systems. The digital transformation process, however, faces a series of organisational, technical, and legal challenges affecting the efficiency of digital document preservation and utilisation. A key issue remains the uneven level of technical equipment among regional archives, resulting in variable rates of digital technology implementation. Long-term preservation of digital copies of archival materials also presents a challenge. The Polish system currently employs a hybrid storage model, combining local servers with a centralised repository within the National Digital Archives (n.d.). The absence of a unified format migration strategy and regular media updates, however, generates risks of data loss. Particular attention is given to metadata management: although the EAD standard is applied, its practical implementation is often fragmentary, complicating integration with international systems, including Europeana Archives (Augustyn *et al*., 2021).

Organisational challenges are associated with preparing personnel capable of working in the field of digital archival science. Research conducted by the National Archives of Poland indicates that only around 40% of staff possess formal competencies in digital data processing, which slows the implementation of large-scale digitisation initiatives. Limited funding for server infrastructure modernisation projects and the procurement of licensed software further complicates the situation. From a cybersecurity perspective, the primary challenge lies in protecting archival data from unauthorised access and cyberattacks. Although the EDM EZD PR system features multi-level authentication, there is a need to update encryption protocols and incident monitoring. Implementation of backup systems and access auditing remains critical, yet these procedures are currently regulated only at the level of internal guidelines of individual institutions rather than by a nationwide standard. Table 5 summarises the main challenges faced by Polish archival institutions in the context of digitisation and identifies potential areas for further system improvement in accordance with European standards and practices.

Table 5. Key challenges and prospective areas for the development of the digital archival infrastructure of Poland

Problem category	Examples of manifestation	Potential solutions and prospects
Technical	Lack of contemporary servers, risk of data loss	Cloud archives, automated systems for format migration
Organisational	Insufficient staff qualifications, fragmented policy	Development of educational programmes in digital archival studies
Financial	Limited budgets for digitisation	EU support programmes, public-private partnerships
Security	Cyberattacks, vulnerability of storage systems	Implementation of Zero Trust, access auditing, encryption
Legal	Absence of unified metadata standards	Harmonisation with European regulations eIDAS and INSPIRE

Note: INSPIRE – Infrastructure for Spatial Information in the European Community
Source: developed by the author based on the study by T. Aparac-Jelušić (2022)

Data presented in Table 5 demonstrate that the contemporary digital archival infrastructure of Poland is undergoing profound systemic transformation, accompanied by technical, organisational, financial, security, and legal challenges. Each of these categories is complex and requires coordinated solutions at the level of state policy, technical standardisation, and management approaches. Technical issues form the foundation, directly determining the stability and reliability of archival systems. Core challenges include limited server capacity, outdated storage technologies, and risks of data loss due to format migration or the absence of backups. Addressing these issues involves implementing a comprehensive programme for transition to cloud-based archival solutions built on Microsoft Azure infrastructure, alongside the establishment of national data centres for long-term archival storage. According to the Strategy for the digitisation of archival resources for 2021-2030 (State Archives, 2021), these systems are expected to provide multi-level redundancy, automated format migration in accordance with international OAIS standards – ISO 14721:2025 (2025), and support for metadata in EAD and Dublin Core formats. This approach positions digital archives not merely as data repositories but as integral components of a unified cultural heritage management ecosystem. Organisational challenges primarily concern

staffing and the fragmented nature of digital transformation policies at the regional archive level. Despite centralised management of the state archives system under the General Director of the State Archives, regional institutions exhibit varying levels of technical preparedness and digital competencies among personnel. Financial barriers are typical for the public sector but are partially mitigated through EU funding and public – private partnership mechanisms, supporting the modernisation of technical infrastructure and software. Security challenges carry strategic significance, as digital archives contain critically important national memory data. In response to increasing cyberattacks and threats to data integrity, Poland is gradually implementing a Zero Trust architecture. This framework includes network micro-segmentation, multi-factor user authentication (MFA), continuous monitoring of behavioural anomalies, transaction auditing, and a policy of least privilege for access to archival resources. Implementation of the Zero Trust framework combined with AES-256 data encryption, digital signatures, and ISO/IEC 27001:2022 (2022) certification establishes a multi-layered cybersecurity model for archival infrastructure. Plans include integration of this architecture with a national cyber incident response centre, enhancing threat detection speed and ensuring continuity of digital processes. Legal challenges are related to the need for harmonisation of metadata standards, electronic signatures, and electronic record management formats. Poland is undertaking legal alignment with European eIDAS (n.d.) regulations, ensuring compatibility of Polish archival platforms with European resources, including Europeana and APE, and enabling cross-border exchange of digital metadata. Systematic implementation of cloud technologies, Zero Trust architecture, European metadata standards, and highly qualified personnel thus provides the foundation for creating an integrated national model of the digital archival ecosystem of Poland. This model combines technological, organisational, legal, and security components, ensuring not only the preservation of cultural heritage but also its sustainable development in the digital environment (Kotyla, 2021).

Prospects for the development of the digital archival infrastructure of Poland include the implementation of artificial intelligence technologies for automatic document classification, text recognition, and duplicate detection. Machine learning applications will optimise archival processes and enable the creation of intelligent search systems capable of semantic analysis of document content. Another area involves opening archival data for public use in open data formats, aligning with contemporary European transparency policies for public administration. The National Archives of Poland is developing API access to its collections, which will enable integration of archival resources with educational, research, and media platforms. The digital archival infrastructure of Poland is therefore undergoing comprehensive modernisation, encompassing technical, organisational, security, and legal dimensions. Implementation of cloud technologies, Zero Trust architecture, European metadata standards, and eIDAS principles establishes the foundation for a resilient, secure, and interconnected archival ecosystem. Future development, focused on integrating artificial intelligence, open data, and process automation, will enhance the efficiency of cultural heritage management and improve accessibility for research, education, and society at large.

Discussion

Analysis of studies from 2020 to 2025 indicates substantial progress in the field of archival digitisation and digital data management. I.A. Carbajal & M. Caswell (2021) examined critical aspects of digital archives, emphasising the importance of regulatory and methodological frameworks for ensuring long-term preservation of digital materials. Compared with the present study, which analysed the implementation of EDM EZD PR and EPUAP systems in Polish archives, their paper demonstrated a broader critical approach to digital collection management. The current study, however, focuses on the practical effectiveness of electronic record management and the integration of national and European platforms. T. Řezník *et al.* (2022) investigated metadata management methods in digital systems, highlighting the importance of standards for ensuring compatibility and inter-system integration. This directly correlates with the findings of the present study, as the implementation of EAD, Dublin Core, and OAIS standards in Polish archives confirmed the practical value of unified metadata for interaction with Europeana and APE. Some aspects, such as the fragmentary implementation of standards at the regional archive level, did not entirely align with T. Řezník *et al.* recommendations, which can be attributed to organisational and resource limitations of Polish archives.

J. Yap *et al.* (2024) analysed the impact of museum digitisation on visitor experience, noting positive effects of open access and interactivity of digital resources. In comparison, the Polish Search the Archives model similarly demonstrates improved access to archival materials and the possibility of remote document use, although archives, unlike museums, require additional mechanisms for data protection and authentication, reflecting the sector's specificities. L. Espina-Romero & J. Guerrero-Alcedo (2022) reached similar conclusions, summarising digitisation trends across various academic domains and emphasising the growing role of technologies in open access and inter-system integration. The findings of the present study correlate with this observation, confirming that Polish archives are actively integrating into European platforms, while also highlighting that technical, organisational, and legal challenges remain significant barriers to the sustainable development of the digital archival infrastructure.

Analysis of the studies by A. Guss (2020) and T. Balogun (2025) allows further evaluation of the legal and

technical aspects of archival digitisation. A. Guss examined the digitisation of cultural heritage in Poland from the perspective of copyright law, emphasising the difficulties in accessing materials protected by legislation and the need to balance openness with legal restrictions. These findings partially correlate with the present study, as Polish archives indeed face challenges regarding the regulation of access rights and the use of digitised documents. The current analysis, however, also highlights technical and organisational components that A. Guss did not explore in detail. T. Balogun investigated strategies for protecting temporary online data, focusing on risks of information loss and methods for its long-term preservation. Compared with the present study, these findings confirm the importance of hybrid preservation models and regular format migration in Polish archives. Current observations indicate, however, that practical gaps exist in metadata standardisation and backup procedure unification, which do not entirely align with T. Balogun general recommendations, reflecting the specific characteristics of the national archival system and resource limitations. Comparison with the studies by A. Guss and T. Balogun thus emphasises that a comprehensive evaluation of Polish archival infrastructure enables more detailed identification of practical issues and solutions than international reviews alone.

Review of papers by F. Amiraslani & D. Dragovich (2022), K. Kutt *et al.* (2024), and L. do Valle Miranda *et al.* (2024) deepened understanding of contemporary approaches to digitising archival and cultural resources. F. Amiraslani & D. Dragovich conducted an interdisciplinary review of documentation, highlighting the role of metadata systematisation and standardisation in ensuring effective search and integration of digital resources. These findings correlate with the conclusions of the present study regarding the importance of unified document description (EAD, Dublin Core) in Polish archives, while also emphasising technical and organisational aspects of digitisation. K. Kutt *et al.* described a cloud-based workflow for cultural heritage digitisation with automated collection of enhanced metadata. Their study confirmed the potential of transitioning to centralised digital repositories with multi-level data integration, reflected in the Polish model through the National Digital Archives and integration with Europeana. However, the Polish system has not yet fully implemented automated metadata processing and relies on fragmentary EAD adoption in regional archives, explaining certain deviations from the idealised cloud workflow model. L. do Valle Miranda *et al.* focused on enhancing metadata for manuscripts within university collections, particularly regarding integration of semantic descriptions and multi-level tagging. These findings partially correspond with the approach observed in the context of national Polish archives but differ in scale and nature of collections: the Polish system combines heterogeneous documents from parish registers to cadastral plans, creating additional challenges for metadata standardisation and integration. Thus, Comparison with these studies confirms the importance of standardisation, centralised repositories, and semantic enrichment of metadata.

Comparison of the study results with other academic sources demonstrates that the Polish experience of archival digitisation broadly aligns with international trends in the management and preservation of digital cultural resources. Other researchers also emphasise the importance of standardised metadata, platform integration, provision of open access, and long-term preservation of digital materials. International sources highlight legal, organisational, and technological challenges, including cybersecurity, copyright, and process automation, which partially correspond with issues identified in Poland. Overall, the comparison indicates that the Polish archival digitisation system reflects contemporary global approaches, although further development and sustainability require integration of new technologies and enhancement of management practices.

Conclusions

The study demonstrated that the contemporary archival system of Poland is undergoing systemic digital transformation, with the implementation of electronic document management systems as a key element. The system encompasses the entire document lifecycle, from creation and registration to archival transfer, establishing a unified ecosystem for managing information flows within the public sector. Central platforms enabling electronic document management are EDM EZD PR and EPUAP. EDM EZD PR manages internal documentation processes, automated creation of archival packages, and their transfer to state archives, ensuring a high level of integration and compliance with international standards, including OAIS, EAD, METS, and JRWA. EPUAP functions as a supersystem, providing electronic identification, digital signatures, inter-agency exchange, and verification of document authenticity in accordance with eIDAS and ISO/IEC 27001:2022.

The implementation of electronic document management considerably enhances archive efficiency: it reduces document registration time from three days to four hours, decreases the number of lost cases by 92%, and enables a complete electronic approval and transfer cycle for archival packages. Challenges remain in the migration of legacy documents, standardisation of formats, and assurance of metadata authenticity. The study confirmed that archival digitisation in Poland is systematic and extensive, providing open access to historical sources, optimising search, and preserving cultural heritage. Key projects include the Search the Archives portal and National Digital Archives, which form the national digital infrastructure, enabling centralised storage and standardisation of digital copies and integration with international platforms Europeana and Archives Portal Europe. Over the past decade, the

number of digitised documents rose from 8.2 million to 70.3 million, and the proportion of archival holdings in digital format increased from 11.3% to 77.6%, reflecting effective and consistent implementation of digital technologies. The Search the Archives platform supports integration with EDM EZD PR and international databases, ensures compliance with OAIS, EAD, and Dublin Core standards, and serves as the national tool for searching archival materials.

Alongside technical achievements, substantial challenges persist: uneven technical capacity among regional archives, long-term preservation of digital copies, metadata integrity, staff training, and cybersecurity. Poland actively develops mechanisms to address these issues through cloud storage implementation, automated data migration systems, digital archival training programmes, international integration, and adoption of a Zero Trust architecture. Key limitations of the study include its focus on the national context of Poland, which restricts the direct applicability of conclusions to other states with different archival practices and legal frameworks. Future research should include an in-depth analysis of artificial intelligence integration in digital archival processes, including automated document classification, text recognition, and semantic search. Further investigation of the digital archival infrastructure management model as a comprehensive phenomenon, encompassing technological, organisational, legal, and security aspects, is also promising, aiming to develop recommendations for other Central and Eastern European states.

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Conflict of Interest

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Анотація. Актуальність дослідження полягає у потребі підвищення ефективності, прозорості та довготривалого збереження архівних фондів через цифровізацію. Метою дослідження було оцінити процеси впровадження електронного документообігу та цифровізації архівних ресурсів Польщі для визначення їхніх переваг, проблем і перспектив розвитку. Дослідження мало описово-аналітичний характер із документальним, компаративним та кейс-методом, що дозволило оцінити нормативно-правові й практичні аспекти цифровізації архівів Польщі та визначити перспективи розвитку національної цифрової інфраструктури. Дослідження продемонструвало, що сучасна архівна система Польщі перебуває на етапі системної цифрової трансформації, ключовим компонентом якої стає впровадження електронного документообігу, що забезпечує автоматизацію циклу обробки документів та відповідність міжнародним стандартам Open Archival Information System, Encoded Archival Description, Metadata Encoding and Transmission Standard, Electronic Identification, Authentication and Trust Services. Результати показали суттєве підвищення ефективності функціонування архівів: скорочення часу реєстрації документів із трьох днів до чотирьох годин, зменшення втрат справ на 92 % та забезпечення повного електронного циклу формування й передачі архівних пакетів. Компаративний аналіз засвідчив, що ключовими інфраструктурними проєктами стали портал Search the Archives та National Digital Archives, які формували національну цифрову екосистему та інтегрувалися з міжнародними платформами Europeana і Archives Portal Europe. Контент-аналіз засвідчив динамічне зростання цифровізації архівних фондів: кількість оцифрованих документів збільшилась із 8,2 млн до 70,3 млн, а частка фондів у цифровому форматі – із 11,3 % до 77,6 %. Водночас були виявлені ключові обмеження: нерівномірна технічна оснащеність регіональних архівів, проблеми довготривалого зберігання цифрових копій, забезпечення цілісності метаданих, недостатня кваліфікація персоналу та виклики кібербезпеки. Отримані результати будуть науково цінними для дослідників, фахівців у сфері цифровізації архівів, працівників архівних установ та державних управлінців, зацікавлених у модернізації архівної справи та інтеграції національних архівних ресурсів у міжнародний цифровий простір

Ключові слова: оцифрування; метадані; цифровий репозитарій; електронні архівні системи; цифрова трансформація; архівна інфраструктура