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Socio-cultural approaches to the phenomenon of disability and the role of special libraries for the blind in the development of an inclusive culture in society

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Abstract. This study aimed to explore the socio-cultural perception of disability and to examine the role of special libraries for the blind in the development of an inclusive society. This article provided a detailed analysis of socio-cultural approaches to the phenomenon of disability and highlighted the importance of special libraries for the blind in promoting an inclusive culture within society. It was determined that specialised libraries for visually impaired individuals played a crucial role in shaping an inclusive environment through the implementation of contemporary initiatives and programmes. Their activities not only ensure access to information, but also broaden opportunities for self realisation among people with disabilities, fostering stronger social connections and promoting a positive societal attitude towards inclusion. Particular attention was given to the shift in perspectives on disability, from the purely medical model to a socio-cultural approach, which views disability as a result of an individual's interaction with the social environment. The article presented specific examples of successful projects implemented by special libraries for the blind, which have contributed to the development of an accessible information space and the realisation of inclusion principles. The influence of such libraries on expanding social interactions for visually impaired individuals, facilitating their adaptation, and integrating them into cultural life was examined. Emphasis was placed on the role of specialised libraries as active participants in social integration processes, providing a platform for inclusive initiatives and collaborative partnerships. The findings of this study can be utilised to develop strategies for integrating individuals with disabilities into the cultural domain, as well as to establish new models of cooperation between libraries, government institutions, and non-governmental organisations

Keywords: social exclusion; social cohesion; cultural adaptation; barrier-free environment; innovative projects

Introduction

The issue of the social integration of people with disabilities into society is one of the key aspects of modern humanitarian science and social policy. In the context of the development of an inclusive society, it is important not only to ensure equal access to social, educational, and cultural resources, but also to create a favourable environment for the self-realisation of people with disabilities. Special libraries for the blind play a significant role in this process, as they serve not only as information centres, but also as hubs for social and cultural adaptation.

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Modern inclusion policy, enshrined in international (Convention No. 995_g71, 2010) and national (Order of the Cabinet of Ministers of Ukraine No. 366-r, 2021) documents, required cultural institutions, including libraries, to implement innovative approaches to working with people with disabilities. However, despite significant progress in this area, there remained a need for a comprehensive analysis of the socio-cultural aspects of disability and an examination of the impact of special libraries for the blind on the development of an inclusive culture.

This study was particularly relevant due to the need to develop effective strategies for the integration of visually impaired individuals into the cultural space, as well as to identify optimal forms of social partnership between libraries and governmental, educational, and public institutions. In addition, the advancement of digital technologies had opened up new opportunities for inclusive library services, which warrants further research and implementation. An analysis of library science literature showed that this topic has been of interest to both scholars and practising librarians, including those in Ukraine. However, for an extended period, the professional literature considered this issue primarily in the context of creating conditions for the effective service of people with disabilities.

Many studies have emphasised the importance of inclusive library services and the role of libraries in promoting accessibility for individuals with disabilities. T. Myskevych (2018) examined the information socialisation of users with special needs in Ukrainian libraries, highlighting national experiences in developing inclusive programmes. The study demonstrated that modern libraries serve as vital social institutions that support the adaptation and integration of visually impaired individuals through specialised services and technological innovation.

According to O. Rivtin (2021), the adaptation of digital platforms was a crucial aspect of ensuring equal access to information for visually impaired users. The research suggested that implementing screen-reader compatibility, high-contrast modes, and simplified navigation significantly improved digital inclusivity. Similarly, M. Hartnett *et al.* (2020) examined the implementation of digital accessibility initiatives in public libraries, assessing their impact on users with disabilities. O. Odnovolykova *et al.* (2022) analysed the role of libraries in creating a barrier-free educational environment. Their research underscored that libraries within academic institutions contribute to creating accessible learning conditions by implementing assistive technologies and developing adapted resources for students with disabilities. This was in line with global trends that position libraries as key actors in building inclusive educational spaces.

Additionally, O. Rivtin (2021) discussed web accessibility for visually impaired users, focusing on the need to adapt digital platforms to ensure equal access to information. The study presented practical recommendations for optimising library websites, such as implementing screen-reader compatibility, high-contrast modes, and simplified navigation. These findings were especially relevant in the context of digital transformation, reinforcing the importance of inclusive design in both physical and virtual library environments.

At the same time, recent trends indicate a shift in terminology and approaches. Researchers were increasingly referring to "inclusion", "inclusiveness", "barrier-free environments", and the accessibility of both physical and virtual library spaces. The study by S. Sinelnikov (2021) focused on inclusive culture as a key element in the development of inclusive education. N. Tiurkedzhy & O. Marina (2023) explored the transformative role of libraries in driving social change and fostering an inclusive society. Global initiatives such as The IFLA-UNESCO Public Library Manifesto 2022 (2022) have played a crucial role in shaping inclusive library environments by emphasising the necessity of equitable access to information for all user groups. Specialised libraries for the blind have also been the focus of contemporary research. J. Meena (2022) examined accessible technologies that support the library experience of visually impaired users, highlighting the significance of digital tools in overcoming accessibility barriers. Similarly, the RNIB Library (Official website of RNIB..., 2024) and the National Library Service for the Blind and Print Disabled (Official website of National Library Service..., 2024) provided exemplary models of inclusive library services, demonstrating the effectiveness of specialised reading technologies and adaptive resources in ensuring accessibility.

This study aimed to examine socio-cultural perspectives on disability and to assess the contribution of special libraries for the blind to the development of an inclusive cultural framework within society. The originality of this research lies in its comprehensive examination of the phenomenon of disability through the lens of socio-cultural discourse, alongside the analysis of libraries as instruments for addressing the social isolation of visually impaired individuals.

Materials and Methods

This research employed an interdisciplinary approach that integrated sociological, cultural, anthropological, philosophical and historical perspectives. The study was based on a detailed review of academic sources, legislative documents and international policies related to library services for people with visual impairments. This methodology allowed for a comprehensive examination of how special libraries contribute to fostering an inclusive society.

The sociological perspective helped to explore the impact of library services on the social adaptation of visually impaired individuals. It was informed by the

theories of symbolic interactionism by G.H. Mead (1934) and social stigma by E. Goffman (1963), which helped to analyse the role of libraries in shaping users' identities and their inclusion in cultural and educational activities. Key documents such as Convention No. 995_g71 (2010) and Order of the Cabinet of Ministers of Ukraine No. 366-r (2021) provided a regulatory framework for these processes.

The cultural analysis facilitated an examination of how libraries have evolved into inclusive spaces that promote accessibility and active participation for individuals with disabilities. This aspect was supported by international guidelines, including The IFLA-UNESCO Public Library Manifesto 2022 (2022), and by academic studies such as those of N. Tiurkedzhy & O. Marina (2023), which emphasised libraries as facilitators of social integration. Additionally, national recommendations highlighted by N. Rozkolupa (2024) have outlined practical strategies for enhancing the inclusiveness of library services. The anthropological dimension enabled an exploration of how visually impaired individuals engage with their social environment through library institutions. Research by N. Malanii (2018) and Ye. Stentsel (2022) provided insights into the role of libraries in fostering independence and self-realisation among individuals with disabilities.

The philosophical perspective helped to explore, how libraries contribute to overcoming societal barriers for people with disabilities. The study referenced T. Parsons' (2005) theory of social systems, which discussed the integration of marginalised groups, as well as the axiological theories of M. Weber (1949) and E. Husserl (1970), which addressed the role of values in shaping inclusive practices. The historical analysis traced the development of specialised library services, focusing on the transition from traditional service models to modern, technology-enhanced approaches. This section drew on legislative acts such as the Law of Ukraine No. 32/95-VR (2022) and The Marrakesh Treaty No. 999_001-13 (2023), as well as scholarly discussions on the historical evolution of library accessibility by V. Yaroshchuk (2005) and V. Pashkova (2010).

To ensure a thorough evaluation, this research applied content analysis to scholarly publications by S.T. Brassai *et al.* (2011) and T. Myskevych (2018), along with legal frameworks and institutional guidelines that define accessibility standards. The findings contributed to assessing the effectiveness of existing inclusive practices and provided recommendations for their further development. The proposed methodology ensured that the study can be reproduced and its results replicated by other researchers.

Results and Discussion

Disability is a multidimensional, historically and socially conditioned phenomenon within sociocultural reality. The need to study this phenomenon arises from its perpetual presence in every society, as well as the continually evolving attitudes towards the challenges faced by disabled individuals and the corresponding legislative changes.

A fundamental shift in the perception of disability occurs, when it was examined through a historical and cultural lens. By tracing how societal attitudes toward individuals with disabilities have evolved, one can observe significant transformations in the conceptualisation of disability across various disciplines, including sociology, psychology, cultural studies and library science. These shifts reflect broader changes in both academic discourse and public policy.

Despite the extensive body of research on the historical aspects of disability, its theoretical and methodological dimensions have remained underexplored, particularly in studies conducted prior to the late 20th century. Disability functions as one of the social institutions of society, dependent on historical context and the prevailing socio-political climate (Yakushchenko, 2019). This ongoing evolution underscored the importance not only of investigating disability as a phenomenon influencing social development, but also of refining and expanding the theoretical frameworks employed in its analysis within contemporary socio-cultural contexts. The increasing recognition of disability as a complex, multidimensional issue has prompted scholars to seek more comprehensive methodological approaches.

L. Yakushchenko (2019) noted two primary models of disability, the medical and the social, which were based on traditional and post-traditional approaches, respectively. The medical model remained the dominant paradigm in Ukraine until the early 21st century. It significantly curtailed opportunities for individuals with disabilities, restricting their access to education, economic activity and recreational pursuits. Consequently, many individuals with disabilities were placed in specialised institutions, resulting in social isolation and reinforcing discriminatory practices (Malanii, 2018).

In contrast, the social model interpreted disability as a consequence of societal structures, attributing its causes to various barriers rather than to individual impairments. This perspective aligned with modern sociological, anthropological, axiological, philosophical and historical approaches to disability studies (Parsons, 2005; Stentsel, 2022). Understanding disability within a socio-cultural context was essential for the development of an inclusive society and for assessing the role of specialised libraries in this process. Table 1 illustrated, how special libraries have evolved to offer tailored services and technologies that enhance accessibility for individuals with visual impairments. From a social perspective, disability can be understood by examining the broader processes that shape interactions and relationships within society. This approach enabled researchers to explore the origins of disability as a social construct, identify key factors that

influence the experiences of individuals with disabilities, and analyse the dynamics of inclusion and exclusion. By identifying these patterns, it became possible to address contradictions and barriers within the "disabled-society" relationship, ultimately contributing to more inclusive policies and practices. Thus, this approach helped to identify areas of interaction between state authorities and people with disabilities.

Table 1. Comparison of traditional and special libraries

Feature	Traditional libraries	Special libraries for the blind
Font accessibility	Standard printed books	Basic reading rooms
Audiobooks	Limited selection	Extensive catalogue
Digital adaptations	Minimal accessibility features	Screen readers, voice synthesis software
Specialised equipment	General-purpose computers	Braille displays, tiflo-complexes, OCR technology
Inclusive services	Basic reading rooms	Inclusive reading spaces, adaptive technology training

Source: developed by the authors

The anthropological approach contributed to understanding the capabilities and needs of a person with a disability in society, as well as their role and purpose within it. The concepts of "disabled person" and "disability" did not attract philosophical interest until the 21st century, when an "anthropological turn" occurred in philosophy (Malanii, 2018). The axiological perspective investigated how societal values related to disability manifest in real-world practices. Drawing on the ideas of M. Weber (1949) and E. Husserl (1970), researchers argued that values were culturally relative rather than universal. Each society established its own framework of values, which in turn shapes public perceptions and attitudes towards individuals with disabilities.

The philosophical and historical perspective focused on the evolving role and status of individuals with disabilities across different historical periods. By applying the method of extrapolation, N. Malanii (2018) identified patterns in how disability has been perceived over time and anticipated future developments in the field. The structural-functional perspective, as formulated by R.K. Merton (1968) and T. Parsons (2005), interpreted disability as a social condition shaped by broader institutional frameworks. This approach examined how established social norms, policies, and institutional structures influence the lived experiences of people with disabilities, either facilitating or restricting their inclusion in society.

The socio-anthropological perspective, rooted in the theories of É. Durkheim (1956) considered disability concerning prevailing social structures and norms. Concepts such as "social norm" and "deviation" were central to this framework, highlighting how societal definitions of normality can marginalise individuals with disabilities. It was suggested that even those without disabilities may, under certain circumstances, be perceived as "different" and experience social exclusion.

The macrosociological perspective, as outlined by V. Bronfenbrenner, examined disability within a multi-level framework. It considered the macrosystem, which encompassed political, economic, and legal structures; the exosystem, referring to the role of social institutions; the mesosystem, which focused on interactions between different societal domains; and the microsystem, representing the immediate environment of an individual (Stentsel, 2022). Within the framework of symbolic interactionism, G.H. Mead (1934) viewed disability as a system of symbols that defined a distinct social group – individuals with disabilities. This theory explored the process of shaping the social "self" of a person with a disability, examining their role in society, the behavioural stereotypes they encounter, and societal attitudes towards them.

According to the theory of stigmatisation, also referred to as the theory of social labelling, E. Goffman (1963) and H.S. Becker (1963) noted that disability was perceived as a deviation from the social norm, leading to the categorisation of people with disabilities as individuals exhibiting deviant behaviour. This process results in their stigmatisation, reinforcing specific societal value systems. Expanding upon this concept, M. Foucault (1977) argued that mechanisms of stigmatisation emerge from the interplay between social phenomena and culturally constructed notions of "norms". Scholars have suggested that societies classify phenomena as either normative or non-normative, constantly redefining what falls within the accepted standards.

Shifts in social structures influence how disability was perceived, impacting both philosophical interpretations and methodological approaches to its study. A significant turning point in this regard was the adoption of Convention No. 995_g71 (2010) by the UN General Assembly. This document laid the groundwork for a new understanding of disability, emphasising inclusion and equal rights. Ukraine ratified the Convention on 16 December 2009, marking a key step towards aligning national policies with international standards.

In modern society, addressing issues related to the social integration and inclusion of individuals with disabilities has become a pressing necessity. Following the ratification of the Convention, Ukrainian legislation

on disability evolved significantly, fostering public discourse on inclusion and prompting institutions to expand their efforts in this domain (Order of the Cabinet of Ministers of Ukraine No. 366-r, 2021; Order of the Cabinet of Ministers of Ukraine No. 285-r, 2021). In particular, the implementation of accessibility policies, such as ensuring digital inclusion, has played a crucial role in promoting equal participation in public life (Accessibility of government..., n.d.).

These legal and institutional developments have also influenced academic research, leading to the refinement of theoretical and methodological frameworks in the social sciences and humanities (Decree of the President of Ukraine No. 533/2020, 2020; Law of Ukraine No. 4170-IX, 2024). Additionally, the role of cultural institutions, particularly libraries, has expanded to support inclusive initiatives, recognising their importance in fostering social cohesion (Regulation on the honorary..., 2018). The broader concept of diversity, equity, and inclusion (DEI) has further contributed to transforming societal perceptions of disability, encouraging the development of more comprehensive approaches to accessibility (Adamenko, 2024). Moreover, international agreements such as The Marrakesh Treaty No. 999_001-13 (2023) have further contributed to shaping policies that promote accessibility and equitable participation in society.

Within the framework of modern innovative paradigms, new perspectives on disability were emerging, closely tied to the establishment of an inclusive society. These perspectives significantly influenced the interpretation and advancement of socio-cultural practices. The inclusive approach has gained widespread recognition in education and culture, emphasising the integration of individuals with disabilities and special needs into all aspects of public life. This approach was grounded in the principle that inclusion was essential for fostering a society in which everyone, regardless of their physical or cognitive abilities, can fully participate. The theoretical foundations of inclusion can be traced to the ideas of T. Parsons (2005), who considered it a crucial component of social evolution. According to his theory, social systems tend to incorporate previously marginalised groups once they demonstrated their contribution to societal development.

Scholarly discussions presented multiple overlapping interpretations of concepts such as "inclusive society", "inclusive culture", and "culture of inclusion". For the purpose of this study, an inclusive society was understood as one that actively creates opportunities for people with disabilities and special needs to engage in various social domains. The fundamental premise of such a society was that every individual, regardless of disability, ethnicity, religion, or cultural background, should have equal access to social interaction and participation in cultural life (Shcherbyna-Yakovleva *et al.*, 2019).

Following the adoption of key legislative acts, including Convention No. 995_g71 (2010), Order of the Cabinet of Ministers of Ukraine No. 366-r (2021), and the Law of Ukraine No. 32/95VR (2022), efforted to foster an inclusive culture expanded beyond the education sector to encompass cultural institutions. These organisations have begun restructuring their activities to support inclusion by developing specialised programmes aimed at habilitation and rehabilitation for individuals with disabilities and special needs. Additionally, numerous initiatives have been launched to promote inclusivity, ensuring that diverse social groups can actively participate in cultural and educational projects.

Special libraries for individuals with visual impairments played a crucial role in fostering an inclusive society. These institutions go beyond traditional library services, offering adaptive reading technologies, digital accessibility solutions, and specialised programmes aimed at socialisation, education, and professional development. As noted by P.T. Jaeger *et al.* (2015), their work was essential in ensuring that visually impaired individuals had equal opportunities for cultural participation and lifelong learning.

Globally, leading institutions providing accessible library services included the National Library Service for the Blind and Print Disabled (NLS) in the United States and the Royal National Institute of Blind People (RNIB) Library in the United Kingdom. The NLS offered free Braille and talking book services to individuals with visual and print disabilities, delivering materials via postage-free mail or online downloads (Fig. 1).

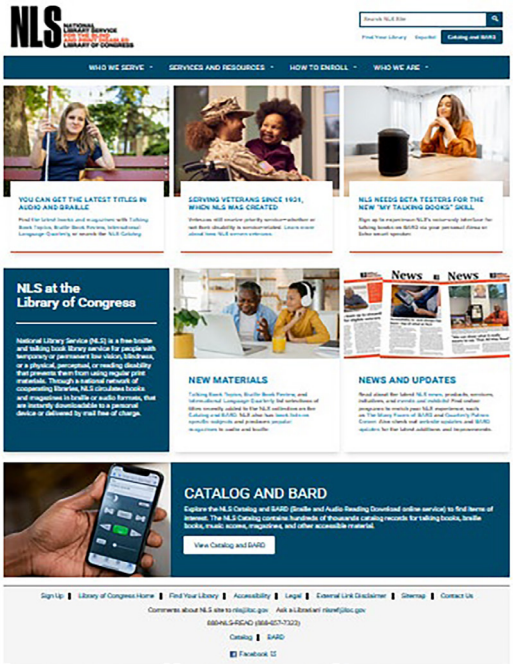

Figure 1. Homepage of the National Library Service for the Blind and Print Disabled
Source: Official website of the National Library Service for the Blind and Print Disabled (2024)

Figure 1 presented the homepage of the National Library Service for the Blind and Print Disabled (NLS). This platform provided access to Braille and talking books for individuals with visual and print disabilities. The interface was designed for ease of navigation, offering multiple formats for reading materials, including audio and electronic versions. Figure 2 illustrated the range of services provided by the Royal National Institute of Blind People (RNIB) Library. The library offered an extensive collection of over 60000 items, including audiobooks, Braille texts, and large-print materials. The interface ensured accessibility, allowing users to browse and request books conveniently.

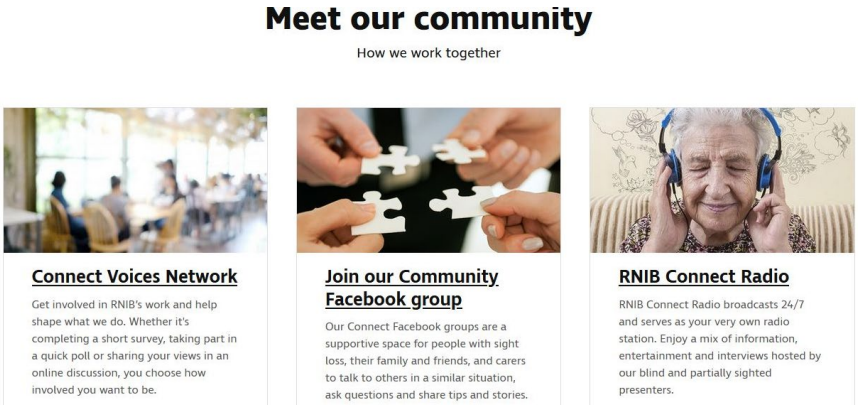

Figure 2. Services of the Royal National Institute of Blind People (RNIB) Library
Source: Official website of RNIB Library (2024)

Figure 3 highlighted additional features of the RNIB Library, focusing on digital accessibility options and support services. The platform enabled users to access reading materials remotely and provided resources for individuals with different levels of visual impairment. These features promoted independent access to information and inclusive reading experiences. As one of the largest libraries of its kind in the UK, the RNIB Library provides access to over 60000 items, including audiobooks, Braille, and large-print formats (Official website of RNIB Library, 2024). Meanwhile, in Ukraine, although there were no national libraries exclusively dedicated to the blind, several institutions were actively enhancing their inclusive services. The Yaroslav Mudryi National Library of Ukraine and the Odesa National Scientific Library have introduced initiatives to support individuals with visual impairments, including Braille collections, digital accessibility programmes, and collaborations with non-governmental organisations (NGOs) to expand inclusive reading opportunities (Accessible libraries..., n.d.).

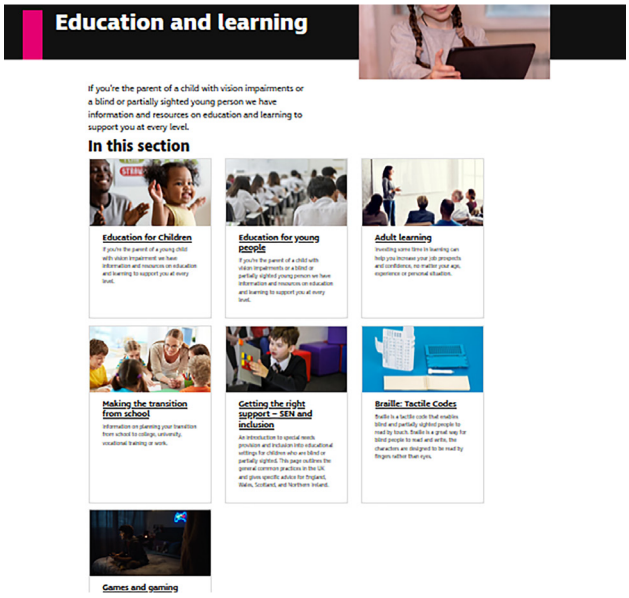

Figure 3. Services of the Royal National Institute of Blind People (RNIB) Library
Source: Official website of RNIB Library (2024)

The official naming of institutions varies depending on their scope and historical development. While some retain the title of "library for the blind", others adopt broader designations such as "special libraries for the blind and visually impaired" or "centres for social and cultural rehabilitation of visually impaired individuals". These evolving names highlighted a shift from a narrow focus on information access toward a more comprehensive role in cultural and social integration (Meena, 2022).

According to the Law of Ukraine No. 32/95-VR (2022), individuals who are blind or visually impaired were entitled to specialised library services and access to materials in adapted formats across different types of libraries. These services were provided not only in dedicated state-funded institutions, but also in public libraries that integrate inclusive practices. Additionally, government authorities and local administrations have the power to establish specialised central libraries designed to cater to specific user groups, including individuals with visual impairments.

The network of specialised library and information services encompassed both institutions specifically created for people with visual disabilities and dedicated departments within national, universal, and public libraries that offer inclusive resources. It examined the role of specialised libraries for the blind within the broader classification of library science, where they were recognised as a subset of public libraries designed to serve specific user groups (Vasylchenko *et al.*, 2002*;* Asharenkova, 2006). A special library was defined as an information and cultural institution that provided library and information services, while also facilitating the socio-cultural rehabilitation of individuals with disabilities and special needs. These libraries employed a range of specialised tools and resources, including printed materials in Braille, audiobooks, tactile books, and electronic publications with text-to-speech functionality. Additionally, they provided access to adaptive technologies such as screen readers (JAWS, NVDA), electronic magnifiers, and refreshable Braille displays.

Beyond providing accessible reading materials, specialised libraries implement educational programmes and cultural projects that promoted social integration. For instance, the RNIB Library offered extensive literacy initiatives and audiobook lending services (Reading and books, n.d.). In Ukraine, the Odesa National Scientific Library has launched a project to record audiobooks with volunteer narrators, while the Lviv Regional Library for Youth has established a collection of tactile books for children with visual impairments (RNIB National Library Service, n.d.). These initiatives demonstrated that special libraries were not merely repositories of adapted books, but active participants in the broader process of inclusion, supporting the personal and professional development of individuals with disabilities.

As a result of the development of an inclusive society, special libraries for the blind have been expanding their user base to include new groups – disabled individuals of various categories – broadening the scope of their collections, incorporating new publication formats, diversifying their activities, and extending their range of services. At the same time, activities aimed at different groups of users were not regulated in legal documents, and therefore, additional reader categories have not been reflected in the names of libraries (e.g., "library for people with disabilities", "library for people with special needs").

Special libraries for the blind were evolving into inclusive information and cultural centres, operating within an inclusive paradigm and aimed at creating and developing an open and accessible information environment for people with special needs. In addition to the availability of publications in special formats and the use of specialised library and information services technologies, these libraries offer a range of services for users with diverse needs: access to personal computers with assistive equipment and guidance on the use of adaptive tools. For example, the Yaroslav Mudryi National Library of Ukraine (Kyiv) provided computers with screen readers such as JAWS and NVDA, allowing visually impaired users to access digital content. The library also offered magnification software, such as ZoomText, for people with low vision. N. Rozkolupa (2024) noted that specialised Braille displays and voice synthesis software were available for users, who required alternative methods of interacting with text. The Odesa National Scientific Library has introduced digital literacy training sessions for visually impaired individuals, guiding them in the effective use of assistive reading devices such as electronic magnifiers, speech-to-text converters, and OCR (Optical Character Recognition) technology. The library collaborated with NGOs to provide tailored workshops for learning how to navigate digital platforms (Accessible libraries..., n.d.). The Vernadsky National Library of Ukraine (VNLU) has been actively working to implement specialised information technologies to support individuals with special needs. In 2016, the library developed a set of technologies aimed at providing remote services for users with visual, hearing, and mobility impairments (Official website of Vernadsky National Library of Ukraine, 2024). However, the official VNLU website does not offer specific information regarding the availability of specialised equipment or software for direct use within the library premises. To obtain detailed information about such services, it was recommended to contact the library administration directly (Official website of Vernadsky National Library of Ukraine, 2024). Meanwhile, other Ukrainian libraries have already introduced specialised services for visually impaired individuals. For example, the Zhytomyr Regional Universal Scientific Library

named after O. Olzhych has established an "Inclusive Reading Room" equipped with assistive technologies such as tiflo-complexes, Braille displays, and portable magnifiers. This space provided access to JAWS and MAGIC software, which facilitated information accessibility for visually impaired users (Fig. 4).

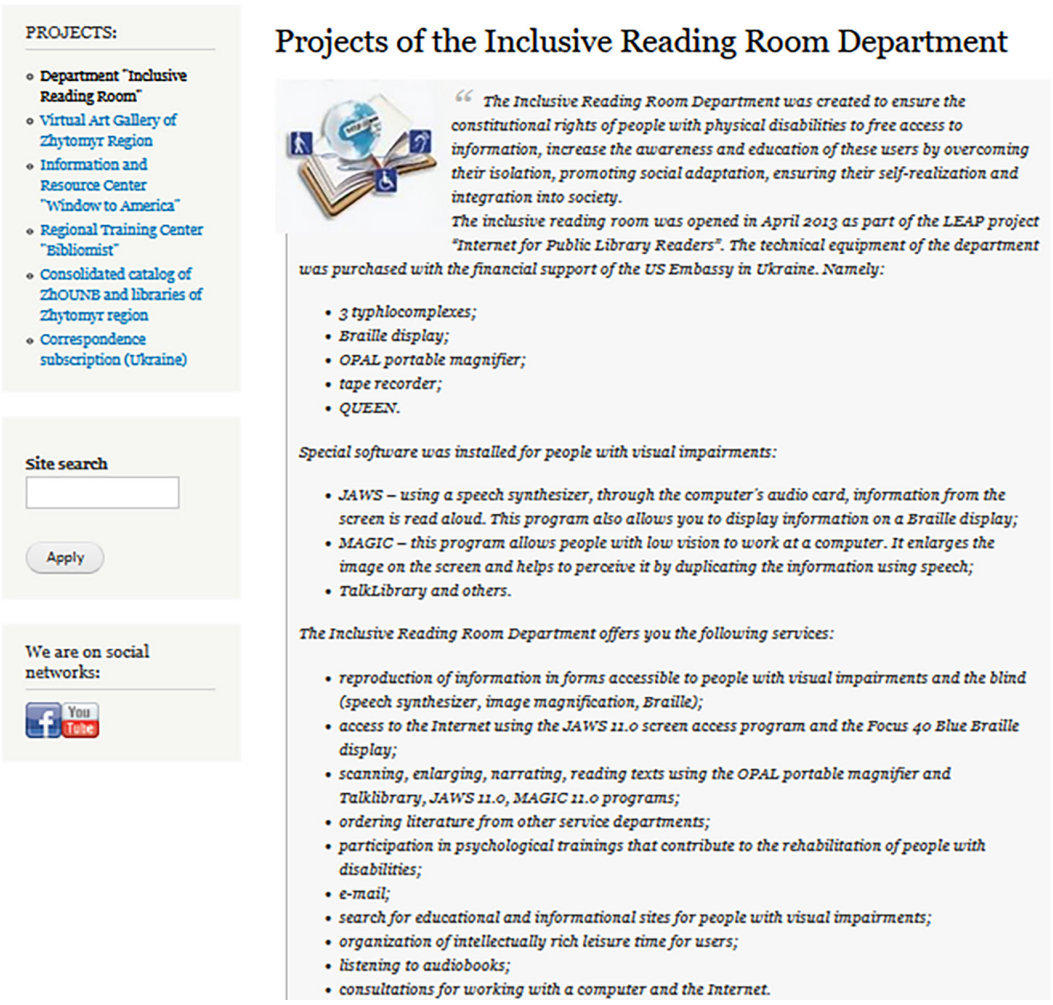

Figure 4. Inclusive Reading Room of Zhytomyr Regional Universal Scientific Library named after O. Olzhych
Source: Projects of the Inclusive Reading Room department (2015)

The Royal National Institute of Blind People (RNIB) Library (UK) provided visually impaired users with access to personal computers adapted with assistive software. The library offered individual consultations, during which specialists train users to work with screen readers, speech recognition tools, and adapted e-books. RNIB also delivered remote support for users, who required assistance in installing and configuring assistive technologies at home (Reading and books, n.d.). The National Library Service for the Blind and Print Disabled (USA) run an extensive programme offering access to assistive technologies and customised digital devices for reading. The library trained users in screen magnification software, refreshable Braille displays, and audiobook navigation tools, ensuring digital accessibility for users with different types of visual impairments (Official website of National Library Service for the Blind and Print Disabled, 2024). In addition, N. Tiurkedzhy & O. Marina (2023) observed that a special library served as a centre that ensures the realisation of the right to equal access to information.

Special libraries for the blind implement a range of inclusive programmes and projects aimed at ensuring access to information and cultural resources for individuals with disabilities. The following were examples of initiatives undertaken by various libraries:

1) The "Library Hub for Everyone" project at the Inclusive Library of Zaporizhzhia. Supported by the Ukrainian Cultural Foundation, this project aimed to create an inclusive creative space that facilitated social adaptation and ensured access to cultural resources for people with disabilities, as well as those mentally and physically affected by war (Horchynska, 2024).

2) An inclusive youth programme in Ukrainian libraries. This initiative developed a youth-focused programme that equiped participants with technological

and practical skills, legal and social support, and opportunities to establish cultural connections and implement creative initiatives within an inclusive environment (Horchynska, 2023).

3) The "Public Space" project at the Central Library of Khmelnytskyi. This project aimed to create a safe, interactive space for communication and information within the library, offering psychological support, educational opportunities, and access to resources and services designed to reduce stress and enhance psychological well-being (Public project: Budget for urban initiatives, 2019).

4) The development of professional handbooks and methodological materials to support the social integration of people with disabilities. Libraries contributed to the creation of specialised handbooks and methodological guides that supported the social adaptation of individuals with various disabilities. These materials helped cultural institutions tailor their services to the needs of people with disabilities and facilitated their integration into society (Aleksyeyenko, 2023).

5) The implementation of universal design in libraries. Many libraries have adopted universal design principles to make their spaces, services, and programmes accessible to all users, regardless of their physical abilities. This included infrastructure adaptation, the development of specialised programmes, and the provision of accessible information (Universal design: How to get…, 2018).

Regional libraries have also introduced a variety of partnership projects (Rozkolupa, 2024). Special libraries for the blind served as methodological centres for public libraries and consulting centres for cultural institutions of various types, offering guidance on working with people with a range of disabilities and adapting services for blind individuals. Collaborative initiatives with cultural institutions have led to the establishment of inclusive venues and have become an integral part of promoting an inclusive culture within society.

It was also important to highlight several additional studies related to libraries for the blind. In particular, S. Vasylchenko *et al.* (2002) examined issues concerning library and information services for people with disabilities. N. Asharenkova (2006) investigated the challenges of providing access for users with special needs in public libraries, while V. Pashkova (2010) analysed the evolution of library services for citizens with special needs in the context of equal access and equal opportunities. The differentiation of library services for users with special needs and the role of digital libraries in this process was the focus of N. Kunanets (2013). The issue of servicing individuals with disabilities had long been the subject of research by V. Yaroshchuk (2005), who analysed it in the context of accessibility to library and information services. S. Vishwakarma & H. Sharma (2019) explored the role of libraries in ensuring equal access to resources for individuals with visual impairments, examining both traditional services and their adaptation to the digital era to enhance users' quality of life. S.T. Brassai *et al.* (2011) investigated contemporary assistive technologies developed for individuals with visual impairments, assessing their role in enhancing information accessibility and promoting social inclusion. These studies underscored the ongoing efforts to improve library services for individuals with disabilities, highlighting both traditional and digital approaches. Researchers have explored various aspects, including accessibility challenges, service differentiation, and the integration of assistive technologies. The findings demonstrated that libraries continued to play a crucial role in fostering equal opportunities by adapting their resources and services to meet the needs of users with specific requirements. Despite the increasing reliance on digital tools, ensuring inclusivity within library environments remained a key priority.

Conclusions

Thus, the inclusive approach conceptualises individuals with special needs or disabilities through the lens of inclusion and was based on the creation of an inclusive society. The formation of such a society relies on the triad of "inclusive policy", "inclusive practice", and "inclusive culture", which can be effectively developed through active interagency cooperation that fostered the implementation of inclusive processes across various spheres of public life. Special libraries for the blind played a crucial role in shaping this process by facilitating collaboration among different institutions, promoting accessibility, and implementing initiatives that ensured equal participation for individuals with disabilities. These libraries served not only as information hubs, but also as centres of social adaptation, lifelong learning, and cultural engagement for visually impaired individuals.

Special libraries for the blind have accumulated valuable experience in working with different categories of disabled users, leading to the modern transformation of these institutions into inclusive information and cultural centres. In 2024, they will operate within a new inclusive paradigm, continuously modernising their services, expanding their collections, and integrating innovative digital and assistive technologies. The implementation of inclusive programmes and projects has strengthened their role as key facilitators of social integration, providing visually impaired users with greater opportunities for education, professional development, and cultural participation. Additionally, by fostering cooperation with local and national authorities, establishing partnerships with specialised and related institutions, and maintaining active communication with media representatives, special libraries contributed to shifting societal attitudes toward

disability and reinforcing the principles of universal accessibility and inclusion.

The growing importance of inclusive libraries highlighted their broader influence on promoting diversity and equity across different cultural and educational sectors. These institutions were not only adapting to the needs of visually impaired users, but were also proactively shaping a more inclusive environment for all social groups. Ensuring continued support for such initiatives requires sustained investment in assistive technologies, staff training, and the development of universally designed library spaces that accommodate users with diverse needs.

Future research should focus on analysing global best practices, assessing the long-term impact of inclusive library initiatives on the social, cultural, and professional inclusion of individuals with disabilities, and exploring innovative ways to integrate artificial intelligence and virtual accessibility tools into library services.

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Conflict of Interest

None.

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Соціокультурні підходи до феномену інвалідності та роль спеціальних бібліотек для сліпих у розвитку інклюзивної культури у суспільстві

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Анотація. У цьому дослідженні розглядалося соціокультурне сприйняття інвалідності та аналізувалася роль спеціалізованих бібліотек для незрячих у формуванні інклюзивного суспільства. У статті представлено детальний аналіз соціокультурного підходу до феномену інвалідності та акцентовано увагу на значущості спеціальних бібліотек для незрячих у просуванні культури інклюзії. Встановлено, що спеціалізовані бібліотеки для осіб з порушеннями зору відіграють важливу роль у створенні інклюзивного середовища шляхом реалізації сучасних ініціатив і програм. Їхня діяльність не лише забезпечує доступ до інформації, а й розширює можливості для самореалізації людей з інвалідністю, сприяє налагодженню соціальних зв'язків і формуванню позитивного суспільного ставлення до інклюзії. Особливу увагу приділено зміні поглядів на інвалідність – від суто медичної моделі до соціокультурного підходу, який розглядав інвалідність як результат взаємодії особистості з соціальним середовищем. У статті наведено конкретні приклади успішних проєктів, реалізованих спеціалізованими бібліотеками для незрячих, що сприяли створенню доступного інформаційного простору та втіленню принципів інклюзії. Проаналізовано вплив таких бібліотек на розширення соціальних взаємодій осіб із порушеннями зору, полегшення їхньої адаптації та інтеграцію в культурне життя. Наголошено на ролі спеціалізованих бібліотек як активних учасників процесів соціальної інтеграції, які створюють платформу для інклюзивних ініціатив і партнерських проєктів. Отримані результати можуть бути використані для розробки стратегій інтеграції осіб з інвалідністю в культурну сферу, а також для формування нових моделей співпраці між бібліотеками, державними установами та неурядовими організаціями

Ключові слова: соціальна ізоляція; соціальна згуртованість; культурна адаптація; безбар'єрне середовище; інноваційні проєкти

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Digital preservation of endangered cultural heritage in conflict zones

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Abstract. The study aimed to explore the role of digital technologies in preserving cultural heritage in conflict zones, ensuring the safety of historical and cultural identity amid warfare. The study examined the risks and digital solutions for preserving both tangible and intangible legacies during armed conflicts. Challenges arising from unstable environments, scarce technical resources, and disrupted infrastructure that hinder the use of methods such as 3D scanning, remote sensing, and digital modelling to document and reconstruct damaged sites were addressed. Ethical concerns regarding ownership and informed consent were evaluated alongside logistical issues resulting from geopolitical constraints and fragmented collaboration among local communities, governments, and international agencies. Case studies from Syria, Afghanistan, Mali, and Ukraine illustrated the application of digital tools for heritage documentation and recovery under adverse conditions. Technological innovations, including blockchain-based provenance tracking, edge computing for local data processing, decentralised storage networks, and AI-assisted predictive risk mapping, were discussed as strategies to secure and maintain digital records. The findings demonstrated that despite technical and geopolitical barriers, local stakeholders have demonstrated remarkable adaptability by using low-cost, open-source tools to continue documentation efforts. Community engagement emerged as a key enabler in digital preservation, with grassroots initiatives often leading data collection and storytelling. International partnerships were most effective, when they supported, not supplanted, local agency. Additionally, respondents emphasised the urgent need for sustainable digital infrastructure and culturally sensitive data governance models. The study also considered relevant international legal frameworks that supported proactive preservation efforts. Lastly, it advocated for integrated digital approaches that combined technological advances with community participation to protect cultural assets and support recovery efforts in conflict-affected regions, ensuring their enduring preservation

Keywords: digital modelling; decentralised storage; heritage documentation; 3D modelling; remote sensing; international law

Introduction

The challenges of digital preservation in conflict zones are complex, encompassing technical, ethical, and logistical dimensions. Technically, the unstable conditions typical of conflict environments often hinder access to necessary equipment and complicate data storage. M. Rahimi (2024) noted that although HBIM and 3D scanning offer significant potential for reconstructing damaged sites, they required specialised tools and training that were often unavailable in war-torn regions. A.Z. Sampaio *et al.* (2021) emphasised the difficulties in implementing digital documentation methods caused by the poor infrastructure and limited professional capacity on-site. According to A. Zerbini (2018), unstable internet and electricity networks made it difficult to reliably store, transmit, or manage digital data, increasing the risk of irretrievable loss during armed conflict. Ethically, digital preservation initiatives must navigate complex issues of ownership, authority, and informed

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consent. Moreover, studies examined the Endangered Archaeology in the Middle East and North Africa (EAMENA) project, which combined satellite imaging with historical mapping to track at-risk heritage sites. The project's success, however, was contingent on effective collaboration between governments, non-governmental organisations, and local actors. R. Alcala (2022) highlighted the importance of including local voices in preservation planning, as communities have deep cultural ties to the heritage in question. Without their consent and active participation, preservation efforts risk perpetuating a form of digital colonialism. L. Kelly (2021) observed that externally driven initiatives often failed, when they overlooked or undervalued indigenous knowledge systems. These ethical concerns were not merely theoretical; it influenced the legitimacy and long-term sustainability of digital preservation projects. Furthermore, the author noted that legal protections were only effective alongside local cooperation and long-term investment in preservation infrastructure. Logistically, digital heritage in conflict zones was constrained by fragmented governance and access issues. L. Rayne *et al.* (2017) observed that such collaborations were often undermined by differing agendas, a lack of trust, or ongoing instability. P. Jakubowski (2019) noted that bureaucratic delays and shifting political alliances further obstruct preservation efforts, especially, when operating across borders or within regions lacking centralised authority.

Digital technologies offer new opportunities, but also new vulnerabilities. X. Zhang *et al.* (2022) demonstrated that digital platforms can democratise access to cultural heritage, enabling global audiences to engage with endangered sites. Similarly, Y. Choi *et al.* (2021) argued that immersive tools such as virtual and augmented reality can reconstruct heritage environments with in high detail, fostering education and awareness. R. Alcala (2022) stated that over-reliance on digital formats introduced sustainability risks, especially as platforms evolved and older data formats became obsolete. These risks were compounded in conflict zones, where maintaining and updating digital systems was often impractical. Legal frameworks provided essential guidance for the protection of heritage in war. G. Baj (2021) evaluated the impact of United Nations Security Council Resolution 2347, which urged states to adopt proactive measures for cultural heritage protection. While symbolically significant, its real-world impact remained limited due to the uneven commitment of member states and the absence of enforcement mechanisms. T.G. Weiss & N. Connelly (2018) examined the legal gap concerning non-state actors, who frequently disregard international norms and pose one of the greatest threats to cultural property during armed conflict.

The study aimed to evaluate how emerging digital technologies, when supported by ethical practices, collaborative logistics, and legal protections, can form an integrated strategy for safeguarding cultural heritage in conflict zones. The study also highlighted the importance of adapting these tools to the complex and rapidly changing conditions characteristic of modern warfare.

Literature Review

Cultural heritage reflected the ways of life cultivated by a community and transmitted through generations. E. Macrì & C.L. Crsistofaro (2021) noted that it encompassed customs, practices, locations, objects, artistic expressions, and values. This element was essential in showcasing the spiritual and intellectual richness of a specific civilisation, society, or nation, as well as contributing to an individual's identity. Cultural heritage can be divided into three main categories: immovable heritage, which included monuments and archaeological sites; movable heritage, comprising items such as sculptures, paintings, manuscripts, artefacts, and other objects of historical importance; and intangible heritage, which referred to traditions, knowledge, and artistic expressions such as music, dance, language, and folklore that were transmitted across generations.

Digital technologies were a vital resource, enabling precise data collection that upholds authenticity and integrity. Z. Ye (2024) noted that advanced high-definition scanning and modelling technologies was substantial in the prevention and intervention efforts for the conservation and restoration of cultural heritage. Since the 20th century, digital technologies were central in the cultural sector. T. Gorbul & S. Rusakov (2022) emphasised that during the latter half of the century digital technologies became instrumental in cataloguing, organising, and digitising sources and artefacts of historical and cultural significance. The convergence of culture and technology has created an intriguing and complex realm referred to as digital heritage. As societies globally face the challenges of preserving their rich cultural legacies, the integration of digital tools and technologies offers both remarkable opportunities and distinct obstacles. M. Sofilkanych (2022) noted that a comprehensive framework aimed at unifying advancements in innovation was currently emerging within modern scientific discussions. U. Maraieva (2022) suggested that this paradigm saw technologies as tools, with information acting as a connecting force among humans, society, nature, and technology.

Consequently, the incorporation of technology and information within this broader framework aimed to promote a comprehensive approach to advancement, highlighting the relationships and mutual reliance of different components in the modern, dynamic social and scientific landscape. In conflict zones, cultural heritage was particularly vulnerable to acts of deliberate destruction and looting. These actions were often used as strategic means in warfare to weaken the morale and identity of targeted populations. E. Cunliffe & L. Curini (2018) investigated the systematic

destruction of cultural heritage in conflict zones and described how such acts were used not merely as collateral damage, but as intentional methods to erase cultural identity. The study highlighted examples from Syria, Iraq, and other conflict-affected areas, where historic monuments and religious sites were specifically targeted. The study underlined the importance of timely digital documentation and the role of remote sensing technologies in capturing and preserving cultural data amid conflict. L. Hajibayova (2019) addressed the preservation of cultural memory through digital platforms, particularly emphasising the ethical dimensions of who gets to document and how heritage was represented. The author advocated for community-centred approaches that empower local populations to take part in digital preservation efforts. This study warned against top-down documentation practices that can distort or omit cultural context, stressing the need for inclusive methods that respect the diversity and complexity of local narratives. Both studies highlighted how heritage destruction in conflict zones was a deliberate and culturally devastating tactic. While E. Cunliffe & L. Curini (2018) emphasised the urgency of documentation, L. Hajibayova (2019) highlighted the need for participatory and ethical frameworks to guide digital preservation. Together, these perspectives underscored the necessity of rapid yet culturally informed responses to protect heritage under threat.

Materials and Methods

The study employed a multidisciplinary approach to investigate the digital preservation of endangered cultural heritage in conflict zones. The research was structured into three key phases: data collection and case study selection, technological assessment, policy and ethical analysis.

The study employed qualitative and quantitative data sources to examine various strategies for digital preservation. The study integrated historical records, academic literature, and policy documents to establish a comprehensive understanding of cultural heritage risks in conflict zones. Case studies from Syria, Afghanistan, Mali, and Ukraine were used as focal points for assessing digital preservation efforts. Primary case studies included analysis of such sources: Palmyra, Syria – 3D reconstruction of the Arch of Triumph following ISIS-led destruction; Bamiyan, Afghanistan – digital restoration of the Bamiyan Buddhas destroyed by the Taliban in 2001; Timbuktu, Mali – remote sensing and satellite monitoring of ancient manuscripts endangered by extremist attacks; Ukraine – emergency digitisation efforts during the 2022 war to preserve museum collections and archives. These case studies were selected due to their representation of different types of cultural heritage (monuments, manuscripts, and museum artefacts) and their exposure to various conflict-related threats.

The study assessed advanced digital tools used in cultural heritage conservation through analysis, including: 1) 3D scanning and modelling – technologies such as photogrammetry, LiDAR (Light Detection and Ranging), and HBIM (Heritage Building Information Modeling) were analysed for their effectiveness in reconstructing destroyed sites; 2) satellite monitoring and remote sensing – multi-temporal InSAR (Interferometric Synthetic Aperture Radar) techniques were examined for tracking structural integrity and documenting damage; 3) blockchain and decentralised storage – the use of blockchain for provenance tracking and decentralised networks such as IPFS (InterPlanetary File System) for secure archiving was explored; 4) AI and predictive risk mapping – machine learning algorithms and federated AI models were assessed for identifying potential threats and prioritising conservation efforts.

The study reviewed international legal frameworks, including the Convention for the Protection of Cultural Property in the Event of Armed Conflict with Regulations for the Execution of the Convention (1954) and Resolution S/RES/2347 (2017), to determine their role in cultural heritage protection. Ethical considerations such as ownership rights, community involvement, and the risks of digital colonisation were discussed. Stakeholder analysis included NGOs (Non-Governmental Organisations), governments, and local communities to evaluate collaboration challenges and solutions. Equally relevant was ethical stewardship, which required engaging local communities in decision-making processes to ensure that preservation efforts reflected the values and needs of those directly connected to their cultural heritage.

Preservation of cultural heritage in conflict zones involved a delicate balance of policy, ethics, and technological innovation. Regulatory documents provided a foundational legal framework for protecting cultural property, mandating state responsibility and international cooperation to prevent and remedy the loss of cultural assets during warfare.

Results and Discussion

The preservation of ancient books, manuscripts, archival materials, and maps in conflict zones presents unique challenges due to threats such as deliberate destruction, looting, and environmental degradation. Various technological interventions were employed to safeguard these cultural assets, ensuring their long-term accessibility and protection.

One of the most notable digitisation initiatives in conflict zones took place in Timbuktu, Mali, where thousands of historic manuscripts faced destruction at the hands of extremist groups. These manuscripts, dating back to the 13th century, contain invaluable knowledge on subjects such as astronomy, medicine, law, and philosophy. Their destruction would have resulted in an irreplaceable loss of Africa's written heritage. To safeguard these fragile documents, remote sensing

and satellite monitoring were employed to assess the condition of storage facilities and track environmental risks, such as humidity, temperature fluctuations, and structural damage (Tapete & Cigna, 2019; Spizzichino & Margottini, 2021). This real-time monitoring helped conservationists identify threats before they resulted in irreversible damage.

In response to the imminent danger posed by militant attacks, local preservationists and international organisations orchestrated a secret operation to evacuate the manuscripts. W. Zhou *et al.* (2015) noted that high-resolution scanning technologies were utilised to create digital replicas, ensuring that even if the original manuscripts were lost, their content would be preserved. The digitisation process involved specialised imaging techniques, including multi-spectral scanning, which captured faded or damaged text that would otherwise be unreadable. Once digitised, the manuscripts were smuggled out of Timbuktu in hidden compartments and transported to safer locations for preservation. These digital records were stored in decentralised databases and cloud-based repositories, ensuring accessibility, while mitigating risks associated with centralised storage failures. The integration of blockchain-based provenance tracking further secured the authenticity and ownership of these manuscripts, preventing illicit trade. This large-scale digitisation effort in Timbuktu serves as a model for heritage preservation in conflict zones, demonstrating the importance of combining technological innovation, strategic planning, and community involvement to protect endangered cultural assets (Fig. 1).

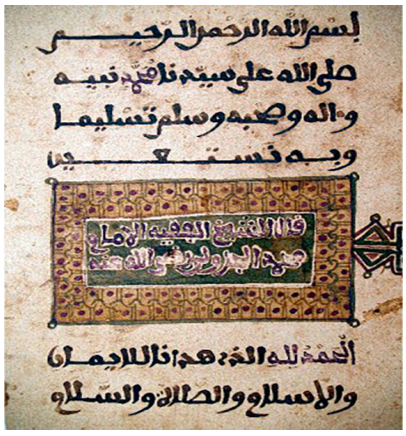

Figure 1. A page from one of the manuscripts. Photo by Seydou Camara via Art Daily
Source: based on H. Neuendorf (2014)

Original manuscripts were saved from destruction, when Islamist militants occupied the ancient city of Timbuktu in 2012. When Islamist militants occupied Timbuktu during the Northern Mali conflict in 2012, Abdel Kader Haidara mobilised 32 of the city's libraries to secretly smuggle their collections of ancient manuscripts on African history, mathematics, chemistry, and law to the capital Bamako. The smugglers risked their lives to preserve the world-renowned artefacts for future generations. Figure 2a showed an example of a manuscript from the IFYL collection, noting the powdery dry mould on the leather binding wrap and part of the information that has already started fading, while Figure 2b showed the digitalisation processes.

Figure 2. Preservation efforts: degraded IFYL manuscript and ongoing digitisation process
Note: a – example of a manuscript from the IFYL collection; b – digitalisation process
Source: based on I. Straughn (2017)

During the 2022 war in Ukraine, cultural institutions faced an urgent need to protect fragile archival collections, as libraries, museums, and historical archives became vulnerable to destruction due to bombings, looting, and infrastructure collapse. Recognising the risks, Ukrainian cultural organisations, in collaboration with international partners, rapidly implemented portable digitisation kits to preserve valuable documents, books, and maps (Boronos *et al.*, 2018). A key innovation in these efforts was the use of low-tech, solar-powered digitisation devices, which enabled scanning and documentation in areas with unreliable electricity supply. These portable units enabled local librarians, historians, and volunteers to digitise thousands of manuscripts and archival materials under challenging conditions. Special care was taken to handle rare and delicate documents, many of which required non-invasive imaging techniques, such as high-resolution

photography and multispectral scanning, to capture faded text and fragile ink.

To prevent data loss in case of physical destruction, the digital copies were immediately uploaded to cloud-based repositories and stored in decentralised storage networks (DSNs), such as IPFS and Filecoin. These systems ensured that even if local servers were compromised, the data would remain accessible from multiple locations worldwide. This distributed approach not only enhanced security, but also made the digital archives resistant to cyberattacks and accidental erasure. One of the defining aspects of Ukraine's emergency digitisation efforts was the role of grassroots participation. Local communities, including students and volunteers, were trained in document scanning and digital archiving. This decentralised, community-led approach ensured the preservation of cultural records despite wartime disruptions. The Ukrainian initiative highlighted how technological innovation, decentralised storage, and civic engagement can collaborate to safeguard national heritage in conflict zones (Fig. 3).

Figure 3. An example of digital preservation of Ukraine's scientific heritage of the late 19th and early 20th centuries

Source: based on N. Khalak (2016)

Figure 3 demonstrated a rich visual narrative that encapsulated a slice of Ukraine's cultural and intellectual history from the late 19th and early 20th centuries. It was a collection that brought together historical photographs, manuscripts, and scanned publications associated with the Shevchenko Scientific Society in Lviv. The collection presented an array of materials, including portraits of individuals in both everyday and formal attire, documents of scholarly work, and pages from old books and journals. Handwritten texts and title pages highlighted the era's vibrant academic discourse, while maps and manuscripts reflected the breadth of research in fields such as geography, ethnography, literature, and history. Overall, this composition was a visual summary of a significant period in Ukrainian scientific and cultural heritage, offering a glimpse into the past through its carefully preserved archival artefacts. Figure 4 depicted the handover of a scanner to the Kyiv-Pechersk Lavra for the digitisation of its archive, supported by UNESCO and the Austrian government.

Figure 4. Delivery of a specialised scanner to Kyiv-Pechersk Lavra for archive digitisation with support from UNESCO and the Government of Austria

Source: based on Yu. Koganov (2023)

M. Danti *et al.* (2017) noted that the ongoing conflict in Syria has led to the destruction and looting of historical archives, prompting urgent digitisation efforts using 3D imaging and AI-assisted restoration. Libraries and cultural institutions employed photogrammetry and LiDAR scanning to create high-resolution digital reconstructions of damaged manuscripts, maps, and historical documents. These technologies were used for precise replication of lost or deteriorated artefacts, preserving their details for future study and restoration. G. Asmolov (2022) and M. Dynel (2024) emphasised that to combat the illegal trade of looted documents, blockchain-based provenance tracking was implemented, ensuring authenticity and preventing unauthorised sales. By assigning immutable digital records to each scanned document, institutions can verify ownership and trace the movement of cultural assets. Additionally, federated AI models have enabled international collaboration in restoring archival data. In contrast to centralised databases, federated learning enables joint analysis and improvement digital records, while maintaining data security and privacy (Cigna *et al.*, 2014; Luo *et al.*, 2019). These technological advancements provided a sustainable solution for preserving Syria's documentary heritage amid ongoing conflict and displacement.

The digital preservation of endangered cultural heritage in conflict zones was a pressing concern, particularly as armed conflicts threaten the integrity of historical sites and artefacts. This response synthesises various case studies and technological solutions that have emerged during the period of 2015-2020, illustrating the multifaceted approaches to safeguarding cultural heritage amidst crises. One prominent case study was the 3D reconstruction of the Arch of Triumph in Palmyra, Syria, and the Bamiyan Buddhas in Afghanistan (Fig. 5). These efforted utilise advanced technologies such as AI-driven 3D modelling and photogrammetry to create accurate digital representations of these significant cultural landmarks. The reconstruction of the Palmyra Arch, for instance, served not only as a means of preserving the memory of the structure, but also as a tool for education and awareness about the cultural heritage that has been lost due to conflict.

Figure 5 illustrated the beginning of the process, where professional and open-domain images were first collected and classified based on their orientation and distribution patterns. Shown in grey was the part from dense multi-view 3D reconstruction, and in red were the parts from panoramic image-based modelling. Dense multi-view 3D reconstruction was then applied to these image sets, processing them in chunks to generate point clouds. From these reconstructions, the positions of the professional panoramic images were accurately retrieved. In Figure 6, the generated mesh was imported into 3D modelling software, where the panoramic images were projected onto it using central projections from the determined positions. The mesh was graphically aligned with the projections, hence two distinct meshes can be created: a high and low-poly version. These meshes were subsequently resampled into one closed solid mesh using tools such as Mesh Mixer. The refined model was then re-imported into the photogrammetry program for texturing, and the final step involved post-processing the texture, where colour balance and contrast were optimised to achieve the appropriate representation of the Arch of Triumph as shown in Figure 6.

Figure 5. The destroyed Arch of Triumph in Palmyra, a projection of a panorama and the reconstructed model
Source: based on W. Wahbeh & S. Nebiker (2017)

Figure 6. The final model of the Arch of Triumph and the used panoramas
Source: based on W. Wahbeh & S. Nebiker (2017)

The triptych in Figure 7 portrayed the rise and fall of the Bamiyan Buddhas in Afghanistan. On the left, one of the two colossal sixth-century statues stands intact, carved directly into the cliff face and gasing over the valley. The centre image depicts the moment of their violent destruction in March 2001, as explosives tear

through the ancient stone, sending plumes of dust and rubble into the air. The final panel revealed the empty niche left behind: a gaping void where a piece of Gandharan art once stood, its absence marked by the outlines of shattered rock and the small figures of local observers, who now confront the stark reality of cultural loss. Together, these three images chronicle the creation, destruction, and lingering absence of a cultural treasure lost to ideological violence. The Bamiyan Buddhas, which were destroyed by the Taliban in 2001, have been the subject of digital reconstruction efforts that aimed to restore their presence in the cultural landscape, thereby promoting a sense of continuity and resilience among affected communities (Danti *et al.*, 2017).

Figure 7. The Great Buddha of Bamiyan before the destruction (left), the explosion of March 2001 (centre) and the hole left in the cliff after the destruction (right)

Source: based on A. Gruen *et al.* (2003)

Figure 8 demonstrated the installation at the Bamiyan cliff site, in which a highluminosity projector mounted on a temporary scaffold casts a full-scale, golden-hued image of one of the destroyed Buddha statues onto the rock face where the original once stood. The projected figure, rendered in warm tones of amber and ochre, recreates the Buddha's serene countenance and draped monastic robes with remarkable clarity, while the surrounding darkness underscored both the monument's absence and its enduring cultural resonance.

Figure 8. Holographic reconstruction of the Great Buddha of Bamiyan: 175-foot installation at the site of the destroyed monument

Source: based on E. Chan (2015)

In addition to 3D modelling, satellite monitoring was substantial in the recovery of Mali's Timbuktu manuscripts, which have faced significant threats from extremist groups. Scientists D. Spizzichino & C. Margottini (2021) demonstrated that multi-temporal InSAR techniques can effectively track environmental changes and detect potential structural damage to the buildings housing these historic manuscripts.

Similarly, D. Tapete & F. Cigna (2019) highlighted that satellite imagery was necessary for assessment of the condition of vulnerable cultural archives, ensuring that critical interventions were made to preserve these invaluable documents. Moreover, researchers noted that the use of remote sensing technologies enabled the assessment of the condition of these manuscripts and the monitoring of their storage environments. V. Boronos *et al.* (2018) noted that during the 2022 conflict in Ukraine, satellite monitoring was key in tracking the looting and destruction of museums, archives, and historical sites. High-resolution satellite imagery was used to document damage to cultural institutions, providing visual evidence that helped inform rescue and recovery operations. This was particularly important for libraries and museums housing rare books and maps, which needed urgent digitisation efforts. Satellite-based environmental monitoring was also crucial in assessing fire risks and infrastructure vulnerabilities at storage facilities, ensuring proactive conservation measures could be implemented before irreversible losses occurred. Ukraine's emergency digitisation efforts during the 2022 crisis further highlighted the importance of digital preservation in conflict situations. As the war escalated, cultural institutions faced immense challenges, prompting rapid digitisation initiatives to safeguard collections and maintain access to cultural heritage. The Ukrainian government and various NGOs mobilised resources to implement portable digitisation kits, enabling local communities to participate in the preservation of their cultural heritage. This community-led approach not only empowered individuals, but also promoted a sense of ownership and responsibility towards cultural heritage, which was crucial in post-conflict recovery. K. Themistocleous *et al.* (2020) emphasised that in Syria, satellite monitoring has been extensively used to track damage to libraries, religious manuscripts, and heritage archives, especially in cities such as Aleppo and Palmyra. This technology was used to analyse before-and-after satellite images to identify illegal excavation activities and the movement of looted artefacts (Luo *et al.*, 2019). W. Zhou *et al.* (2015) stated that by employing advanced multi-temporal InSAR techniques, researchers can detect changes in the structural integrity of buildings housing these manuscripts, thereby informing conservation strategies and ensuring their protection. This approach exemplified how remote sensing can be integrated into cultural heritage management, providing valuable data for decision-making processes (Elfadaly *et al.*, 2018).

T. Greene (2023) noted that technological solutions such as blockchain for immutable provenance tracking have also emerged as vital tools in the preservation of cultural heritage. Projects such as "Salsal: Blockchain verification service for cultural artefacts" were a Web3-based verification-as-a-service model designed for cultural heritage organisations. It was used to upload images and descriptions of artefacts, which were then evaluated by experts. Once validated, artefacts can be minted as Non-Fungible Tokens (NFTs), creating immutable records on the blockchain that document authenticity and ownership. This was particularly relevant in conflict zones, where looting and illicit trafficking of cultural property were prevalent. R. Marigliano *et al.* (2024) emphasised that by providing a reliable means of documenting the provenance of artefacts, blockchain can help deter illegal activities and promote ethical practices in cultural heritage management. Moreover, the integration of AI-driven technologies in the preservation of cultural heritage has opened new avenues for innovation. For instance, machine learning algorithms can analyse vast datasets to identify patterns and predict potential threats to cultural sites (Cigna *et al.*, 2014).

As highlighted by B.M. Garcia (2021), this proactive approach was used to implement preventive measures, thereby contributing to the resilience of cultural heritage against the impacts of conflict and environmental changes. In conclusion, the digital preservation of endangered cultural heritage in conflict zones was a complex and multifaceted process that required the integration of advanced technologies, community engagement, and international collaboration. The case studies of Syria, Afghanistan, Mali, and Ukraine illustrated the diverse strategies employed to safeguard cultural heritage amidst crises.

Edge computing can be deployed in conflict zones to process data locally. For example, a Raspberry Pi-based system paired with a LiDAR scanner can perform 3D scans and process satellite images on site. A pertinent example is the study conducted on the Koszalin city walls in Poland by P. Kędziorski *et al.* (2024), where researchers explored the efficacy of affordable LiDAR systems for 3D modelling and degradation assessment of heritage buildings. In this study, the research team employed mobile devices equipped with LiDAR capabilities, such as the Apple iPad Pro, to capture detailed 3D scans of the city walls. The process involved two phases: initial evaluation of the measurement accuracy and subsequent assessment of the detection of structural degradations. The findings indicated that while low-cost LiDAR solutions were suitable for small-scale documentation, their accuracy diminishes, when applied to larger, more complex structures compared to traditional terrestrial laser scanning (TLS) methods. Nevertheless, the study suggested that these accessible technologies can reduce costs and enhance the reach of heritage conservation efforts, especially when complemented by further development of mobile applications. This solution minimised dependency on cloud services and supports rapid documentation even when connectivity was unstable. Figure 10 depicted the result of the design of a rendered 3D model of the complete system.

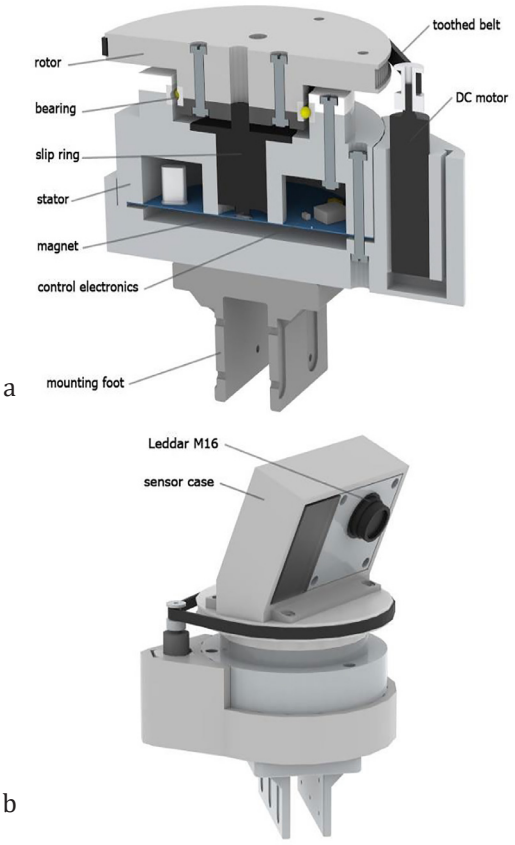

Figure 10. The 3D model of the designed 3D LIDAR sensor
Note: a – the sectional image of the structure, stator, without sensor; b – the complete unit
Source: based on T. Bécsi *et al.* (2017)

Federated learning enabled multiple institutions, such as museums and NGOs, to train shared AI models without centralising sensitive data. In practice, collaborative AI systems can analyse satellite imagery to detect patterns of looting, while preserving the privacy of each participant's data. This method increased the quality of predictive analytics without exposing information to cyber risks. Moreover, the establishment of collaborative frameworks for cross-border preservation was crucial in addressing the transnational nature of cultural heritage. R. Doszhan (2023) noted that many cultural sites and artefacts were not confined to national borders; thus, international cooperation was essential for their protection. Collaborative frameworks can facilitate knowledge sharing, resource mobilisation, and joint initiatives among countries facing similar challenges in cultural heritage preservation. For instance, regional partnerships can be formed to address the illicit trafficking of cultural property, which often throve in conflict zones (Zhang *et al.*, 2022). Such collaborations can also enhance the capacity of local institutions to manage and protect cultural heritage, ensuring that preservation efforts were sustainable and contextually relevant.

Quantum-resistant encryption can protect from future advances in computing. Lattice-based cryptography within blockchain ledgers can secure provenance records of repatriated artefacts. This technique created digital archives that remained secure even as quantum computing develops. Low-tech digitisation kits equipped with solar-powered components provided a practical solution in remote, off-grid areas. Portable devices integrated with terrestrial LiDAR backpacks, for example, enable local communities to digitise manuscripts or record oral histories without reliance on external power sources. Such kits broaden access to preservation technologies in resource-limited settings.

Digital twins that incorporate IoT sensor integration can be used to create updatable virtual models of heritage sites. Sensors placed on a structure can monitor parameters such as vibration or humidity, and the real-time data feeds into a digital replica, for instance, of Yemen's Old City of Sana'a to signal potential damage. This arrangement supported early intervention by those responsible for conservation. Decentralised storage networks (DSNs) distributed digital heritage data across peer-to-peer systems such as IPFS or Filecoin. By storing 3D models of heritage sites on these networks, the risk of data loss was reduced if centralised servers were compromised. This distributed approach was resistant to both cyberattacks and physical damage.

Holographic preservation and augmented reality (AR) can reconstruct lost artefacts for educational use. Initiatives such as UNESCO's #Unite4Heritage used AR to overlay digital reconstructions onto physical ruins, thereby reuniting displaced communities with a visible reminder of their past (Shang *et al.*, 2017). AI-powered predictive risk mapping combined conflict reports, climate models, and heritage inventories to identify sites at imminent risk. For instance, a tool such as Project Mosul's RiskMap can prioritise areas that required urgent digitisation and intervention before damage occurs.

Crowdsourced verification platforms that incorporate gamification engage volunteers around the world in validating heritage data. Platforms such as MicroMappers enabled users to tag satellite imagery of damaged sites, accelerating the data-checking process, while raising public awareness about heritage preservation. Predictive risk mapping using conflict data analytics was a promising direction for enhancing the protection of cultural heritage. B.M. Garcia (2021) emphasised that by integrating data on conflict dynamics, social unrest, and environmental factors, stakeholders can develop comprehensive risk assessments that identified vulnerable cultural sites. Such predictive models can inform proactive measures to safeguard cultural heritage, enabling targeted interventions in high-risk areas. A. Gravagnuolo *et al.* (2021) determined that the application of participatory mapping techniques can facilitate community engagement in identifying potential threats to cultural heritage,

thereby promoting a sense of ownership and responsibility among local populations. This collaborative approach not only enhanced the effectiveness of preservation efforts, but also strengthened community resilience in the face of conflict.

Biometric authentication systems enhanced the security of digital archives. By employing iris or fingerprint scanning, access to sensitive records such as those maintained by the Iraqi Museum can be restricted to authorised personnel only, thereby reducing the risk of unauthorised data breaches. Innovations in material science also contributed to a hybrid approach that protected both physical and digital records. For instance, nano-coated storage drives or ceramic nanodots can encode 3D scan data into heat-resistant plaques. These materials helped ensure that digital backups survive extreme conditions, such as fires or explosions. Swarm robotics involved the use of autonomous drone swarms to document sites that were too dangerous for human teams. Synthetic media techniques used AI-generated voice cloning to reconstruct oral histories that were fragmented or lost. Projects that restored recordings damaged during conflict not only preserved the content of these narratives, but also maintained the cultural practices associated with them. Ethical AI audits provided an essential check on algorithms used in heritage preservation. By establishing audit frameworks modelled after initiatives such as MIT's Moral Machine, stakeholders can review AI outputs for cultural bias and ensure that digital reconstructions accurately reflected the intended heritage narratives without imposing external interpretations (Brogan, 2016; For driverless cars, a moral dilemma…, 2017).

The protection of cultural heritage in conflict zones required a combination of modern technologies, strategic planning, and community involvement. Digitisation, including multispectral scanning and cloud storage, enabled preservation of vulnerable documents even under the threat of war. Successful examples in Mali and Ukraine demonstrated the effectiveness of mobile equipment, decentralised archives, and grassroots initiatives in safeguarding cultural assets. These approaches ensured the long-term accessibility and authenticity of historical materials.

Conclusions

The digital preservation of endangered cultural heritage in conflict zones was essential for protecting both physical monuments and the associated traditions of affected communities. The study highlighted the transformative role of 3D scanning, remote sensing, and blockchain-based records in documenting and safeguarding cultural heritage, when direct access to sites was restricted by violence or instability. The use of advanced imaging technologies enabled researchers to create high-resolution digital replicas of heritage sites, ensuring their long-term preservation and accessibility for future generations. Despite these advancements, challenges persist, including technical limitations, inadequate infrastructure, and restricted access to specialised equipment. Many conflict-affected regions struggle with unstable electricity supplies and limited internet connectivity, making real-time documentation and data storage difficult. However, case studies from Palmyra, Bamiyan, Timbuktu, and Ukraine demonstrated that a combination of local digitisation initiatives and international collaboration can effectively mitigate these challenges. By providing digital tools and preservation training, heritage documentation efforts became more sustainable and reflective of the cultural identity of affected populations. The documentation of written monuments, such as manuscripts in Timbuktu and Ukraine, has further revealed the critical importance of safeguarding textual heritage alongside architectural relics. Digitising fragile manuscripts not only protected them from physical destruction, but also ensured continued scholarly access and cultural relevance, particularly for communities, whose identities were closely tied to these historical texts. Furthermore, investments in technology transfer, digital repositories, and capacity-building initiatives will contribute to the resilience of heritage preservation efforts. Establishing secure, decentralised archives will ensure that digitised cultural records remain accessible and protected from cyber threats or physical destruction. Further expansion of international partnerships and interdisciplinary collaborations will be critical in strengthening digital preservation initiatives. By integrating technological innovation with community engagement, cultural heritage can be maintained as a vital resource for historical memory, education, and cultural continuity, even amid the disruptions of armed conflict.

Further research should explore scalable and context-sensitive preservation strategies, particularly those that integrate indigenous knowledge systems and prioritise underrepresented heritage forms.

Acknowledgements

None.

Conflict of Interest

None.

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Цифрове збереження культурної спадщини, що перебуває під загрозою зникнення, в зонах конфліктів

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Анотація. Метою дослідження було вивчення ролі цифрових технологій у збереженні культурної спадщини в зонах конфліктів, забезпечення безпеки історичної та культурної ідентичності в умовах воєнних дій. У дослідженні проаналізовано ризики та цифрові рішення для збереження як матеріальної, так і нематеріальної спадщини під час збройних конфліктів. Були розглянуті виклики, що виникають через нестабільне середовище, обмежені технічні ресурси та зруйновану інфраструктуру, які перешкоджають використанню таких методів, як 3D-сканування, дистанційне зондування та цифрове моделювання для документування та реконструкції пошкоджених об'єктів. Етичні проблеми, пов'язані з правом власності та інформованою згодою, оцінювалися разом з логістичними питаннями, що виникають внаслідок геополітичних обмежень і фрагментарної співпраці між місцевими громадами, урядами та міжнародними організаціями. Тематичні дослідження з Сирії, Афганістану, Малі та України проілюстрували застосування цифрових інструментів для документування та відновлення спадщини в несприятливих умовах. Технологічні інновації, зокрема відстеження походження на основі блокчейну, периферійні обчислення для локальної обробки даних, децентралізовані мережі зберігання та прогнозне картування ризиків за допомогою штучного інтелекту, обговорювалися як стратегії захисту та збереження цифрових записів. Результати дослідження показали, що, незважаючи на технічні та геополітичні бар'єри, місцеві зацікавлені сторони продемонстрували неабияку адаптивність, використовуючи недорогі інструменти з відкритим вихідним кодом для продовження зусиль із документування. Залучення громад виявилося ключовим фактором у збереженні цифрової спадщини, причому низові ініціативи часто очолювали збір даних і розповідь історій. Міжнародні партнерства були найефективнішими, коли вони підтримували, а не підміняли місцеві організації. Крім того, респонденти наголосили на нагальній потребі у створенні сталої цифрової інфраструктури та моделей управління даними з урахуванням культурних особливостей. У дослідженні також розглянуто відповідні міжнародні правові рамки, які підтримують проактивні зусилля зі збереження даних. Насамкінець, воно закликає до інтегрованих цифрових підходів, які поєднують технологічні досягнення з участю громадськості для захисту культурних цінностей і підтримки зусиль з відновлення в регіонах, що постраждали від конфлікту, забезпечуючи їхнє тривале збереження

Ключові слова: цифрове моделювання; децентралізоване зберігання; документація про спадщину; 3D-моделювання; дистанційне зондування; міжнародне право

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Socio-communicative technologies in the context of the library and information sector

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Abstract. The relevance of the research topic stems from the rapid digital transformation of society, the growing role of information technologies, and the need for libraries to adapt to new communication challenges. This study aimed to highlight the essence of socio-communicative technologies and to determine the prospects for their use as a tool for managing the library and information sector. The research methodology involved the application of general scientific methods, specifically structural analysis and synthesis, which have facilitated the clarification of key terms and concepts relevant to the functioning and development of the phenomenon of socio communicative technologies. The methods of systematisation and generalisation were used to propose the implementation of action frameworks involving socio-communicative technologies within the library and information domain. The findings indicated that socio-communicative technologies played a significant role in shaping and supporting the functioning of the library and information sector, which was influenced by rapid social change and substantial internal transformations within library institutions resulting from informatisation processes. Socio communicative technologies in the library and information sector have included social media platforms, chatbots for user interaction, webinars and online lectures, automated library information systems, mobile library applications, virtual tours, and gamification. In 2024, these technologies reflected emerging characteristics and relationships within the sector, supporting professionals in generating new ideas, tracking developments in the field by monitoring document and information flows and datasets, formulating tasks for the automation of information processes, and functioning confidently as effective communicators in the modern information space, while fulfilling their professional responsibilities. In the modern world, the use of socio-communicative technologies in the library and information sphere remained limited and lacks sufficient tools for social design and effective methods of influence. Nonetheless, these technologies serve an important role in identifying challenges in library operations, accurately determining their causes, and exploring optimal solutions

Keywords: social media; chatbot; webinars; automated library and information systems; mobile applications; virtual tours; gamification

Introduction

The relevance of researching socio-communicative technologies in library and information activities stems from their contribution to the modernisation of libraries, the expansion of their social function, and the provision of convenient access to knowledge. In line with contemporary trends and societal progress, society, as an organised community of people, cannot exist and develop without the constant exchange of information in its various forms. With societal progress, the volume of the global information flow has increased, necessitating the effective preservation and transmission of data. G. Koloskova & O. Kobieliev (2022) noted that in the process of digitalising the library sphere, traditional information resources and products are constantly supplemented by electronic ones, forming a unified library and information potential. Through the implementation

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of modern technologies, the range of services was expanded, satisfying the needs of various categories of users both within the library walls and beyond.

The library and information sphere has played a decisive role in the new historical phase of development that society is currently undergoing. The uniqueness of this sphere lied precisely in the creation, preservation, dissemination of, and access to information resources that meet society's educational, scientific, cultural, social, and economic demands. Without socio-communicative technologies as the tools, methods, and techniques that ensured effective interaction between communication subjects in the social environment, it was impossible to modernise library activities, enhance access to knowledge and information, develop communication with users, and increase their engagement. Socio-communicative technologies were aimed at managing information flows, shaping public opinion, stimulating social activity, and achieving set goals. Their significance in the library and information sphere was determined by the development of the information society, the growing demand for convenient access to knowledge, and the necessity of improving communication mechanisms between the library and its users. Libraries function not merely as institutions that store information, but as interactive centres that facilitate access, systematisation, and efficient exchange of information resources.

In 2022, digitalisation significantly enhanced traditional library functions, and the organisation of knowledge in a library format was characterised by the rapid growth of a body of structured electronic information resources. Ye. Chumak (2022) indicated that electronic library and information resources were a collection of information that was obtained, processed, and stored on the servers of library institutions, transmitted via electronic, network, or software means, operates continuously in online mode, and was aimed at increasing the efficiency of library and information services for societal information needs. The implementation of the latest technologies and largescale modernisation of library processes have already provided fundamentally new opportunities for access to information regardless of the time and location of both the document and the user.

As S. Khrushch *et al.* (2023) noted, electronic libraries were transforming not only into information repositories, but also into platforms for creativity, collaboration, and innovation. Thanks to speech and text recognition technologies, their resources were becoming more accessible and efficient to use, while integration with external sources ensured openness and flexibility. Collaborative work, collective problem-solving, and active user participation contributed to the formation of an innovative information space that played a key role in the development of society, where knowledge was the foundation for continuous growth and enlightenment.

According to O. Karakoz (2023), the implementation of virtual reality technologies in modern libraries opened up broad possibilities for improving user experience and engaging visitors in new interactive formats, which was relevant in the context of increasing media saturation in society. Thanks to VR (virtual reality), libraries can adapt to changing user needs, facilitate effective learning, and provide virtual access to rare and valuable materials. Furthermore, this technology was capable of transforming the library space into an engaging environment, where new worlds can be explored, complex concepts visualised, and collaboration with other institutions fostered. However, successful VR implementation required adequate funding, staff training, and the creation of userfriendly, high-quality content.

O. Shevchenko (2024) indicated that the library system of Ukraine possesses significant potential for further modernisation and digital transformation. The implementation of automated library information systems was a key stage in the process of library digitalisation, as it contributed to the optimisation of time and resources for both library institutions and users. This also ensured a gradual transition to modern information technologies and increased the efficiency of library service provision.

Scholars I. Borodai *et al.* (2022) noted that leadership in the development and implementation of communication technologies belonged to libraries in the USA, which were the first to digitise their fonds and establish electronic libraries as a core element of the library process of informatisation. Among European countries, information and communication technologies were most actively implemented in libraries in Germany, Sweden, and Denmark. The concept of the mechanism of information flows was developed in the East, and leadership in the implementation of communication technologies belonged to libraries in China, Japan, and Korea. The use of sociocommunicative technologies has contributed to the modernisation of library activities, particularly through automated library systems, digital catalogues, electronic libraries, interactive platforms, social networks, and mobile applications. This has raised the level of information services, expanded possibilities for remote access to resources, and shaped a new model of libraryuser interaction. Consequently, the implementation of socio-communicative technologies in the library sphere has become a key direction in the development of modern library and information institutions, responding to the challenges of the digital age and facilitating effective information exchange in society.

This study aimed to examine and analyse the role, possibilities, and prospects of implementing socio-communicative technologies in libraries to enhance the quality of information services, optimise library processes, and broaden access to knowledge in the digital environment. The following objectives were set: to elucidate the conceptual and categorical framework of

sociocommunicative technologies; to identify the types of socio-communicative technologies in the library and information sphere; and to investigate the advantages, disadvantages, and prospects of implementing socio-communicative technologies in the library and information sphere.

The scientific novelty of the research lies in the study, development, and improvement of tools and methods for information transfer in the digital environment, specifically the investigation of new communication formats and channels such as virtual and augmented reality, interactive platforms, and artificial intelligence in social networks, the study of manipulation mechanisms in the digital environment, methods for combating fake news and information threats, and the automation of communication processes.

Materials and Methods

The research methodology involved the use of general scientific research methods, specifically structural analysis and synthesis, comparison, systematisation, and generalisation. The application of the method of structural analysis and synthesis enabled the clarification of the meaning of individual terms and concepts, including "social communications", "communication tools", "communication technologies", and "information resources", for the functioning and development of the phenomenon of socio-communicative technologies. A systemic approach allowed the library and information sphere to be viewed as a holistic system, where socio-communicative technologies act as a structural element interacting with other components. Additionally, the comparative method was used during the research, which helped to analyse different models and practices of utilising socio-communicative technologies in libraries, contributing to the identification of their advantages and disadvantages. The interactive model was analysed – the use of social networks for communication and resource promotion, chatbots and online consultations for information and communication interaction with readers; online events for audience engagement – and the structural-functional model for elucidating socio-communicative technologies in the library and information sphere. The study of socio-communicative technologies in the library and information sphere was conducted based on the practices of using social networks, library institution interaction platforms, the provision of virtual library services, gamification, and VR/AR (augmented reality) technologies. The method of systematisation and generalisation was applied to propose the use of action complexes of socio-communicative technologies in the library and information sphere. The research on this topic was conducted in three stages. The first stage involved the explication of the theoretical concept of the research topic, utilising the main approaches of scholars to the posed question, scientific articles by Ukrainian authors, namely O. Mariina (2013), V.O. Ilhanaieva (2019), and I. Levchenko (2022), as well as the analysis plan and research outline, including the illumination of the main aims and objectives. The second stage involved the analysis of various types of socio-communicative technologies, specifically social platforms for informing about events, new publications, and library services; chatbots as a means of interactive communication with visitors; online lectures and webinars for promoting literature and disseminating knowledge in the digital environment; automated library resource management systems; mobile applications for accessing information materials and communicating with librarians; virtual tours – digital presentations of libraries introducing users to fonds and services; and gamification – the use of game mechanics in educational and informational activities to engage the audience. The third stage was the concluding part of the study and involved the analysis and exposition of the solutions and the role of sociocommunicative technologies in the library and information sphere.

Results and Discussion

Modern methods and forms of information transfer have undergone significant changes. In 2024, diverse means and tools were employed for information transfer, such as cloud technologies, physical servers, and so forth. A constant shared characteristic of these tools, irrespective of their evolution, has remained the primary objective – the preservation and transmission of knowledge and cultural heritage to future generations. Communication tools have become the means, methods, and technologies that facilitate information exchange between subjects of the communication process. They can be classified into several groups depending on their form, purpose, and technical level: traditional – oral language and printed materials (books, journals, newspapers, posters); information and communication technologies (email, social networks, messengers, video conferencing); mass media platforms (radio and television, Internet websites and blogs); interactive forms – chatbots, online forums and platforms; artificial intelligence technologies (personalisation of information for users, voice identification).

Information and information resources within social communications must be considered not only from the perspective of their acquisition, processing, storage, and transmission but also from the perspective of their functioning within information flows and socio-communicative processes. Information flows circulate in corresponding structural logical schemes which share common characteristics: sources of origin, information consumers, transmission directions, periodicity, degree of stability, structure, volume, type of information carrier, information capacity of individual messages, degree of utilisation, and place and type of storage. Document-information flows function within

defined structural-logical schemes characterised by common parameters: sources of origin, end-users, directions of dissemination, periodicity, level of stability, structure, volume, type of carrier, information capacity of individual messages, level of utilisation, as well as place and method of storage. Therefore, information resources in the context of socio-communicative interaction can be characterised as a collection of knowledge, facts, documents, and other information objects used to ensure effective social communication between subjects of society. They form the basis for information exchange, decision-making, and the creation of new knowledge in the process of interaction. The main characteristics of information resources in this context have become: accessibility, relevance, quality, structuredness, and dynamism (Fig. 1).

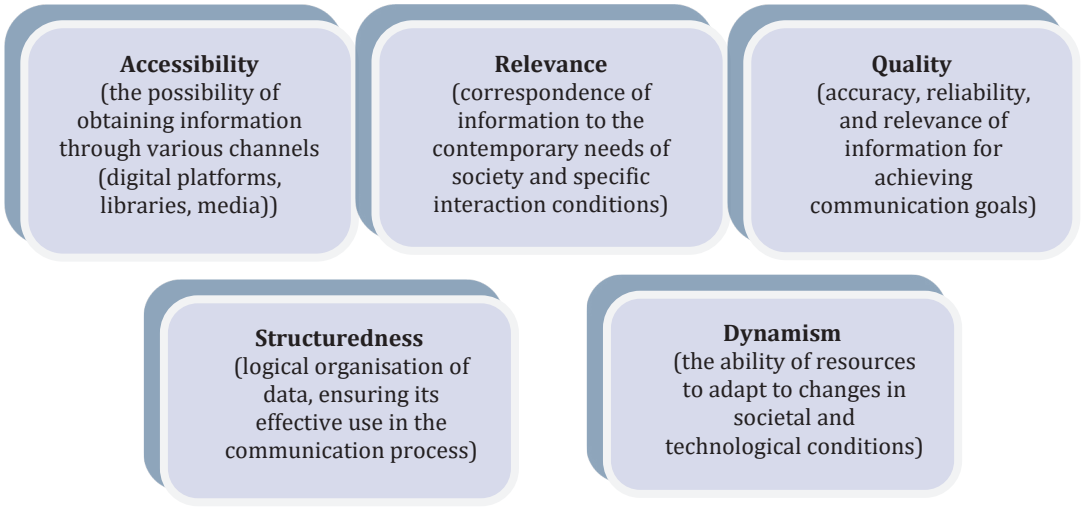

Figure 1. Main characteristics of information resources in the context of socio-communicative interaction
Source: developed by the author

As of 2024, the library and information sphere has witnessed a combination of established practice with the capabilities of socio-communicative technologies, with traditional library and information services being transformed into the provision of electronic information resources and services via telecommunication means. Such changes have led to an increase in the informationcommunication and socio-cultural role of the library in the contemporary processes of Ukrainian society. In 2024, modern socio-communicative technologies played a significant role in the development of libraries, the application of which created the necessary conditions for the effective functioning of the sector.

The main aims for introducing socio-communicative technologies into the library and information sphere are: obtaining additional resources to ensure the viability and sustainability of its organisational system; expanding the range of information products and services, enhancing their competitiveness; creating a system of social partnership; forming comfortable conditions for professional activity; implementing innovations and professional creativity, organisation and self-organisation, diagnosis, tactics and strategy for the development of library activities; changing the value perceptions and motivations of different categories of library users and representatives of the library community (Mariina, 2013).

All these technologies are based on innovative solutions, yet differ in their social and technical prerequisites: organisational (e-catalogues, databases); service-oriented (virtual services); product-oriented (e-fonds, multimedia products, etc.); technical (presentation of information on websites, in social networks, messengers, blogs); and business-oriented (paid services). Sociocommunicative technologies in the library and information sphere (LIS) include: social networks, chatbots, webinars and online lectures, automated library information systems, library mobile applications, virtual tours, and gamification (Fig. 2). Social networks are a powerful tool in the library and information sphere, fostering communication with users, promoting services, analysing audience interests, improving operations, and ensuring feedback. They offer libraries broad opportunities for interacting with readers and effectively promoting their services. T. Byrkovych & Ya. Morozova (2024) noted that libraries actively used social networks for: advertising events, competitions, and book exhibitions; disseminating information, including library and bibliographic resources, news, and interesting articles; interacting with readers through polls, quizzes, and online discussions; recommending books, providing reviews, thematic selections, and book trailers; and showcasing their work via photo reports, videos, and live broadcasts.

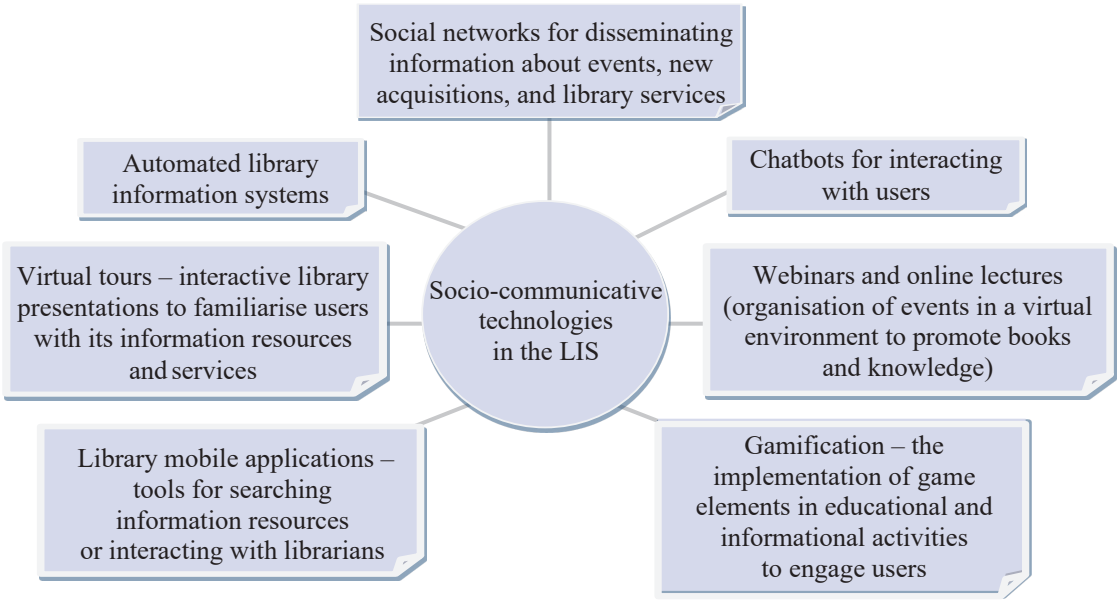

Figure 2. Socio-communicative technologies in the library and information sphere
Source: developed by the author

According to O. Onyshchenko (2021), the role of digital presentations of library fonds, new acquisitions, academic conferences, and libraries themselves was continuously growing. A library's authority was determined by its activity on social networks. Mastering digital platforms opened up new opportunities for libraries to integrate into the global information space. Such a presence extended beyond individual posts or brief discussions. However, social networks have become a potentially powerful tool for conducting meaningful dialogue regarding academic and cultural values, the role of libraries in shaping digital culture and literacy, preserving national heritage, and contemplating the professional identity of librarians in the context of digital transformation.

The modern internet space was evolving towards the creation of a symbiotic web – an open, interconnected, and intelligent network that ensured harmonious and precise interaction between people and machines. The first manifestations of this process have been chatbots, and virtual assistants, which, thanks to personalisation, blur the boundary between the user and the device. The key principle of Web 4.0 functioning may become the concept of "always connected", and network communication will approach the format of interpersonal interaction. Mobile technologies were a key service-technological basis for the functioning of Web 4.0. In the sphere of library services, this trend has manifested in the growing popularity of library services based on mobile technologies. These have provided users with the possibility of personalised access to necessary information and communication via smartphone at any time and from any location. This has contributed to the creation of a comprehensive library mobile service, known as the mobile library (M-library) (Bondarenko & Granchak, 2021).

In the modern context of the information society's development, libraries must master the use of social media for knowledge dissemination. Ukrainian librarians must be prepared to transform their social media presence into platforms for learning, knowledge exchange, and youth development. Public libraries can contribute to the formation of modern literacy by promoting information and digital skills. Traditional library lessons, aimed at developing the ability to work with books and text, can be updated through information and communication technologies and become a tool for fostering critical thinking, a key aspect of the critical model of media education. By supporting internet education, libraries using video hosting services have the opportunity to provide access to video collections of masterclasses, training sessions, and webinars (Kulyk, 2015).

A key characteristic of the modern library has become its maximum orientation towards user needs. In light of this, a modern library must possess an automated information system that integrates all library processes and has clear prospects for further development. These systems represent specialised software complexes designed to automate the core processes of library activity, such as accounting, searching, fond management, and user services. They allow for the optimisation of library operations, ensuring rapid access to information resources. The main functions of an automated library information system include: cataloguing information resources – creation and maintenance of electronic catalogues for books, periodicals, and multimedia materials; information retrieval – quick access to fonds via interfaces for users and staff; fond management – recording acquisitions, control, statistics, and reporting; user services – reader registration, tracking book loans and returns, creating electronic

library cards; integration with electronic resources – access to databases, online libraries, and full-text materials; and interlibrary loan organisation – ensuring interaction between libraries.

Mobile interaction with users has become one of the key directions in the development of librarianship in the near future. O. Makarova (2022) underscored that mobile library application technologies hold significant potential. In particular, the number of augmented reality applications is growing, which utilise QR codes and RFID tags that can be effectively integrated into the work of modern libraries. QR codes can be used for downloading books to smartphones, organising cultural and educational events, and also in advertising, informational, and presentation materials. Applications based on RFID technology allow for the identification of recommended books, finding new publications, gaining access to related literature, reading comments, and participating in the ranking of publications.

Virtual tours, i.e., interactive library presentations to familiarise users with its resources and services, are a modern way of showcasing its services, resources, and opportunities through digital technologies that ensure interactivity and audience engagement. They contribute to increasing interest in the library and improving communication with users. Examples of such interactive presentations include virtual library tours, where users can explore the library premises, and become acquainted with its fonds and service areas through 3D excursions or interactive maps (Fig. 3).

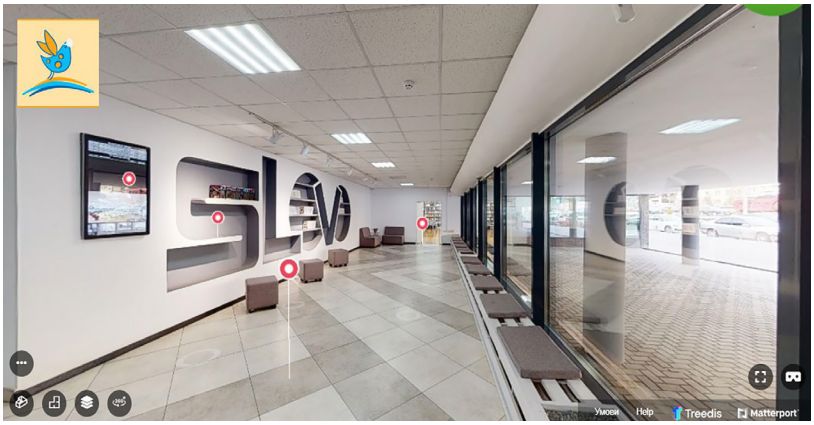

Figure 3. Virtual 3D tour of the T.H. Shevchenko Central Library for Children of Kyiv
Source: Official website of Taras Shevchenko Central Library for Children (2024)

A type of virtual tour also included the organisation of interactive stands (information kiosks or touch panels in libraries), which allowed users to independently find out about services, book locations, or events, and the demonstration of promotional videos with interactive links – short videos showcasing the library's main services and containing interactive buttons for navigating to relevant sections of the website. Such presentations help libraries become closer to their users, engaging the audience through innovative methods of communication and interactivity.

Modern libraries are implementing innovative approaches to communication and interactive engagement with users. In the search for creative formats for such interaction, O. Skachenko (2019) emphasised the significant potential of gamification in the library sphere. Its advantages included the possibility of conducting large-scale events, creating new communication formats, highlighting the library as a space for creative exchange, and forming an active community of "friends of the library", who were ready to participate in the organisation and implementation of informational, educational, and cultural events. Gamification encourages the exploration of the culture and art of Ukraine and the world, facilitates effective knowledge acquisition, and helps reduce information overload through emotional relief. The use of gaming technologies in libraries develops purposefulness, intellectual activity, communication skills, and teamwork.

Analysis has shown that the scale of using socio-communicative technologies in the library and information sphere remains insufficiently studied and is not supported by the necessary tools for social design and established methods of influence. They serve as a means of diagnosing problems in library activities, clearly identifying their causes, and determining methods for their resolution. O. Mariina (2013) noted that modern socio-communicative technologies encompassed all spheres of activity, manifesting most vividly in the field of social management. Scientifically grounded social strategies and solutions in this domain were becoming a key trend in the development of the information society.

Analysis of different approaches to defining the concept of socio-communicative technologies has indicated that the most well-reasoned were the concepts of V. Rizun and O. Kholod, particularly that the study of the phenomena, processes, and functions of social

communications should be carried out through a socio-communicative approach. Its essence lay in the monitoring, recording, description, analysis, and interpretation of data within the framework of socio-communicative engineering. The main task of this approach was to determine, whether the studied object exerted the planned influence on society and precisely how society reacts to it (Kholod, 2023).

A group of authors has been engaged in researching the role of socio-communicative technologies in student training, notably Ya. Tsetsyk *et al.* (2021), studied their role in the professional training of specific specialities, namely documentation specialists. Scholars M. Komova & S. Zhavoronko (2022) investigated the application of a complex of sociocommunicative technologies in social networks for building the brand of professional and organisational qualities of catering companies, conducting a content analysis of company profiles on Facebook and Instagram. The terminology proposed by these researchers fully satisfies the general needs of definition. However, when it comes to an in-depth analysis of sociocommunicative technologies and their increasing role in the development of the library and information sphere, it is more appropriate to apply a more detailed approach with a clear differentiation of concepts. The conceptual and categorical framework of socio-communicative technologies encompasses terms and concepts that describe the essence of social communications, communication tools and technologies, information resources, and the influence of cultural, historical, economic, and political factors on the formation and development of communication processes.

As of 2024, scholars have developed a concept regarding the phenomenon of social communications, which was determined by the specificity of concrete historical conditions, the sectoral focus of research, and the basis for defining structural and classification links that occur in reality. V.O. Ilhanaieva (2019) noted that phenomenologically, social communication can be viewed as a type of social interaction carried out using certain sign systems that serve as the means of necessary connection. L. Levchenko (2022) indicated that social communication is an active and effective element in the structure of the modern information and communication space, allowing for the consideration of rapid changes in society, their impact on human well-being, and the development of social institutions.

V. Rizun (2012) defined social communication as a system of societal interaction that includes specific pathways, methods, means, and principles for establishing and maintaining contacts. This system was based on professional and technological activity aimed at the creation, implementation, organisation, improvement, and modernisation of social relations. In such processes, the initiators of communication were typically socio-communicative institutions and services, while social groups and communities actively participated in the interaction as full subjects of social dialogue.

It was worth agreeing with the assertion by O. Kholod (2022), who, in studying the parameters of the range of the concept "processes of social communications", found that the theory and history of social communications, along with the theory and history of journalism, remain overlooked. As objects of study, specialists do not pay attention to documentation studies, archival studies, book studies, library science, bibliography studies, the theory and history of publishing and editing, and social informatics. The reasons for researchers' lack of attention to these fields of knowledge do not depend on a holistic explication of their essence, but merely confirm an epistemic imbalance between current and non-current areas of human activity. O. Klymenko & O. Sokur (2021) considered that library communication, oriented towards a long-term focus, was a fundamental factor in the effective functioning of the library and information sphere.

No library, regardless of its type or specialisation, can fully satisfy the information needs of society and users without employing multimedia technologies and the possibilities of the virtual space. Therefore, the issue of socio-informational communications is important for ensuring effective public information exchange and further development. Specifically, multimedia technologies serve as a key tool for presenting the products, resources, and services that result from the activities of various structures.

Socio-communicative technologies play a key role in the development and functioning of the library and information sphere, which is driven by dynamic social changes and profound transformations of libraries in the process of informatisation. The activation of economic, political, cultural, and social processes underscores the importance of studying and improving these technologies as an effective instrument for influencing social reality.

Conclusions

The development of the library and information sphere has occurred under the influence of global civilisation processes, notably informatisation and the establishment of a market economy. This contributed to the transformation of libraries into powerful information centres, the growth of their communication potential, and the expansion of user access to knowledge, thereby fostering the intellectual development of society. The conceptual model of the library, through the implementation of socio-communicative technologies, should harmoniously combine these directions, ensure a socio-economic balance in the service system, and achieve consistency between the types of information services, resource expenditure, and the ultimate goal – the most effective satisfaction of contemporary information needs. In the library and information sphere,

sociocommunicative technologies have encompassed the use of social networks, chatbots for user interaction, conducting webinars and online lectures, implementing automated library information systems, utilising library mobile applications, organising virtual tours, and incorporating elements of gamification. Modern socio-communicative technologies have reflected new functions and interconnections of the library as a social institution and have also contributed to the professional development of specialists in the library and information sphere. They helped generate creative ideas, track industry development trends through the analysis of information flows and datasets, effectively manage innovative projects, and determine directions for the automation of information processes. Furthermore, these technologies provided specialists with confidence in their role as communicators and participants in the modern information environment, contributing to increased efficiency in performing their professional duties.

However, while analysing the positive development of socio-communicative technologies in the library and information sphere, their research perspectives remain, covering several priority areas: cloud services and blockchain for providing library services, processing and storing information, and preserving user personal data; the automation of library processes using chatbots, voice assistants, and artificial intelligence; the implementation of VR and AR for user engagement and optimising library processes; the use of Big Data for analysing and studying reader needs and providing modern information services; and the use of artificial intelligence for selecting information resources. Further research in this direction involves studying the characteristics of library and information institutions in their desire to become more adaptive to the digital environment and effectively utilise modern socio-communicative technologies.

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Conflict of Interest

None.

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Соціально-комунікаційні технології в контексті бібліотечно-інформаційної сфери

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Анотація. Актуальність досліджуваної теми зумовлена стрімкою цифровою трансформацією суспільства, зростаючою роллю інформаційних технологій та необхідністю адаптації бібліотек до нових комунікаційних викликів. Мета дослідження полягала у висвітленні сутності соціально-комунікаційних технологій та визначенні перспективи їхнього використання як засобу управління бібліотечно-інформаційною сферою. Методологія дослідження полягала у використанні загальнонаукових методів дослідження – застосування методу структурного аналізу та синтезу, що дало змогу з'ясувати значення окремих термінів та понять для функціонування і розвитку феномену соціально-комунікаційних технологій. Метод систематизації та узагальнення застосовувався для пропозиції використання дій-комплексів соціально-комунікаційних технологій в бібліотечно-інформаційній сфері. У результаті цього дослідження було виявлено, що соціально-комунікаційні технології відіграють важливу роль у формуванні та функціонуванні бібліотечно-інформаційної сфери, що обумовлено швидкими темпами соціальних змін і значними внутрішніми трансформаціями бібліотечних установ під впливом процесів інформатизації. Соціально-комунікаційні технології у бібліотечно-інформаційній сфері включали: соціальні мережі, чат-боти для взаємодії з користувачами, вебінари та онлайн-лекції, автоматизовані бібліотечні інформаційні системи, мобільні додатки бібліотек, віртуальні тури, гейміфікацію. У 2024 році соціально-комунікаційні технології відображали нові властивості та відносини в бібліотечно-інформаційній сфері, а фахівцям допомагали продукувати нові ідеї, стежити за трендами розвитку предметної галузі шляхом моніторингу документно-інформаційних потоків та масивів, формулювати завдання автоматизації інформаційних процесів, впевнено почуватись ефективним комунікантом у сучасному інформаційному просторі при виконанні своїх професійних обов'язків. У сучасному світі використання соціально-комунікаційних технологій у бібліотечно-інформаційній сфері залишається обмеженим і не забезпеченим достатнім інструментарієм соціального проєктування та ефективними методами впливу. Водночас ці технології виконують важливу функцію у виявленні проблем бібліотечної діяльності, точному визначенні їхніх причин і пошуку оптимальних шляхів розв'язання

Ключові слова: соціальні мережі; чат-бот; вебінари; автоматизовані бібліотечно-інформаційні системи; мобільні додатки; віртуальні тури; гейміфікація

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The issue of electronic document preservation in the context of international information security standards

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Abstract. The relevance of this study is driven by the rapid development of electronic document management and the growing need for reliable digital data preservation amid contemporary cyber threats and technological challenges. The research aimed to conduct a comprehensive analysis of electronic document preservation issues and develop recommendations for implementing effective electronic records management systems in accordance with international standards. The study employed an analytical method to examine international information security standards, a systems approach to conceptualise document preservation processes as an integrated system, a comparative method to analyse different approaches to electronic document preservation, and a case study method to evaluate practical implementations of electronic document management systems. The findings underscored the critical importance of addressing technological obsolescence of data formats, the complexities of electronic document management processes, and data loss risks. Key aspects of managing and preserving electronic records in line with international information security standards were examined. Emphasis was placed on the necessity of implementing comprehensive strategies to ensure the long-term preservation of digital documents. Six core strategic approaches were identified: adherence to international standards; development of holistic policies for document collection, storage, and access; creation of an operational model for digital preservation; implementation of effective data administration and transfer policies; regular system audits and updates; and provision of adequate staff training and education. Attention was given to the potential of emerging technologies such as blockchain and artificial intelligence, which can enhance the efficiency of electronic document preservation. Blockchain ensured integrity, authenticity, and transparency through decentralised record-keeping, while artificial intelligence technologies optimised document classification, indexing, and retrieval, addressing confidentiality concerns. The need to integrate these technologies in compliance with established international standards to guarantee the authenticity, immutability, and persistent accessibility of electronic documents was highlighted. The practical value of this research lies in its recommendations for implementing a set of best practices for electronic document preservation, including regular material assessments, metadata management, and technological infrastructure maintenance. The study's findings can be utilised by organisations to improve their electronic document management systems and enhance information security levels

Keywords: electronic document management; ISO standards; cybersecurity; digital preservation; metadata management; technological infrastructure

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Introduction

In the context of rapid digitalisation spanning 1995-2024, the preservation and protection of electronic documents have been accorded significant importance. At the state level in Ukraine, electronic document management systems have been widely implemented, large-scale digitisation of paper-based and other media documents has been undertaken, and specialised information-communication systems have been established to meet the needs of the country's population.

Under these conditions, the theoretical, methodological, and organisational principles of forming electronic resources, as outlined in the UNESCO Charter on the Preservation of Digital Heritage (2003), have gained particular significance. The Charter defined digital heritage as "a unique repository of human knowledge encompassing cultural heritage originally created in digital form". However, Ukrainian society still insufficiently addressed issues related to the risks of losing photo documents, audio and video recordings, personal or professional correspondence, contacts, files, and other important digitally stored records. These matters played a crucial role in sustainable national development, as state and commercial data were increasingly generated exclusively in digital form, as noted by M. Senchenko (2022).

P. Joseph *et al.* (2012) examined shifts in the documentation management paradigm and their impact on the implementation of the international standard ISO 15489. The authors explored how technological evolution and organisational restructuring alter responsibility distribution for record preservation. The study highlighted challenges associated with the practical application of ISO 15489 and proposed approaches to overcoming institutional barriers. Special attention was devoted to integrating document management systems with other organisational information systems and ensuring compliance with regulatory requirements in document processing.

Challenges in digital preservation included file format management, metadata accuracy assurance, and addressing complexities associated with compound documents. A. Bullock's (1999) research laid the foundational understanding of long-term digital information preservation issues. The author analysed key challenges organisations face, when attempting to ensure the longevity of electronic records, focusing on technological obsolescence, media degradation, and the necessity of maintaining continuous data accessibility.

S. Marulin (2013) proposed developments in information technologies to facilitate efficient data exchange between electronic document management systems and information system databases. The author examined technical aspects of integrating diverse information components and proposed a methodology to optimise data transfer processes. The work addressed issues of format compatibility, data integrity, and information security in inter-system document exchange.

Specific aspects of preserving digital evidence were explored by B. Guttman *et al.* (2022). The researchers provided detailed recommendations for professionals handling electronic documents in legal contexts. The study described methods ensuring the integrity, authenticity, and accessibility of digital evidence throughout its lifecycle, covering critical aspects such as chain of custody, data integrity verification techniques, and strategies for guaranteeing long-term access to digital materials. Compliance with international standards and regulatory requirements was emphasised.

Methods such as technology preservation, emulation, encapsulation, and migration to standardised formats (e.g., XML, ASCII, and PDF/A) were essential for overcoming these challenges and ensuring the prolonged accessibility of digital data. Such a multifaceted approach has become indispensable for maintaining digital documents in a usable form over extended periods, given that the lifecycle of a document's technical format was typically limited to 5-10 years (Information security, n.d.).

Beyond technical aspects of electronic document preservation, semantic protection methods have gained equal importance. Researchers B. Durniak & V. Sabat (2010) examined innovative dimensions of information security in document management systems, focusing on semantic protection methods. The authors analysed issues of ensuring confidentiality, integrity, and availability at the level of document content, presenting theoretical foundations and practical techniques for implementing semantic safeguards to detect unauthorised content alterations and prevent document forgery.

Methodological frameworks for securing electronic document management in hierarchical automated control systems were explored by V. Sabat (2023). The scholar developed theoretical and methodological foundations for information technologies protecting document workflows in hierarchical automated management systems overseeing complex technological processes under active threats and attacks. This has become particularly relevant in the modern era of digital transformation and escalating cyber threats targeting electronic documents and data.

The authors A.L. Cushing & G. Osti (2023) examined the impact of artificial intelligence (AI) technologies on expertise in the field of digital archiving. The scholars also analysed how AI concepts were transforming traditional approaches to digital information preservation, and what new challenges and opportunities it create for archival professionals. The study proposed a conceptual framework for understanding the interaction between human experts and AI systems in the context of digital information preservation. Particular attention

was paid to balancing diverse needs: processing efficiency for large volumes of data, maintaining document authenticity, ensuring accessibility, and protecting confidential information.

The publication by Z. Teel (2024) constituted a significant contribution to research on the application of artificial intelligence technologies for preserving historical archives. The author explored innovative approaches to the digital conservation of cultural heritage using advanced AI algorithms. The study analysed key advantages of AI in archival preservation, including: automation of digitisation and indexing processes for large volumes of historical documents; enhanced accuracy in text and metadata recognition for ancient manuscripts and damaged documents; prediction of digital object degradation and proactive planning of conservation measures; identification of connections and patterns between archival materials, facilitating a deeper understanding of historical context. Special attention was devoted to ethical issues arising from AI applications in archival practice, particularly concerns regarding confidentiality, accurate attribution, and the representativeness of preserved materials. The researcher proposed approaches to ensuring that AI-driven preservation processes comply with international standards and ethical norms. This study was particularly valuable in developing a comprehensive understanding of the role of modern technologies in ensuring the long-term preservation of digital heritage. It complemented the work of A.L. Cushing & G. Osti (2023), which offered a more specialised perspective on the technological aspects of digital preservation of historical documents using artificial intelligence.

The study aimed to examine and systematise methodological approaches to ensuring the long-term preservation of electronic records in accordance with international information security standards.

Materials and Methods

The research employed a comprehensive methodology combining various methods and approaches for a thorough investigation of electronic records preservation within the context of international information security standards. The foundation of the study was the analytical method, which facilitated the examination of international information security standards, particularly ISO 15489-1:2016 (2016) and ISO/IEC 27001:2022 (2022). A systems approach ensured that electronic records preservation processes were considered as an integrated system, where technical, organisational, and regulatory aspects interact and influence one another. The comparative method was used to juxtapose different standards and approaches to electronic records preservation. The case-study method enriched the research with practical examples, including an analysis of the Welsh Journals Project and an examination of the British Library's strategy. An interdisciplinary approach encompassed technical, managerial, and legal dimensions of the research topic. A holistic approach provided a comprehensive examination of the issues, including technological solutions and organisational processes. The predictive approach helped outline future developments in electronic records preservation technologies.

The research strategy was based on documentary analysis of international standards and scholarly publications, examination of practical implementations of electronic records preservation systems, and systematisation of best practices in this field. Given that electronic documentation has become a critical component of business processes across organisations, the need for robust standards to manage these records effectively has emerged. The ISO 15489-1:2016 (2016) standard emphasised the importance of records in business operations and aimed to support electronic records management systems. Furthermore, usability criteria, adaptability across devices, and access control implementation were crucial for maintaining the confidentiality and integrity of sensitive information, as outlined in ISO 14641:2018 (2018). An analysis of ISO 15489-1:2016 (2016) confirmed its fundamental role in shaping modern electronic records management systems. This document, along with the related ISO 14641:2018 (2018), delineated key specifications and organisational policies for the collection, storage, and access to electronic records. This ensured not only access control and record integrity, but also traceability throughout the entire preservation lifecycle. Supporting evidence can be found on the Digital Preservation Coalition (2024) platform, which described the significance of international standards for effective electronic records preservation by organisations.

The ISO/IEC 27000 series, referenced in Publicly Available Standards (2024), constituted information security standards jointly published by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). The Complete List of Cyber Security Standards (n.d.) noted that these standards provided a framework of guidelines to support infrastructure – primarily corporate data centres – in adhering to legal, technical, and physical policies to ensure the confidentiality, integrity, and availability of data stored within them. These standards applied to various forms of electronic records, whether created through scanning, conversion from analogue formats, or generated directly within information systems and electronic records management systems. Additionally, the study examined issues of long-term electronic records preservation and data loss risk management (McLeod, 2008). A key source was an analytical report on the Welsh Journals Project, which highlighted practical aspects of document digitisation (Digital Preservation Case Notes…, 2010).

Institutional strategic documents demonstrated the practical implementation of electronic records

preservation principles. A notable example was the British Library Digital Preservation Strategy (2016), which outlined systematic approaches to digital preservation and identified essential components for long-term storage. Institutional digital preservation strategies and policies were examined in sources such as Digital Preservation Strategy 2022-2026 (2022) and Institutional policies and strategies (n.d.), which provided recommendations for developing and implementing relevant policies. Technological aspects of electronic records preservation and obsolescence challenges were addressed in Preservation issues (n.d.), which analysed various strategies for mitigating technological obsolescence and ensuring long-term access to electronic records.

The research's source base encompassed a wide range of materials, from international information security standards to thematic studies and organisational best practices. This comprehensive approach to source selection provided a robust foundation for developing practical recommendations. The chosen methodology not only facilitated an in-depth analysis of electronic records preservation challenges, but also enabled the formulation of specific proposals for improving existing practices in this field.

Results and Discussion

Electronic records preservation faces numerous challenges that organisations must address to ensure long-term accessibility and integrity of digital content. These challenges can be broadly categorised as issues related to format, storage, and the inherent nature of digital objects. One of the primary challenges in electronic records preservation is the rapid obsolescence of file formats and storage media. Access to digital records is only possible through specific combinations of hardware and software, which may become obsolete within a cycle of no more than three years (ISO 19005-4:2020, 2020). Consequently, organisations must continually migrate digital objects to current formats and media to prevent data loss and ensure uninterrupted access (Guttman *et al.*, 2022). The migration process itself can be complex and costly, often requiring specialised expertise for effective management (McLeod, 2008).

The complexity of electronic processes and their interactions also creates challenges for preservation. Organisations employing intricate systems with numerous interdependencies may require extensive documentation to maintain clarity and control over their processes (Biswas, 2023). Over time, such complexity can lead to difficulties in ensuring the preservation of all components of a digital document in a usable form. Furthermore, during document conversion or migration between formats, there is a risk of losing critically important elements of presentation, functionality, and contextual relationships within the data (ISO 19005-4:2020, 2020).

Data loss poses a significant risk in the field of electronic document preservation. Such loss may occur due to hardware failures, viral, spyware, or unlicensed software, cyberattacks, or human error, potentially leading to severe consequences for organisations, including financial losses, legal complications, and reputational damage. A notable example is the large-scale cyberattack in 2023 on Kyivstar, one of Ukraine's largest mobile operators, with all its negative repercussions. Research by J. McLeod (2008) revealed that 93% of companies that lost their data centres for ten or more days filed for bankruptcy within a year of the disaster, underscoring the urgent need for robust backup, redundancy, and data recovery strategies, as well as enhanced organisational cybersecurity measures and employee cyber hygiene.

Organisations must also navigate a diverse array of legislative and regulatory requirements governing electronic document preservation. Different industries and jurisdictions may impose specific standards regarding documentation practices, necessitating careful consideration during the preservation process. Compliance with these requirements adds another layer of complexity, as organisations must ensure adherence to legal and regulatory frameworks while effectively managing their data preservation efforts. Engaging relevant stakeholders in the data preservation process was crucial yet challenging. Input from various departments and external parties was essential for creating and accurately updating documentation (Biswas, 2023).

However, coordinating such stakeholder involvement can be difficult, particularly in large organisations where multiple stakeholders may have divergent priorities or perspectives. Key issues concerning data/information/document preservation are addressed in international information security standards. These play a pivotal role in establishing guidelines and boundaries that organisations can apply to safeguard their electronic resources/information assets. These standards encapsulate best practices for security risk management, ensuring data confidentiality, integrity, and availability across various sectors.

A. Guz (2013) traced the historical development of global information security standards and analysed their transformation under the influence of technological changes. The work examined key standards in information protection, their interrelationships, and practical applications. Particular attention was devoted to the ISO/IEC 27000 series, which regulated the establishment of information security management systems. This study became an important resource for understanding the evolution of approaches to information security in the modern world.

According to E. Zierau *et al.* (2021), ISO/IEC 27001:2022 was the most widely recognised international standard for Information Security Management Systems (ISMS). It outlined requirements for establishing, implementing, maintaining, and continually

improving an ISMS, emphasising a structured approach to managing an organisation's confidential information through risk management processes. The standard defined three key aspects of information security: confidentiality, integrity, and availability, ensuring that information was accessible only to authorised individuals, remained accurate and unaltered, and was available when needed. Organisations implementing ISO/IEC 27001:2022 (2022) may obtain certification, demonstrating their commitment to secure and effective information management. The Center for Internet Security (CIS) has published widely accepted security benchmarks, serving as configuration guides for various IT systems, including mobile devices, network appliances, and web browsers. These benchmarks have been instrumental for organisations seeking to assess and enhance the security of their IT infrastructure (Teel, 2024).

D. Antonucci (2017) presented a comprehensive approach to cyber risk management in organisations of varying scales. The work explored risk assessment methodologies, mitigation strategies, and cybersecurity best practices. It provided practical recommendations for developing security policies, staff training, and implementing technical information protection measures. Special emphasis was placed on the interplay between risk management and organisational business processes. The book became a valuable resource for executives and information security professionals.

The National Institute of Standards and Technology (NIST) standards were integral to cybersecurity efforts in the US and globally. For instance, NIST SP 800-115, Technical Guide to Information Security Testing and Assessment (2020), established a framework for information security testing and evaluation, assisting organisations in identifying vulnerabilities within their IT systems. The International Standard ISO/IEC 27400:2022 (E) (2022) provided guidelines for Internet of Things (IoT) solutions, addressing security and privacy risks associated with IoT devices and applications. It outlined principles and control measures to effectively mitigate these risks.

The ISO/SAE 21434:2021 (2021) standard focused on cybersecurity in the automotive industry, presenting requirements for cybersecurity risk management and a process framework to help original equipment manufacturers effectively communicate security-related risks. PCI Data Security Standard (PCI DSS) (2024) established security requirements for organisations handling credit card transactions, ensuring that sensitive payment data is protected against breaches and unauthorised access.

Additionally, the OWASP Top Ten 10 2025 (2024) annually published a list of the ten most critical web application security risks, serving as a vital resource for organisations to identify and mitigate vulnerabilities in their applications. The official source has announced the forthcoming release of the Top 10 Web Application Security Risks for 2025. Collectively, these standards contributed to a robust foundation for information security, guiding organisational efforts to protect sensitive data against an ever-evolving cyber threat landscape.

Beyond international standards, thematic case studies were a crucial component of research on this subject. Notably, B. Guttman *et al.* (2022) presented a case study outlining a digital evidence preservation model for criminal forensic institutions. This model emphasised compliance with legal admissibility requirements for court evidence. It included a comprehensive implementation guide, development plans, and outcome assessments, supporting institutions in aligning their digital evidence preservation practices with strategic objectives. The proposed model also enhanced the integrity and admissibility of digital evidence through long-term preservation methods based on the Open Archival Information System (OAIS) model.

Another relevant example was the analytical brief Preservation issues (n.d.), which discussed data preservation. This initiative illustrated the challenges associated with digital preservation, particularly in managing the interests of diverse stakeholders. The project highlighted the necessity of appointing a responsible officer to oversee digital preservation efforts, thereby clarifying responsibilities and ensuring effective leadership across institutional departments. This approach reduced ambiguity often surrounding preservation duties, fostering collaboration and stakeholder engagement. Strategic content sources enabled organisations to structure their own action plans for electronic document preservation, drawing on the experience of others.

The British Library Digital Preservation Strategy (2016) served as a significant practical example, outlining systematic approaches to preserving digital materials. The strategy examined various aspects of digital preservation, including the necessity of identifying components of digital works that required preservation and implementing measures to ensure their long-term survival. It emphasised the adoption of standards and practices facilitating digital content migration, as well as the importance of preserving both original hardware and software to access obsolete data formats (ISO 19005-4:2020, 2020).

A broader analysis of strategies to combat technological obsolescence can be found in the studies by S. Findlay (2018) and S. Findlay (2019), which explored several methods of information preservation. Among these were: migrating information to subsequent generations of technology, emulating the behaviour of legacy software, and maintaining original systems to run obsolete applications. Each strategy presents unique advantages and challenges, necessitating careful consideration of contextual factors to ensure effective long-term digital data preservation (Preservation issues, n.d.).

The Digital Preservation Strategy 2022-2026 (2022) became a foundational document that defined

key directions for the development of digital archiving at a national level. Of particular value was its comprehensive approach to addressing contemporary challenges in electronic records preservation, including issues of technological obsolescence, information security, and data accessibility. The strategy also established clear priorities and objectives to ensure the long-term preservation of the USA's digital heritage, making it an important benchmark for other institutions and organisations in developing their own approaches to digital preservation.

The risks associated with data loss underscored the need for robust data management strategies. In a study by J. McLeod (2008), the potential consequences of data loss were outlined, including financial and reputational damage due to the loss of business documentation or personal information. This highlighted the importance of implementing effective backup, redundancy, and recovery systems as part of any digital preservation efforts to mitigate risks – a point further emphasised by L.G. Paule (2023). Collectively, these thematic studies and strategic sources underscored the interdisciplinary nature of digital information preservation, stressing the significance of strategic planning, stakeholder engagement, and the implementation of best practices to ensure the longevity and integrity of digital information in accordance with international standards.

It was worth examining examples of best practices for effective digital data preservation, which have been crucial in ensuring the long-term accessibility and integrity of digital materials. Key methods included determining which materials should be preserved, ensuring data integrity, and applying technological solutions to combat obsolescence. Preservation strategies must account for the specific challenges posed by digital formats and rapid technological advancements, which may render certain formats obsolete – a point also discussed by S. Findlay (2018) and L.G. Paule (2023). An essential aspect of preservation has been the decision-making process regarding which materials to retain. This involves evaluating the strengths and weaknesses of data collections, particularly in contexts with limited storage capacity. Z. Teel (2024) noted that integrating artificial intelligence could streamline this decision-making process, helping responsible parties identify critical materials that might otherwise be overlooked due to human limitations in processing vast datasets.

The relationship between metadata and content has been fundamental to effective digital preservation. Metadata may be embedded within a digital object or stored separately, as in systems like the Open Archival Information System (OAIS), which proposed the use of "information packages" to combine content with descriptive preservation metadata (ISO 19005-4:2020, 2020). Proper documentation was crucial for maintaining the context and integrity of digital files, facilitating future access and use.

Maintaining a robust technological infrastructure has been essential for digital data preservation. This includes conducting annual audits to verify file integrity, updating storage media, and ensuring redundancy through backup replication. Techniques such as checksums can help verify that files remain unaltered over time (Paule, 2023; Preservation issues, n.d.). Furthermore, establishing a managed storage environment with multiple copies in geographically dispersed locations enhances protection against catastrophic data loss.

Forging partnerships between corporations and archives or libraries has been vital for sharing best practices and developing functional requirements for digital preservation. Such collaborations can lead to the creation of joint governance frameworks that address both immediate and long-term preservation needs in line with ISO 19005-4:2020 (2020). While existing guidelines often focus on the initial creation and capture of digital objects, it is equally critical to consider their ongoing accessibility. Continuous staff training is essential for effectively leveraging the capabilities of emerging digital preservation technologies. Professionals in this field must engage in ongoing career development to adapt to new challenges and methodologies. This entails attending workshops, courses, and exchanges, participating in professional networks, and staying informed about cutting-edge practices and technological advancements (Paule, 2023).

The future preservation of electronic records will be influenced by continuous technological advancements and the increasing complexity of digital records. As organisations grapple with managing vast volumes of data, a proactive approach to records management has become imperative. This approach highlights the importance of developing robust policies and systems to ensure the effective creation, capture, and management of records in alignment with organisational objectives, legal requirements, and regulatory frameworks – particularly ISO 15489-1:2016 (2016) and ISO/IEC 27001:2022 (2022). Consequently, based on the information presented, key trends in the development of electronic records can be outlined, as illustrated in Figure 1. The integration of artificial intelligence (AI) and machine learning into records management practices has created both opportunities and challenges. While AI can enhance efficiency through the automation of processes such as descriptive metadata generation, concerns persist regarding the potential displacement of records management professionals and the implications of over-reliance on automated systems. This has also been noted by P. Joseph *et al.* (2012) and A.L. Cushing & G. Osti (2023). As organisations seek to leverage AI, it is crucial to maintain a balance between technological advancements and the human expertise necessary for effective archival practice.

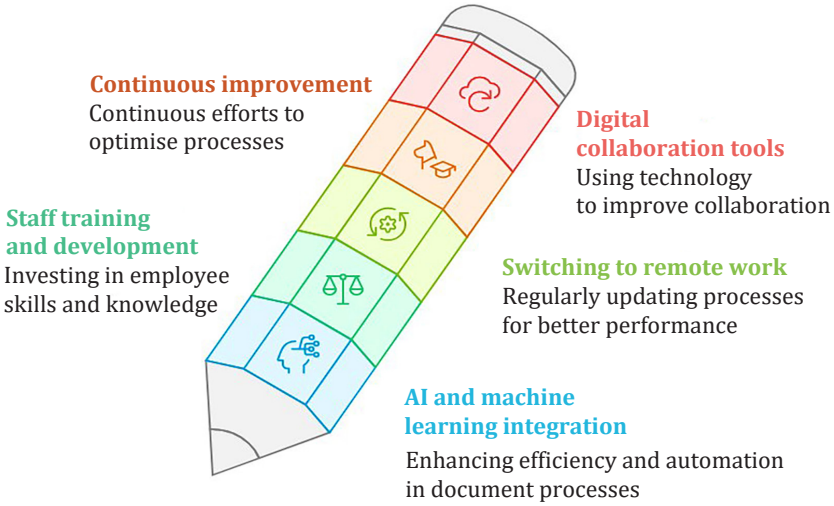

Figure 1. Trends influencing the development of electronic records management
Source: based on L.G. Paule (2023), Z. Teel (2024)

As the regulatory landscape evolves, organisations must remain cognisant of legislative and compliance requirements related to electronic records retention. A practice of continuous improvement, including regular review and updating of documented information management processes, will be essential for organisations to adapt to new regulatory demands while maintaining operational efficiency and adhering to international standards (Mancini, 2009; Biswas, 2023).

The shift to remote work and digital collaboration tools has introduced new challenges in electronic records preservation. Organisations must develop strategies that account for the diverse environments in which records are created and stored, ensuring usability across multiple devices without compromising functionality (Biswas, 2023). Furthermore, as data privacy concerns grow in significance, organisations must implement stringent measures to safeguard sensitive information from unauthorised access while complying with data protection regulations.

To effectively navigate the complexities of modern records management, organisations must invest in staff training and development. P. Joseph *et al.* (2012) noted that fostering knowledge-sharing and upskilling can empower records management professionals, ensuring their preparedness to operate within the evolving landscape of electronic records preservation. According to A.L. Cushing & G. Osti (2023), such investments in human capital will prove decisive as organisations strive to balance technological progress with the need for expert oversight in records management.

Preserving electronic records in accordance with international information security standards has presented organisations with numerous serious challenges. These challenges have been compounded by the rapid pace of digital transformation and the shifting compliance requirements landscape. One major issue has been data loss. As organisations increasingly transitioned to digital environments, the risk of losing valuable digital content became more pronounced. This has been emphasised in the works of I. Ismaili & R. Sülçevsi (2015) and L.G. Paule (2023). Data loss could occur due to various factors, including hardware failures, software corruption, accidental deletion, and cyberattacks. This underscored the necessity for robust backup and recovery strategies to ensure the longevity of digital records.

Another critical concern has been file format and software obsolescence. Over time, digital file formats and the software required to access them may become obsolete, complicating or even preventing access to archived records. Organisations must proactively engage in data migration processes to transfer information from obsolete formats into contemporary ones, ensuring continued accessibility. Compliance with ever-changing regulatory requirements also poses a significant challenge. International information security standards and industry regulations are continuously updated to address emerging threats and technologies (McLeod, 2008; Ismaili & Sülçevsi, 2015). Organisations must keep pace with these changes and adapt their information preservation strategies accordingly. Non-compliance with these standards may result in legal repercussions, financial penalties, and reputational damage.

Another issue has been the interoperability of diverse systems within and beyond organisational environments. Adherence to relevant standards facilitates regulatory compliance and ensures compatibility in digital preservation efforts across different platforms and sectors. Such interoperability is crucial for maintaining the integrity and accessibility of electronic records in the long term. According to B. Guttman *et al.* (2022), organisational challenges, such as insufficient resources and a lack of digital preservation expertise, may hinder

effective implementation. Developing and maintaining a digital preservation strategy requires substantial investments in technology, personnel, and training. Organisations must prioritise these efforts to safeguard their digital assets.

The management and preservation of electronic records have become critical for historical documentation and the protection of state and citizen interests, as noted by E. Zierau *et al.* (2021) and P. Biswas (2023). For instance, institutions must ensure the identification of vital records and their transfer to appropriate archival bodies for long-term preservation, such as the U.S. National Archives and Records Administration (NARA). Thus, preserving electronic records in line with international information security standards has entailed addressing challenges related to data loss, format obsolescence, regulatory compliance, system interoperability, and resource allocation (Fig. 2).

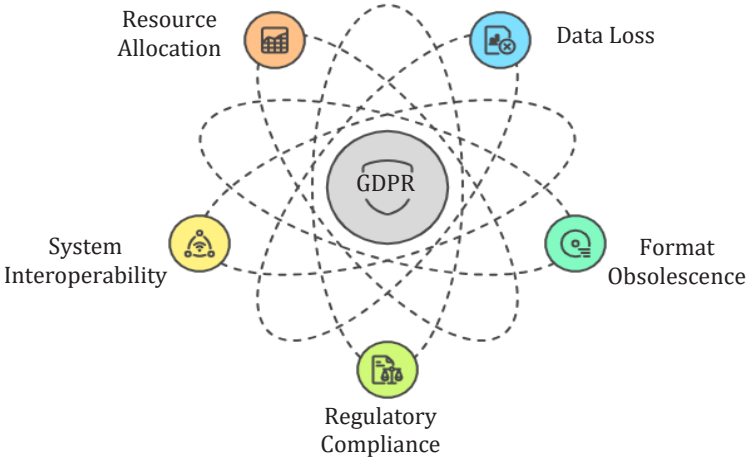

Figure 2. Challenges addressed by international standards
Source: based on E. Zierau *et al.* (2021), P. Biswas (2023)

By acknowledging these challenges and implementing comprehensive preservation strategies, organisations can safeguard their valuable digital content and ensure its accessibility for future generations. Specific strategies or best practices may be recommended to organisations to ensure the long-term preservation of electronic records in compliance with international information security standards. To guarantee the long-term preservation of electronic records, while adhering to international information security standards, organisations must adopt a holistic strategy encompassing both technical specifications and organisational policies. Several specific strategies and best practices were presented in Table 1.

Table 1. Strategies and best practices for electronic records preservation

No.	Strategy/Practice name	Description	Relevant standards & sources
1	Compliance with standards	The use of robust and up-to-date standards fundamental to the information industry. This facilitates access, retrieval, and exchange of digital resources, as well as their long-term preservation	ISO 14641:2018 (2018)
2	Comprehensive policies for records collection, storage, and access	Implementation of policies for the collection, storage, and access to electronic records, ensuring their integrity and traceability over extended periods. Such policies apply to records from diverse sources: scanned paper documents, converted analogue audio/video content, and digitally born content	I. Ismaili & R. Sülçevsi (2015), ISO 19005-4:2020 (2020)
3	Development of an operational model for digital preservation	Organisations should develop an operational model incorporating both industry-specific and universal standards to support digital preservation. Such a model ensures compliance and interoperability across different systems, while adherence to standards enables organisations to undergo auditing and certification	ISO 14641:2018 (2018)
4	Data administration and transfer policy	Establishment of a clear data administration and records transfer policy to ensure secure handling of electronic records throughout their lifecycle. The policy supports the transfer of records and databases in a manner that guarantees their long-term accessibility and integrity	B. Guttman *et al.* (2022)

Table 1. Continued

No.	Strategy/Practice name	Description	Relevant standards & sources
5	Regular auditing and updating	Conducting regular audits to ensure ongoing compliance with relevant standards and adaptation to evolving requirements. This includes monitoring updates to standards and integrating them into organisational policies and operational models	J. McLeod (2008), B. Guttman *et al.* (2022)
6	Education and training	Providing staff training on the importance of digital preservation and the specific policies and procedures they must follow	B. Guttman *et al.* (2022)

Source: developed by the authors

Thus, the study identified key standards ensuring the preservation of electronic records within the context of information security. Figure 3 presented the standards that safeguard information security in electronic records management, highlighting core provisions related to preservation, protection, and governance of electronic records.

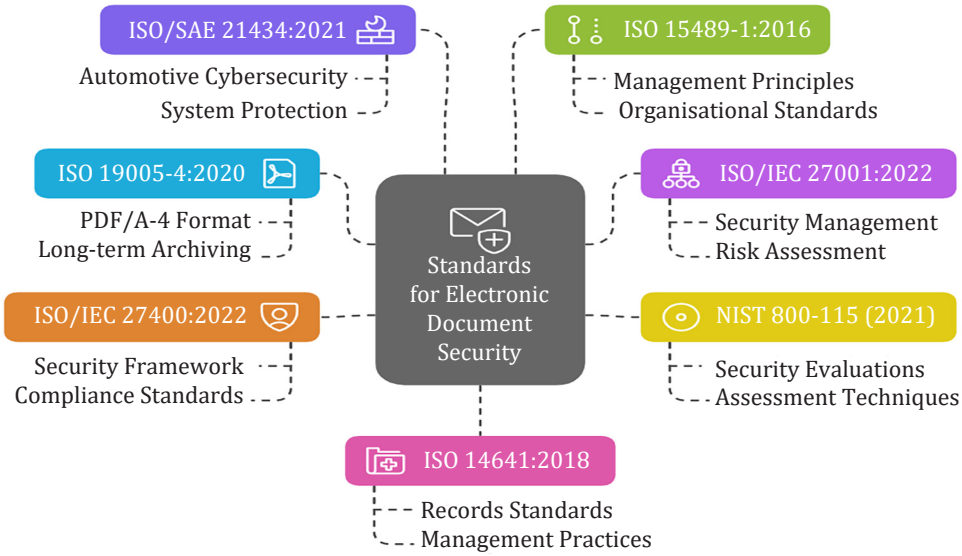

Figure 3. Key data of the electronic document security and management standard
Source: based on ISO 19005-4:2020 (2020), NIST SP 800-115, Technical Guide to Information Security Testing and Assessment (2020), ISO/IEC 27001:2022 (2022)

The capabilities of emerging technologies, such as artificial intelligence and blockchain, were designed to enhance the preservation of electronic documents in compliance with international information security standards. Blockchain technology has introduced a transformative approach to document management by ensuring the integrity, authenticity, and transparency of digital records. Blockchain employed a decentralised and immutable ledger system, where records were sequentially organised and cryptographically linked. This decentralised nature reduced the risk of unauthorised alterations and fraud, thereby preserving document integrity and traceability. The append-only nature of blockchain made it ideal for maintaining a verifiable record of document changes, ensuring compliance with standards such as ISO 14641:2018 (2018). Furthermore, blockchain can be integrated with existing document management systems to enhance their security and transparency. Organisations adopting blockchain for document management benefit from reduced risks associated with centralised data storage, as distributed ledger technology eliminates single points of failure (ISO 19005-4:2020, 2020).

Artificial intelligence (AI), including its subfields such as machine learning and natural language processing, can assist in various aspects of digital preservation management. AI technologies can automate document classification, indexing, and retrieval, thereby improving accessibility and efficiency. For instance, AI algorithms can analyse large volumes of documents to detect patterns and metadata, facilitating better organisation and search processes for required information or causal relationships within data. AI has also played a role in addressing privacy concerns by implementing automated redaction and anonymisation of sensitive information before documents are archived. Additionally, AI-based tools can support archivists by providing insights and recommendations, though human

oversight remains crucial to ensure ethical governance and contextual accuracy (Paule, 2023).

The integration of these technologies must align with established international information security standards. For example, the ISO 14641:2018 (2018) standard defined technical specifications and organisational policies for the collection, storage, and access of electronic documents to ensure their readability, integrity, and long-term traceability (Zierau *et al.*, 2021). Blockchain and AI can support compliance with these standards by ensuring that electronic documents remain authentic, unaltered, and accessible throughout their lifecycle. Thus, the combination of blockchain's immutable ledger and AI's automation capabilities can enhance electronic document preservation.

K. Sibil (2005) analysed the role of international descriptive standards ISAD(G) and ISAAR(CPF) in shaping a unified information space. The author examined the structure and application principles of these standards for archival description and the creation of standardised hierarchical metadata systems. The study highlighted mechanisms for ensuring compatibility between archival descriptions across institutions through the use of standardised approaches. This work contributed valuable insights into the fundamental principles of international standardisation in the archival field.

The authors S. Artamonova & L. Odynoka (2009) explored the role of national standards in unifying technological processes within reference libraries of archival institutions. The authors analysed practical aspects of applying standards to streamline document handling, optimise search systems, and ensure the preservation of collections. They also examined prospects for developing standardisation systems to integrate library and archival resources. The study demonstrated the interconnectedness of various branches of information activity within the context of standardisation.

L. Kyseleva (2012) examined European standards in archival science and records management within the framework of public administration. The author discussed key principles and requirements of European standards, their impact on the development of the archival sector, and governmental documentation management processes. The study included recommendations for implementing European approaches in Ukrainian contexts. S. Purser (2014) analysed the role of standards in cybersecurity and their practical application for protecting computer networks. The study reviewed key international and industry-specific standards, their interrelations, and evolution. It emphasised the importance of standardisation in developing effective incident detection and response systems. The work also examined future prospects for cybersecurity standards in light of emerging threats, offering valuable insights for professionals involved in designing and implementing information protection systems.

Scientists G. Kalinicheva & R. Romanovskyi (2015) investigated the harmonisation of international archival standards in Ukraine. The authors analysed challenges in adapting ISO standards to Ukrainian contexts, addressing improvements in regulatory frameworks for records management. The study provided an overview of achievements and future directions for national standardisation systems within Ukraine's integration into the European information space, with particular attention to practical implementation in Ukrainian archival institutions.

Data cybersecurity is also of critical importance. A. Davydiuk & O. Potii (2024) published a report as part of a series of national reports providing a comprehensive overview of cybersecurity governance across countries. Their research aimed to raise awareness of cybersecurity management in different national contexts, assisting countries in improving internal cybersecurity governance, promoting best practices, and fostering interagency and international cooperation. The report focused on NATO member states sponsoring the NATO Cooperative Cyber Defence Centre of Excellence (CCDCOE). Each national report outlined the distribution of roles and responsibilities in cybersecurity among institutions, describing their mandates, tasks, and competencies, as well as interagency coordination. The report also contextualised the broader digital ecosystem of each country and outlined national cybersecurity strategy objectives to clarify the organisational approach within specific states.

Conclusions

The preservation of electronic documents was a critical challenge for modern organisations, requiring a comprehensive approach aligned with international information security standards. The study identified several key aspects of this issue. In particular, the primary challenges in electronic document preservation included technological obsolescence of data formats and storage media, complexities in electronic records management, data loss risks, and regulatory compliance requirements. Data loss emerged as a particularly critical issue, potentially leading to severe consequences for organisations, including financial losses and reputational damage. International standards played a foundational role in establishing effective electronic document management systems. These standards provided a structured approach to safeguarding information assets and ensuring long-term document preservation.

Successful electronic document preservation required the implementation of best practices, including regular material assessments, proper metadata management, reliable technological infrastructure, and continuous staff training. Collaboration between organisations and adherence to standardised preservation approaches were also essential. Future developments in electronic document preservation were linked to the

integration of cutting-edge technologies, such as AI and machine learning, which can significantly enhance documentation management efficiency. However, maintaining a balance between technological innovation and expert oversight remains crucial.

Ultimately, the study underscored the need for a proactive approach to electronic document management, encompassing clear policy development, investment in technological infrastructure, and continuous process refinement in response to evolving cyber threats and regulatory demands. Thus, effective electronic document preservation required a systemic approach combining technological solutions, organisational policies, and compliance with international information security standards.

Further research in this field should focus on examining the impact of emerging technologies on document preservation practices and developing innovative approaches to ensuring long-term access to electronic information.

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None.

Conflict of Interest

None.

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Питання збереження електронних документів у контексті міжнародних стандартів інформаційної безпеки

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Анотація. Актуальність дослідження зумовлена стрімким розвитком електронного документообігу та зростаючою потребою у забезпеченні надійного збереження цифрових даних в умовах сучасних кіберзагроз та технологічних викликів. Мета дослідження полягала у комплексному аналізі проблем збереження електронних документів, розробці рекомендацій щодо впровадження ефективних систем управління електронною документацією відповідно до міжнародних стандартів. У дослідженні використано аналітичний метод для вивчення міжнародних стандартів інформаційної безпеки, системний підхід для розгляду процесів збереження документів як цілісної системи, порівняльний метод для аналізу різних підходів до збереження електронних документів, метод кейс-стаді при розгляді практичних прикладів впровадження систем електронного документообігу. Отримані результати продемонстрували критичну важливість врахування технологічного старіння форматів даних, складності процесів електронного документообігу та ризиків втрати даних. Розглянуто ключові аспекти управління та збереження електронних записів відповідно до міжнародних стандартів інформаційної безпеки. Наголошено на важливості впровадження комплексних стратегій для забезпечення довгострокового збереження цифрових документів. Було визначено шість основних стратегічних підходів: дотримання міжнародних стандартів; розробка комплексних політик збирання, зберігання та доступу до документів; створення операційної моделі для цифрового збереження; впровадження ефективної політики адміністрування та передачі даних; проведення регулярного аудиту та оновлення систем; забезпечення належної освіти та навчання персоналу. Було приділено увагу потенціалу новітніх технологій, таких як блокчейн та штучний інтелект, які можуть застосовуватися для підвищення ефективності збереження електронних документів. Блокчейн забезпечує цілісність, автентичність і прозорість через децентралізовану систему обліку, а технології штучного інтелекту оптимізують класифікацію, індексування та пошук документів, вирішують проблеми конфіденційності. Зазначено необхідність інтеграції цих технологій відповідно до встановлених міжнародних стандартів для забезпечення автентичності, незмінності та постійної доступності електронних документів. Практична цінність дослідження полягає у розробці рекомендацій щодо впровадження комплексу найкращих практик збереження електронних документів, включаючи регулярну оцінку матеріалів, управління метаданими та підтримку технологічної інфраструктури. Результати дослідження можуть бути використані організаціями для вдосконалення власних систем електронного документообігу та підвищення рівня інформаційної безпеки

Ключові слова: електронний документообіг; стандарти ISO; кібербезпека; цифрове збереження; управління метаданими; технологічна інфраструктура

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Digitisation of genealogical documents based on automatic text recognition technology

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Abstract. This study aimed to examine existing approaches and technologies for the digitisation of genealogical documents, drawing on international experience. This enabled more efficient organisation of digitisation processes and mechanisms for archive groups, their centralised storage, accelerated genealogical research, and improved user accessibility. The digitisation of archives had became a critically important aspect of preserving cultural heritage, particularly in the context of Russia's military aggression against Ukraine. The introduction of automatic text recognition technology had contributed to the optimisation of this process, facilitating access to information and enhancing the efficiency of research, particularly in the field of genealogy. The study analysed the operating principles of optical character recognition, its advantages, the features of ready-made solutions, and the functionality of software based on this technology. The strategy for digitisation in Ukraine was assessed, along with the challenges facing the archival sector in terms of digitisation and access to archive groups. The research also examined the outcomes of implementing automatic text recognition in leading archives worldwide, as well as the capabilities of online archives that offered contextual search functions. Particular attention was given to the opportunities afforded to researchers through the integration of such systems into archival operations, notably the ease of locating required information, the increased speed of data processing, and the provision of round-the-clock access to archival resources regardless of users' geographical location. The study also reviewed the research of scholars involved in the development and implementation of optical character recognition in archival institutions. Drawing on international experience, the potential of modern Optical Character Recognition technologies to modernise the archival sector in Ukraine was identified, with positive implications for genealogical research and the preservation of cultural heritage. The practical value of the study lies in demonstrating the effectiveness of information technologies in improving the digitisation process of archival documents and enhancing access to them. The proposed recommendations aim to optimise the organisation of digital archives, improve document storage and retrieval processes, and accelerate genealogical research. These developments will contribute to the preservation of cultural heritage and improve access to archival information for users

Keywords: archive group; scanning; genealogical research; Optical Character Recognition; information technologies; automation

Introduction

Since the late 1990s, there is been a big increase in interest in family history research worldwide, thanks to online services like Ancestry.com and FamilySearch. This trend started in Ukraine around 2010. Because of this, looking after, organising, and making archival documents accessible has become a really important part of how archives were developing (Logvynenko *et al.*, 2024). Ukraine had a huge number of unique and valuable archive groups that held information about historical figures. With Russia's aggression, these

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groups were at risk, making it really important to efficiently turn them into digital copies and allowed people to access them remotely.

The issue of using text recognition technology and how well it works with Ukraine's archive groups has been looked at by K. Lipianina-Honcharenko *et al.* (2024). They pointed out how particularly effective it was and the need for more research. N. Korzhyk *et al.* (2023) noted that the work of archival institutions in Ukraine has faced challenges due to Russia's military aggression, including the destruction of buildings and the loss of some archive groups. Because of this, it was necessary to took several steps to preserve documents, which included speeding up the process of making archive groups digital. I. Khoma *et al.* (2023) highlighted that making documents digital was really important for protecting cultural heritage, education, and engaging with history. Digitising archives helped to keep and promote valuable cultural resources, made research easier, and allowed more people to access historical documents and other materials. O. Artemenkova (2022) looked at the theoretical ideas and methods developed by leading archival experts in Ukraine regarding the information tools used to improve, how effectively family history research was done. The academic O. Artemenkova (2023) also considered the role of information technology as a key tool for making family history research more popular in Ukrainian archives and argued for the need to create a single platform for accessing digitised family history data. The author identified, how archive websites work, categorised family history resources, and clarified the terminology used. The findings were important in practical terms as a foundation for making archival work digital, improving communication, and preserving national memory.

The author L. Kovalska (2019) analysed, how important looking back at the past through access to archival documents was for the development of Ukrainian society, stressing the significance of new methods in making archival information more widely available. The academic identified the need to introduce automated and online information systems to improve the quality of archival services and the development of archival practices, which opened up new possibilities for social communication. O. Rybachok (2018) identified the role of UNESCO and international organisations in creating strategies and methodological approaches for developing joined-up digital resources and also researched the historical background and stages of development of documentary cultural heritage in an international context. M. Friedewald *et al.* (2024) analysed the impact of digitisation on the accessibility of archival documents in the digital age, finding positive results such as improved ease of access and reduced burden on users. However, only a small part of archive groups had been digitised, highlighting the need for further efforts in this area. One of the main problems was data protection and copyright, which created legal restrictions and uncertainties, as well as challenges with the compatibility and organisation of digital records. For the effective preservation and access to digital collections, collaboration between archival institutions and new groups of users was important, as was the use of artificial intelligence technologies to improve metadata processing.

J. Nockels *et al.* (2024) developed guidelines to help researchers, data providers, platforms, and institutions understand, how the results of handwriting recognition technology interact with the wider information environment. The researchers found that the technology made it easier to access more materials, including languages that were at risk of disappearing. This allowed for a new focus on personal and private materials (diaries, letters), broadens access to historical voices not usually included in historical records, and increases the amount and variety of available material. A.L. Silva & A.L. Terra (2023), using Europeana as an example, noted that using the principles of linked data had a positive effect on the speed of digitisation and the preservation of cultural heritage for libraries, archives, and museums.

This research aimed to highlight the advantages of using automatic text recognition technologies, drawing on global experience in digitising genealogical documents. The scientific novelty of the study lies in determining the impact of automatic text recognition technologies on the speed of digitising archive groups and the effectiveness of conducting genealogical research based on the experience of leading archival institutions.

Materials and Methods

The research methodology was based on general scientific methods of analysis and synthesis, methods of comparative and content analysis of academic literature, and the use of modelling, grouping, and generalisation methods. The analysis of scientific publications and legal documents helped to identify current trends in the digitisation of archival documents, particularly in the field of genealogical research. A content analysis was carried out on academic articles, reports from archival institutions, and technical documentation regarding the implementation of automatic text recognition technologies (OCR – Optical Character Recognition). The stages of the research were:

- analysis of literature on the digitisation of genealogical documents using automatic text recognition technologies, which allowed for the formulation of the main approaches and problems in this area;
- study of the current state of digitisation processes of archive groups in Ukraine, including an examination of existing archival systems and infrastructure for document digitisation;
- familiarisation with the theoretical aspects of OCR technologies, explaining their operating principles, algorithms, and application possibilities;

- analysis of existing OCR-based solutions, studying their functional capabilities as well as limitations that affect the effectiveness of their use for processing archival data;
- examination of the experience of leading archival institutions and their practices in implementing and using OCR, as well as an evaluation of the effectiveness of online archives in improving access to archival documents and optimising genealogical research.

The main method for gathering materials was bibliographic and internet research, which allowed for an understanding of existing archive digitisation strategies in Ukraine and abroad. For the comparative analysis, several international archival institutions were selected, including the Arolsen Archives, the National Archives of the Netherlands, the National Archives of Zurich, and the National Library of Finland, all of which have implemented OCR technologies and capabilities for processing genealogical documents. Documentation from companies developing OCR technologies was also studied, and their technical features, particularly the possibilities for automating data processing, were analysed.

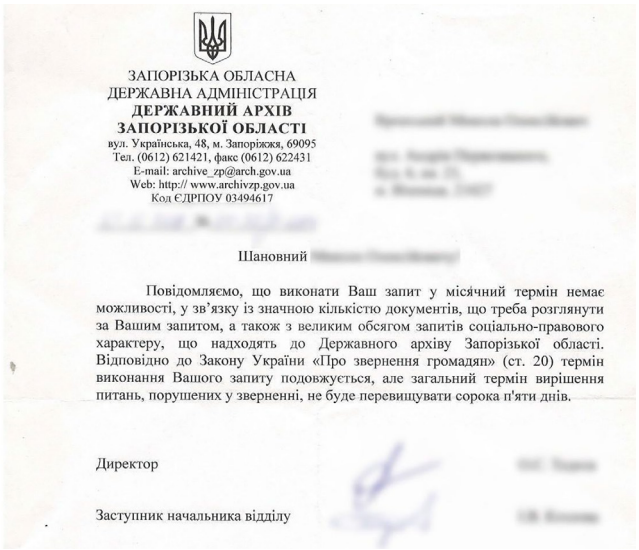
For the research, the Strategy for Digital Transformation of Ukraine was analysed. This Strategy outlined the directions for the development of digital services in the public sector, including the creation of a unified electronic archive and improved access to archival data. The Strategy also involved the implementation of digital technologies to simplify access to information and increase management efficiency (Order of the Cabinet of Ministers of Ukraine No. 1353-r, 2020). Furthermore, the work plan of the Ministry of Digital Transformation for 2023 was examined, which included measures for the development of open data and the improvement of legislation for the digitisation of archives (Report on the implementation…, 2023). These documents helped to outline the key directions for the development of archival practice in Ukraine.

Methods of grouping and generalisation were used to systematise and classify data related to the digitisation of archives and the implementation of OCR technology. Grouping allowed for the organisation of information according to specific criteria, such as types of archival documents, digitisation technologies, and the countries and institutions implementing these tools. Generalisation helped to formulate overall conclusions regarding the effectiveness of using OCR in genealogical research and to identify the main trends and challenges in the processes of digitising archive groups. The results of the research highlighted the advantages of a centralised implementation of OCR in institutions.

Results and Discussion

In line with the Strategy for Digital Transformation of Ukraine, digital services provided by government bodies and institutions were actively developing. One aspect of this strategy was information accessibility, specifically ensuring the retro-conversion of existing paper-based primary documents, including those in archives, to create a single, centralised electronic archive (Order of the Cabinet of Ministers of Ukraine No. 1353-r, 2020). For example, according to this policy, the Ministry of Digital Transformation set the following goals for 2024: 100% of public services should be accessible to citizens and businesses online, 95% of transport infrastructure, populated areas, and their social facilities should have access to high-speed internet, 6 million Ukrainians should be involved in digital skills development programmes, and the share of IT products in the country's GDP should be at least 10% (Digital transformations in Ukraine…, 2020). According to the work plan of the Ministry of Digital Transformation of Ukraine for 2023, measures were planned in the area of open data development, their compliance with European legislation, and the improvement of legislation in the field of public electronic registers and their implementation (Report on the implementation…, 2023).

The digitisation of archival documents and fonds was a pressing issue. It will allow for the preservation of documents from negative external factors (physical damage, loss, destruction) and provide the possibility of quick, free, and transparent access to documents (Onuchak, 2024). These factors will positively contribute to the development and simplification of genealogical research through the possibility of remote access to the archive groups of institutions and the ability to search quickly using information retrieval systems. This will allow a researcher, based on a search query, to receive all records held in archival institutions that mention the required surname within a specified period. This was unlike the current procedure, which involved writing a request to each individual archival institution, where documents might potentially be located and waiting 30 days for the request to be processed. Additionally, it should be noted that if a certain number of requests were exceeded, for example, 10 archival references simultaneously, the archive may extend the processing time for that request from 30 to 60 days (Fig. 1).However, as of 2024, there was not a unified strategy for the methods of processing digitised documents, their storage, and the analysis of data obtained from archive groups. Each archival institution had its own mechanisms for digitising archival documents, which could include scanned copies with added information about the document, photographs, or manually typed documents. To solve the problem of access to archive groups, optimise genealogical research, speed up the digitisation of archival documents, and simplify their search, Optical Character Recognition technology can be used (What is optical character…, 2024).



ЗАПОРІЗЬКА ОБЛАСНА
ДЕРЖАВНА АДМІНІСТРАЦІЯ
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Шановний

Повідомляємо, що виконати Ваш запит у місячний термін немає можливості, у зв'язку із значною кількістю документів, що треба розглянути за Вашим запитом, а також з великим обсягом запитів соціально-правового характеру, що надходять до Державного архіву Запорізької області. Відповідно до Закону України «Про звернення громадян» (ст. 20) термін виконання Вашого запиту подовжується, але загальний термін вирішення питань, порушених у зверненні, не буде перевищувати сорока п'яти днів.

Директор

Заступник начальника відділу

Figure 1. Example of an archive extending the processing time for a request
Source: State Archive of Zaporizhzhia Region (2024)

Optical Character Recognition was a set of technologies that converted images of text into a machine-readable text format. For example, it can turn a scanned archival document into text data that can be analysed by other software. This allowed access to all the data in the document, the ability to edit it, search for text fragments, and automate search processes based on the document's metadata. The principle of how OCR technology works involved the following stages: image acquisition, pre-processing, text recognition, conversion to text format, and saving the results obtained (Fig. 2).

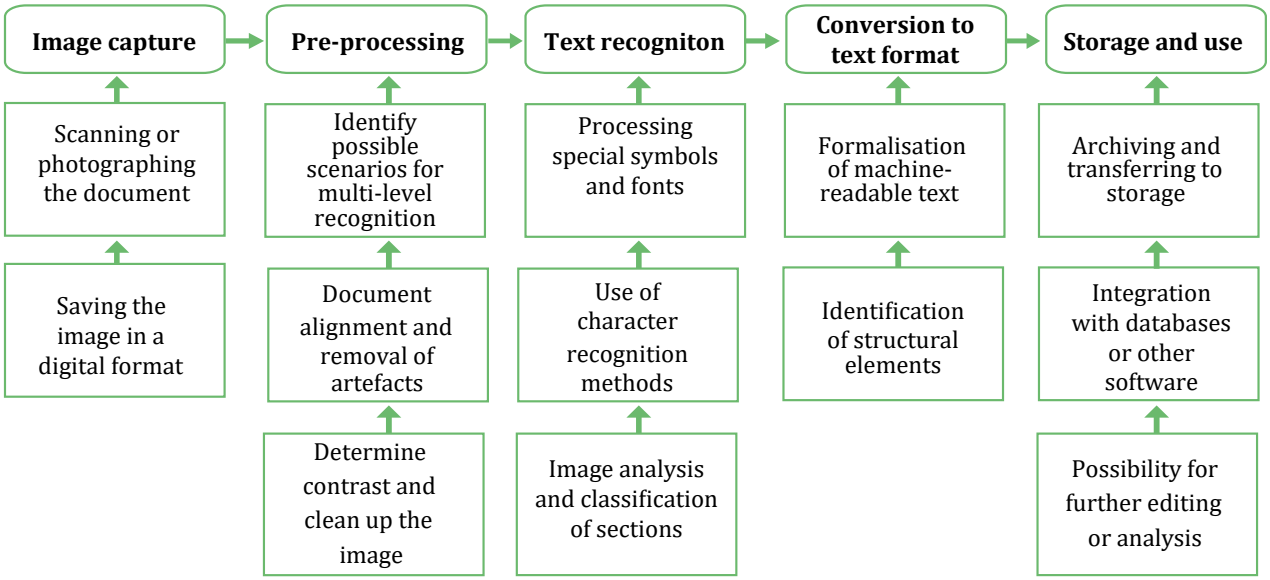

Figure 2. The process of digitising a document using OCR
Source: based on What is OCR (Optical Character Recognition)? (2024), What is optical character recognition (OCR)? (2024)

To obtain the image, all necessary documents were scanned. Next, the OCR system converted the digital document into a two-colour or black-and-white version. The resulting image was analysed for light and dark areas, where the programme subsequently identified the dark areas as characters to be recognised and the light areas as the background (What is optical character..., 2024). In the pre-processing stage, the document was cleaned of unnecessary pixels. This involved correcting skew to fix any misalignment of the image during scanning and removing graphic lines and frames that were part of the printed image (What is OCR

(Optical Character Recognition)..., 2024). It was worth noting that this process was very important, when processing archival documents, as the paper usually loose its properties over time and became thinner, leading to more digital noise. Parts of symbols from the reverse side of the document may also be present.

Text recognition involved the identification and processing of letters, numbers, or symbols. This stage typically targeted one character, word, or block of text at a time. The characters were then identified using one of two algorithms: pattern recognition or feature recognition. The elements were identified through one of the following algorithms:

- pattern recognition (or pattern matching): the OCR was pre-trained on examples of text in various fonts and formats to recognise characters by comparing them to a template in the digital document or image file. Each unique combination of shape, size, and font was called a glyph. For this to work, the characters had to be in a font that the OCR programme had already been trained on;
- feature recognition (detection or extraction): this was used, when the OCR programme analysed a font it had not been trained on. The OCR applied rules about the specific characteristics of a particular letter or number to recognise characters in the digital document. Features included the number of lines at an angle, line intersections, loops, or curves in a symbol. For example, the capital letter "A" was stored as two diagonal lines intersecting with a horizontal line in the middle. Once a symbol was identified, it was converted into an American Standard Code for Information Interchange (ASCII) code, which computer systems used for further manipulation (What is optical character..., 2024).

Subsequently, OCR analysed the structure of the obtained image. During this process, the page was divided into elements such as blocks of text, tables, or images. The lines were then split into words and subsequently into characters. After the characters were extracted, the programme compared them to a set of image templates. Once all possible matches were processed, the programme returned the recognised text (What is optical character..., 2024).

After all the image processing steps were completed, depending on the capabilities and features of the software, it was possible to preview the results and make certain corrections to the resulting text or to run the analysis again with a different set of parameters. This stage was important for ensuring the high quality of the final text, as it allowed the user to identify and correct any errors that may have occurred during the automatic recognition, especially in the case of handwritten documents, where certain elements could be mistakenly identified as digital noise. The resulting text was saved to a digital file, which was then archived and stored.

Using OCR offered the following advantages: reduced costs for searching, providing, and analysing documents, when requested; faster processes for conducting genealogical research, specifically reducing the time to obtain and search documents with the possibility of context-based searching across all available digitised archival groups; centralisation and standardisation of data format and the ability to export it in various formats (JSON, CSV, SQL tables, machine-readable text) for further use; and the ability to store data in cloud storage or remote servers, protecting data from fire, loss, or damage, as well as quick copying to electronic media if needed (What is optical character..., 2024). There are several popular software solutions based on OCR:

- Tesseract – a neural network-based software tool focused on online recognition as well as character pattern recognition. The programme can recognise over 100 languages, including Ukrainian, and supports various input data formats. Advantages include the fact that it is free, open-source software with the ability to modify it and add new languages. Disadvantages include the lack of a graphical interface (third-party solutions are needed for this) and the complexity of installation and configuration (Tesseract OCR, 2024).
- OCR4all – free software designed for working with handwritten documents, but it can also handle printed text. The workflow is structured so that all operations and tools are in one consistent interface and are as user-friendly as possible. A drawback is the need to create a language model for Ukrainian (User guide – introduction, 2024).
- Google Cloud Vision and Document AI – solutions from Google that allow for text recognition in documents and also use AI to create workflows for analysing, describing, and structuring documents. They have very well-written documentation and a user-friendly interface, with Ukrainian language support, but are fully paid software products (Vision AI: Extract insights from..., 2024).
- Transkribus – a platform that enables automatic text recognition, editing, collaboration, and, if necessary, the training of specialised artificial intelligence to digitise and interpret historical documents of any kind. Transkribus already has a pre-trained model for Ukrainian handwriting. The platform offers 100 free scans each month, after which scans become paid, but they have individual organisational plans for scientific and cultural institutions that include more features (Unlock the past with Transkribus, 2024).
- Amazon texttract and Amazon rekognition – these are machine learning services that use OCR to automatically extract handwritten text and data from scanned documents. The service can also analyse distorted text and attempt to normalise it (Amazon rekognition, 2024).
- IBM cloud pak for business automation – this is a modular suite of integrated software components designed for work automation. It includes a Document Processing module that allows for obtaining data from

documents regardless of format, classifying them, and finding and interacting with the necessary fields within the document. The main disadvantage is the price and the need to purchase the entire software package (IBM cloud pak for..., 2022).

The Arolsen Archives was an international centre on Nazi persecution, whose mission was to protect documents and preserve them for future generations. This involved digitisation, preservation, the addition of keywords, and detailed archival descriptions to make them more suitable for a wide range of purposes, including historical research, genealogical research, and searching in the online archive. Since 1998, staff have been digitising documents in Bad Arolsen. As of 2024, between 85% and 90% of the groups have already been scanned – a rate that only a small number of other archives can match. Digital documents and processes not only help to speed up the process of responding to enquiries, but they also provided much better access to documents, whether in the reading rooms in Bad Arolsen, on the premises of selected partner institutions, or in the Bad Arolsen online archive. The archive actively indexed documents due to the significant number of enquiries from journalists, academics, and educators, who were interested in key topics, specific locations, nationalities, or victim groups. Because of this, they have actively started using OCR to record the entire content of documents. Private companies such as the genealogical portal Ancestry have also been involved, which facilitates the quick and easy searching of as many documents as possible. In 2019, Ancestry processed lists of displaced persons as well as a large collection of Allied documents about formerly persecuted individuals, making them easier to find in the online archive (Documentation and archiving, 2024).

The Arolsen Archives have organised a user-friendly online archive, where individuals can search for information by topic, full name, or specific words within documents, thanks to completed descriptions or the prior processing of documents using OCR. There was a convenient filter that allowed users to refine their search query (Fig. 3). It was possible to download a search report with information on the filtered records. As an additional feature, users can leave comments on records and share them via social media. When clicking on a relevant record, a detailed card was displayed with the full title, reference link and code, document creation date, number of documents, volume and content of the collection, the direct source of acquisition or transfer, the language of the documents, subject indexes, and an annotation with usage rules, as some documents may have been transferred to the archive by other institutions.

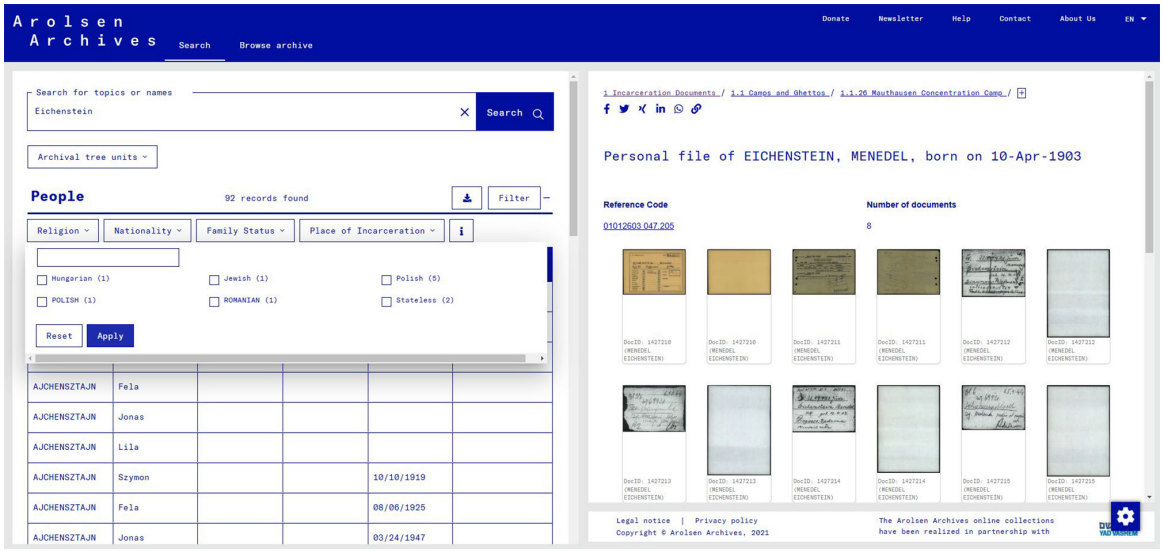

Figure 3. Example of a surname search query in the Arolsen Archives
Source: based on Documentation and archiving (2024)

An example of the successful use of technologies based on automatic text recognition in state archives and specific archive groups was the experience of the State Archives of Zurich, which digitised more than 50000 pages of Zurich council meeting minutes from the 18th century using the Transkribus programme (Unlock the past with Transkribus, 2024). To train the model, the following strategy was developed: for each volume of material, 1-2 pages were transcribed manually as training material, and the remaining pages were recognised based on the information obtained. Due to the inconsistent fonts, the automatic recognition of handwritten text in the initially processed 18th-century volumes showed an error rate of 5 to 8%, which provided both good searchability and good readability. In the edited volumes up to 1700, the error rate was 3%-5%. Digital documents can be viewed and accessed through the online catalogue of the Zurich Archives,

where it was possible to search by text or by category (Zurich council manuals 1642-1798, 2024).

On the archive's webpage, a search function was implemented with various parameters, including keywords, contextual search within the documents themselves, tag-based searching, and a wide range of filters for more precise identification of the required information. It was important to note that selecting one filter automatically adjusts the number of available options for other filters. This was done to ensure that the system only processes correct data. When accessing a selected document, an interactive preview of the digital copy of the document and its full text, obtained using OCR Transkribus, was available (Fig. 4).

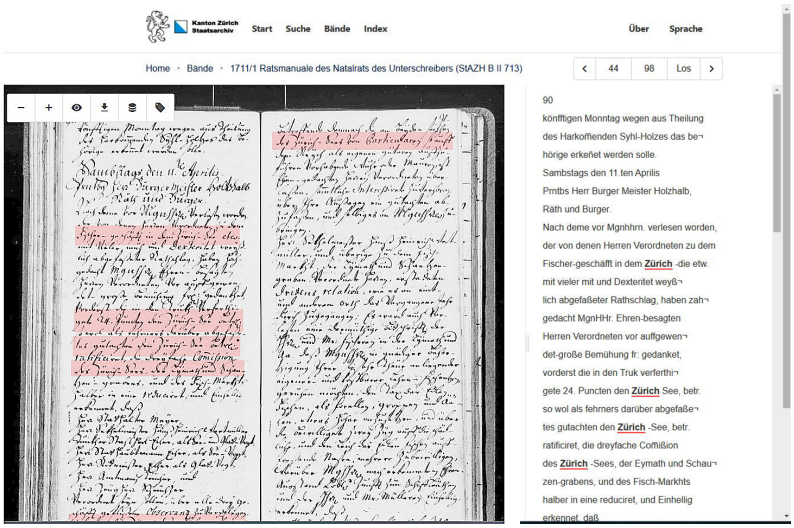

Figure 4. Example of a document digitised using Transkribus at the National Archives of Zurich
Source: based on Zurich council manuals 1642-1798 (2024)

As part of a large-scale project to digitise fonds, the National Archives of the Netherlands aimed to scan approximately 10% of its collection annually, amounting to over 10 million scans. The digitised archival documents, including notarial deeds and records of the Dutch East India Company, contained important information for genealogical research, such as records of marriages, inheritances, family relationships, and professional activities. Thanks to the recognition of contextual entities within the documents, it was easy to construct search queries that aid in tracing ancestry and the socio-economic context of families. To make access to historical documents easier, the archive also transcribed some of the materials. In particular, using Transkribus software, 3 million documents, including handwritten ones, were digitised and were now freely available on their online resource. At the beginning of their work with Transkribus, they experienced a character error rate of 20%. However, after the model processed 6000 pages of training data, the rate improved to 7%, which was even better than they had anticipated (Unlock the past with Transkribus, 2024). As part of the work in digitising these fonds, an artificial intelligence model called "Dutch Handwriting 17th-19th century" was developed. This model contained 1.5 million words and could be used by any Transkribus user working with similar documents, with an error rate of 4%-10%. This model was trained to work with manuscripts written in Dutch from the 17th to the 19th centuries (Dutch handwriting 17th-19th century..., 2023). On the archive's online platform, there was a user-friendly filter with a search function for document context and information retrieval queries (help was available on how to construct such queries with different parameters). The filter also allowed users to specify a time period for the search and the archive department, where the search will take place (Fig. 5). When results were returned, the user sees brief information about the document and its inventory number, allowing for a quick assessment of the search results. When a user selects a relevant document, they were taken to a page with its digital copy and the text, which can be interacted with. Three viewing modes were available: original, transcription, and advanced transcription (Fig. 6). The document was accompanied by a full set of metadata, the option to download the original and a JSON structure file, as well as navigation through the collection. An example of the digitisation of specific collections was the experience of Jessica Sherrill (Cook), a PhD candidate in the English department at the University of California, Los Angeles. She worked on digitising Ada Lovelace's archive, which comprised approximately 14000 pages. She developed her own Lovelace AI model, which actively developed for Transkribus to work more effectively with the documents (Creating a digital scholarly edition..., 2021).

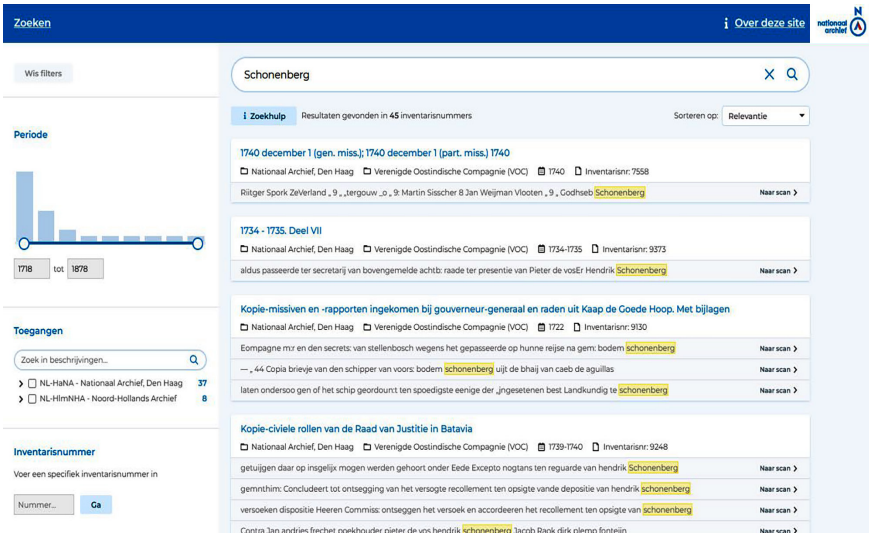

Figure 5. Search mechanism on the website of the National Archives of the Netherlands
Source: based on National Archives (2024)

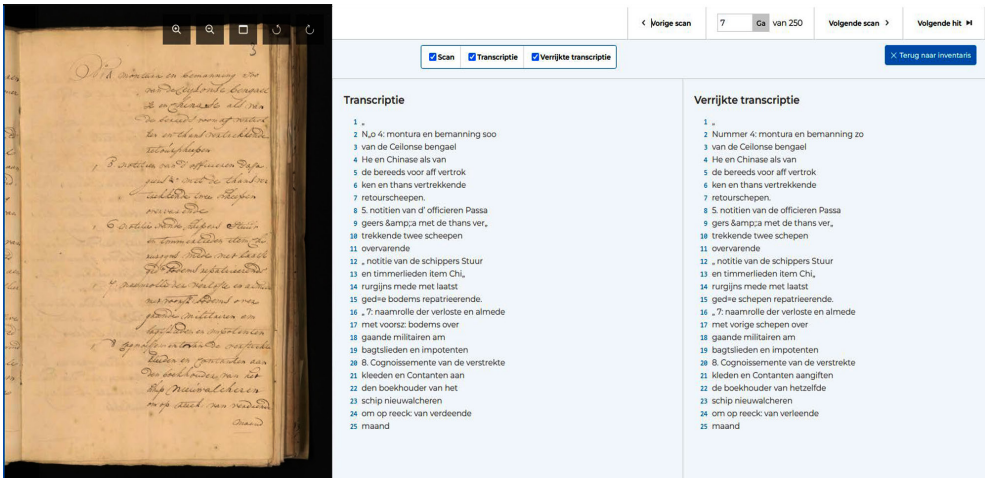

Figure 6. Example of Transkribus working with a document from the National Archives of the Netherlands
Source: based on National Archives (2024)

As part of the NewsEye project, the National Library of Finland, in collaboration with READCOOP, successfully improved the text recognition of nearly two million pages of historical Finnish newspapers using Transkribus technology, with funding from the European Union. This resulted in higher text recognition accuracy, making historical sources more accessible and userfriendly. The digitised Finnish newspapers contained birth, marriage, and death announcements, obituaries, court reports, and lists of residents, which helped to establish family connections and find ancestors. Thanks to the improved text recognition, this data became easily accessible, significantly simplifying genealogical research and information retrieval. Updated versions of the newspapers gradually replaced older ones in the digital library, starting in the summer of 2021, and the library plans further processing of newspapers published after 1914 (Unlock the past with Transkribus, 2024). An example of a digitised newspaper with contextual search capabilities and an interactive original document was shown in Figure 7. The digitisation and indexing of archival documents have become an important step in ensuring their accessibility to the wider public and have improved the research process, including genealogical research. The Arolsen Archives, the State Archives of Zurich, and the National Archives of the Netherlands have demonstrated successful examples of using OCR technologies to digitise archive groups. Their online catalogues provide convenient searching and access to digital copies of documents and the context of the documents, which has allowed for faster research and access to previously inaccessible information. This has also positively impacted the interconnectedness of data between documents within the same archive group and, overall, the preservation of historical and cultural heritage for future generations.

Figure 7. Example of a digitised document from the website of the National Library of Finland
Source: based on Savon Työmies (1920)

I. Tiurmenko *et al.* (2022) researched the digitisation processes of documents in regional state archives of Ukraine, which intensified from 2016 and peaked in 2019-2020. They noted that, although all archives already have electronic resources, the digitisation process remained unsystematic due to the lack of a unified state policy. The authors pointed out the chaotic selection of documents, problems with the structure of archive websites, and the need to expand digital collections to increase the accessibility of cultural heritage. M. Sokil *et al.* (2024) highlighted the significant losses of Ukraine's cultural heritage as a result of the Russian invasion and analysed measures for its preservation, including the creation of digital models of architectural sites.

The authors L. Salamanca *et al.* (2024) proposed a developed automation mechanism for processing and structuring the content of archival records using automatic text recognition technology, using the example of records from the Swiss Parliament from 1891 to 1995. The result of their work was the processing of over 200000 pages of documents, which exceeded the budget of most projects that used manual processing. The authors also noted that the developed mechanism not only made it possible to link documents that Swiss Members of Parliament discussed over the years, but also connected these draft laws with parliamentary speeches, legislative proposals, or votes.

M. Paliienko (2023) emphasised that despite the war and limited funding, the digital transformation of Ukrainian archives was actively continuing, contributing to the preservation of documentary heritage and the expansion of international cooperation. The integration of Ukrainian archival science into the global space, the development of educational programmes, and the attraction of financial and technological support have become important. A. Tikhonov & A. Rabus (2024) presented a universal AI model for recognising handwritten Ukrainian text on the HTR Transkribus platform, which achieved a CER of 4.2% and can be used for the mass digitisation of cultural heritage.

The research by Yu. Kovtaniuk (2023) highlighted the need to create a unified legal framework in Ukraine for the digitisation of cultural institution collections, with an emphasis on the integration of international standards and best practices. The absence of such a framework has led to technological incompatibility of electronic resources, causing inefficiency and potential risks to the preservation of fonds. S. Ferro *et al.* (2023) investigated the process of digitising historical documents using automatic handwriting recognition, applying a specific neural network (CRNN). They showed that with data augmentation techniques and fine-tuning on modern handwriting, transcription accuracy with an error rate of less than 10% can be achieved, even with a limited amount of labelled data. However, they emphasised that this method was only a supporting tool for experts, not a complete solution for the digitisation of historical documents.

S. Martínez-Cardama & A.R. Pacios (2022) analysed the strategic plans and vision statements of 159 national archives, including archives belonging to regional branches of the International Council on Archives (ICA). They found that most archives focus on preserving and digitising their collections, as well as providing access to them. However, many websites lack strategic documents, which limits citizens' access to information about future plans. One of the main problems was the digital divide, which complicated the process of digitising archives, especially in developing countries. The research highlighted the need to create digital policies and regularly update strategic plans to ensure the transparency of archives and accessibility for the public.

The National Library of Israel has actively invested in the digitisation of Hebrew manuscripts through the NLI Ktiv platform, using automatic text recognition technologies, particularly Transkribus, to transcribe

Hebrew manuscripts such as 15th-century Sephardic semi-cursive script. This process has significantly improved access to the textual content of manuscripts that were previously inaccessible and has facilitated the mass digitisation of cultural heritage. The results showed that even with small investments, great results can be achieved by using around 15000 transcribed words to train the model. This has made the mass digitisation of unpublished manuscripts easier, opening up wide possibilities for future research (Prebor, 2024).

S. Spina (2023) considered the impact of artificial intelligence on the digitisation processes of archival heritage, particularly regarding the automatic recognition of manuscripts, their correction, and normalisation. The influence of digitisation on the re-evaluation by scholars of the role of the archive and history for processing large amounts of data was emphasised. The article provided an analysis of two artificial intelligence-based systems for text digitisation, namely Transkribus and ChatGPT.

The analysis of academic studies had shown an intensification of the digitisation processes of archive groups both in Ukraine and abroad. Researchers have emphasised the importance of implementing modern technologies, particularly OCR and artificial intelligence-based solutions, to automate the processing of archival documents and processes, preserve cultural heritage, and ensure open access to them. The need to create a unified legal framework, strategic planning, and the development of digital archival infrastructure has been highlighted. International experience has demonstrated the effectiveness of using such tools, which have significantly accelerated the pace of digitisation and ensured the preservation of archive groups.

Conclusions

In modern world, where information played a crucial role, converting paper documents into digital formats had become a necessary step for preserving historical and cultural heritage. The digitisation and indexing of archival documents have become important for ensuring their accessibility to a wide audience, including researchers, historians, and genealogists. Many unique and valuable archive groups have been put at risk of destruction or loss. The effective digitisation of these documents and the provision of remote access to them have become important tasks for the state.

The use of automated text recognition technology has accelerated the pace of digitising archive groups and provided opportunities to improve the working processes of archival institutions. Depending on the chosen platform, it had simplified access to archive groups, provided a convenient tool for searching information within archive groups and documents, automatic classification of documents, and the ability to analyse large amounts of data for various research purposes.

The use of OCR had been particularly valuable from the perspective of genealogical research. Using information-retrieval queries, researchers had been able to automatically search for the necessary data and conduct in-depth analysis based on it. The use of OCR has made it possible to process large volumes of data in a short time, which has significantly sped up the information retrieval process. It also provided the ability to access digitised documents remotely, and the digitised data can be used to conduct statistical analysis and identify patterns in family relationships. This has greatly facilitated and accelerated the process of finding information about ancestors and building a family tree.

Considering the positive experiences of the Arolsen Archives, the State Archives of Zurich, and the National Archives of the Netherlands, adopting similar approaches in Ukrainian archival institutions would allow for the significant potential of modern technologies to be used to update archival practices. Applying their experience in Ukraine could substantially improve the processes of digitisation, searching, and access to archival documents, opening up new possibilities for research.

Further research into the digitisation of genealogical documents will involve studying approaches to building a centralised repository of archival documents, taking into account the experience of global institutions, and developing methodological recommendations for the implementation of such a system in Ukraine.

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None.

Conflict of Interest

None.

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Цифровізація генеалогічних документів на основі технології автоматичного розпізнавання тексту

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Анотація. Метою дослідження було висвітлення наявних підходів та технологій щодо цифровізації генеалогічних документів, спираючись на світовий досвід. Це надало змогу більш ефективніше організувати процеси та механізми оцифрування архівних фондів, їх централізоване зберігання, пришвидшення проведення генеалогічних досліджень та доступність для користувачів. Оцифрування архівів стало критично важливим аспектом для збереження культурної спадщини, особливо в умовах воєнної агресії росії проти України. Впровадження технологій автоматичного розпізнавання тексту сприяло оптимізації цього процесу, полегшуючи доступ до інформації та підвищуючи ефективність досліджень, зокрема генеалогічних. У роботі було проаналізовано принципи роботи Optical Character Recognition, його переваги, особливості готових рішень і функціональні можливості програмного забезпечення на його основі. Було оцінено стратегію цифровізації в Україні, проблеми архівної галузі в сфері оцифрування та доступу до архівних фондів. Досліджено результати впровадження автоматичного розпізнавання тексту в провідних архівах світу, а також можливості онлайн-архівів з функціоналом контекстного пошуку. Приділено увагу тим можливостям, які відкриваються перед дослідниками завдяки впровадженню подібних систем у роботу архівів, зокрема зручності здійснення пошуку необхідної інформації, підвищенню швидкості обробки даних, а також забезпеченню цілодобового доступу до архівних ресурсів незалежно від географічного розташування користувачів. Також, було проаналізовано роботи вчених, які займалися розробкою та впровадженням Optical Character Recognition в архівних установах. На основі міжнародного досвіду визначено потенціал сучасних технологій Optical Character Recognition для модернізації архівної справи в Україні, що може позитивно вплинути на генеалогічні дослідження та збереження культурної спадщини. Практична цінність дослідження полягає в підтвердженні ефективності застосування інформаційних технологій для покращення процесу оцифрування архівних документів та забезпечення кращого доступу до них. Запропоновані рекомендації допоможуть оптимізувати організацію цифрових архівів, вдосконалити процеси зберігання та пошуку документів, а також прискорити генеалогічні дослідження. Це сприятиме збереженню культурної спадщини та покращенню доступу до архівної інформації для користувачів

Ключові слова: архівні фонди; оцифрування; генеалогічні дослідження; Optical Character Recognition; інформаційні технології; автоматизація

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Blockchain as digital memory: Documenting crimes against cultural heritage during armed conflicts

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Abstract. In the contemporary world, armed conflicts pose a threat not only to human lives, but also to cultural heritage, which serves as crucial evidence of the history and identity of nations. Research into the potential of blockchain technology draws attention to its capabilities in preserving evidence of cultural heritage and crimes committed against it during military conflicts, particularly in the context of the Russian-Ukrainian war. This study aimed to analyse the use of blockchain technology for documenting crimes against cultural heritage, focusing on its potential for long-term preservation, authentication of digital evidence, ensuring open access to records, and supporting digital memory at a national level. The research methodology combined general scientific methods – analysis, synthesis, abstraction, logical exposition, and generalisation – with specialised research methods, including bibliographic analysis, content analysis, and critical approaches. Blockchain is a distributed ledger (or database) composed of a chain of blocks, each containing specific information. The potential of blockchain technology can be harnessed to document crimes against cultural heritage, particularly in the context of the Russian-Ukrainian war. This involved: preserving digital evidence of crimes, creating a register of lost heritage, decentralising archival data, securing international recognition of facts of criminal destruction, and facilitating crowdfunding and funding for restoration. Existing blockchain initiatives, such as Salsal, Monuverse, and Ukraine DAO, by transforming cultural heritage into an interactive digital resource, can become tools for documenting criminal damage, preserving memory, countering illicit trafficking of artefacts, and establishing a novel form of resilient digital documentation in wartime. The practical significance of the research lies in the use of blockchain for preserving the heritage of Ukraine and other countries experiencing cultural losses due to war. This is crucial for ensuring digital memory, transparency, and the legal reliability of information for subsequent legal prosecution and historical accountability for crimes against heritage in Ukraine

Keywords: digital preservation of evidence; protection of cultural property; digital technologies; international documentation standards; data decentralisation

Introduction

UNESCO and other international organisations have attempted to address the issue of documenting crimes against cultural heritage, notably through databases and websites. Accurate documentation of cultural heritage status was therefore essential for its protection and for conducting scientific research during restoration and renewal processes (Yastikli, 2007). However, these structures were as vulnerable as the cultural and historical assets they were intended to document.

The 2020s saw an increase in the use of blockchain technology and NFTs (non-fungible tokens) across various societal sectors, including economics, information technology, and art. While blockchain was most frequently associated with cryptocurrencies, its properties of immutability and durability have drawn

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the interest of archives, libraries, museums, and galleries. This interest particularly pertained to its potential benefits in the context of developing and promoting approaches and protocols for improving the management and documentation of digital cultural and historical heritage. M. De Santo *et al.* (2017) noted that contemporary challenges included the consequences of technological transformations, specifically changes in rights, ownership, and responsibility concerning cultural heritage, taking into account evolving forms of access to and new manifestations of digital heritage. S. Lvping (2021) indicated that, while blockchain cannot replace existing database technology, it was often employed as a supplementary technical tool in combination with other technologies. N. Zoannos *et al.* (2023) noted that this offered the potential to ensure the continuity of heritage for future generations by creating a decentralised global network among stakeholders to facilitate its preservation and worldwide dissemination. D. Buragohain *et al.* (2024) stated that the use of blockchain was important not only in connection with the rapid progress of globalisation and modernisation, which constantly threaten historical artefacts and commemorative sites globally, but primarily during periods of significant uncertainty, military conflicts, and systemic risks that jeopardise destruction or damage. This also necessitated the punishment of perpetrators and compensation for damages to lost cultural resources.

Researchers abroad have actively investigated the possibilities of blockchain technology in managing digital heritage. J. Zhang *et al.* (2021) explored the specificities of the process of transporting cultural relics, which required special risk prevention mechanisms. The authors presented a real-time management system for transporting cultural relics using Internet of Things terminals and blockchain technology. A detailed example of the system's application during the transportation of cultural relics from the Changsha Museum to the Museum of the Nanyue King of the Western Han Dynasty was described by the authors.

Scholars L. Zhao *et al.* (2023) constructed a cryptographic interaction method, the Museum Art Exchange Protocol (MAXP), for museum digital collections based on blockchain technology. They created a digital collection exchange system on Ethereum to facilitate online exchange between two museums, which helped to avoid risks caused by subjective and force majeure factors in the digital collection exchange process, such as hackers and network viruses. This could promote the exchange of collections between museums and holds significant importance for the popularisation of cultural heritage and the dissemination of scientific knowledge. Authors N. Zoannos *et al.* (2023), focusing on the implementation of the UNESCO 2003 Convention for the Safeguarding of Intangible Cultural Heritage, considered how blockchain can ensure its preservation by creating a decentralised network among stakeholders. Using a systems approach, the authors described the process of placing a new element into Greece's repository to demonstrate to UNESCO the necessity of a clearly defined process, which needs to be followed worldwide, and which was yet to be established. In doing so, the authors addressed a series of questions: what difficulties arise in determining the type and selecting the best metadata model for use in each specific case during collection; what technologies should be used for storing digital cultural heritage, presenting a challenge to physical and technological threats. Authors H. Stublić *et al.* (2023) analysed the research of other authors from 2017-2022 concerning the application of blockchain and NFTs in the field of cultural heritage. Specifically, the scholars highlighted the topics reviewed, as well as proposed models and projects. The second part of the article discussed use cases for the technology, identified unexplored topics warranting further study, and aimed to bring the potential of blockchain and NFT technology closer to experts in the cultural heritage sector.

In Ukrainian scholarship, blockchain technology has also established a significant presence. Several researchers have mainly focused on exploring its application in the cultural and artistic sectors. I. Spodenets & O. Zhukova (2022), based on a review of blockchain application experience, outlined its potential uses in the sphere of immovable cultural heritage, particularly fortification architecture. They documented the experience of successful use of NFT tokens in the Ukrainian museum and cultural sector and the experience of forming a crypto-heritage market. The scholars highlighted perspectives for cooperation between representatives of cultural and creative industries and individual territorial communities regarding the preservation, popularisation, and capitalisation of Ukrainian fortification heritage through the creation of NFT tokens. K. Ishchenko (2024) analysed the main stages of formation and characteristics of non-fungible tokens with a projection onto their use in the cultural and artistic sphere. The author also sought to substantiate the importance of applying NFTs for the preservation of cultural values, the authorship of works of art, and the creative industries. L. Krestyanpol *et al.* (2023) examined blockchain technology as used for NFTs, including the development of a unique collection of digital assets and their placement on a marketplace. This research was aimed at creating a blockchain-based system for the protection of cultural heritage. It can be stated that researchers were interested in the possibilities of blockchain for documenting and preserving cultural heritage, particularly in the context of transparency, authenticity, and traceability of artefacts, including the recording of crimes committed against them.

This study aimed to determine the possibilities of using blockchain technologies for preserving digital archives of cultural heritage that has been destroyed or was under threat of destruction in conditions of

global instability, as well as for documenting crimes against it during military conflicts. The scientific novelty was that this was the first time in Ukrainian documentation studies that the potential of blockchain technology for documenting crimes against cultural heritage has been substantiated.

Materials and Methods

The interdisciplinary nature of the research subject necessitated the use of a range of methods and approaches integrated from various fields of scientific knowledge: documentation studies, social communications, digital management, information technologies, and history.

General scientific methods, including analysis, synthesis, abstraction, logical exposition, and generalisation, enabled a thorough exploration of the topic and the achievement of the study's aim. The bibliographic method involved a systematic analysis of scholarly literature on the research topic, which allowed for the identification of key concepts, definitions, and theoretical approaches. Works from related fields of knowledge, such as museum technologies and art expertise, were examined, contributing to the formation of a comprehensive view of the problem. The content analysis method was applied for a deeper study of the content of scholarly publications and official documents. Key analytical categories were identified, such as technological aspects of blockchain and NFTs, documentation of crimes against cultural heritage, and digital archives, which facilitated the structuring of the obtained data and the identification of patterns within the research topic. The historical method was used to synthesise previous theoretical and practical developments; the structural-systemic approach was employed to define the features of blockchain for its application in documenting crimes against cultural heritage. Triangulation of methods and sources occurred by comparing data obtained from different research approaches, which allowed for a reduction in the risk of subjective interpretations. For example, the results of the content analysis were compared with conclusions drawn from the bibliographic method, and different scholarly viewpoints were considered to achieve greater reliability in the generalisations.

The research was conducted in several interconnected stages. The first stage involved clarifying the scientific directions: the research topic was studied, which allowed for characterising its multidisciplinary nature and integrating knowledge from various fields for a more comprehensive analysis. An analysis of methods and approaches was conducted: methods and approaches were considered taking into account the specifics of the research, its aims, and object; the justification for the choice of methods: emphasis was placed on the necessity of obtaining scientifically grounded and representative results, which was crucial for the reliability of the conclusions.

In the second stage, scientific methods were selected, the research plan was developed, and the collection of information commenced, utilising existing studies and examining the results of scholars' activities. This stage was used for analysing and systematising existing materials and research findings, defining the scientific context of the research, and evaluating the modern state of theoretical and practical developments to form a scientific understanding of blockchain and its potential for documenting crimes against cultural heritage.

In the third stage, the information obtained from scholarly and practical sources was processed and analysed. Taking into account the historical method and the method of generalisation, the methods of abstraction and specification, as well as the structural-systemic approach, the main features of blockchain were identified. These features allow for asserting its advantages and developing a theoretical model for its application in documenting cultural heritage that was damaged, illegally displaced, or under threat of destruction as a result of military conflicts. The fourth stage involved formulating the research results using methods of synthesis, generalisation, and concretisation, while also adhering to the principle of reliability. In the fifth stage, potential directions for the future development of blockchain technology in documenting and protecting cultural heritage were proposed, along with prospects for further academic research in this aspect.

Results and Discussion

The idea of documenting cultural heritage during military conflicts to preserve evidence about it belongs to the Austrian-Bosnian architect, artist, and Massachusetts Institute of Technology (MIT) professor Azra Akšamija. She was known for her research at the intersection of architecture, art, and the humanities in the context of cultural heritage, migration, and religious identity, as well as for projects aimed at preserving cultural heritage and developing design in crisis conditions (for refugees and displaced persons). As A. Akšamija emphasised in her analysis of the Balkan Wars and conflicts in the Middle East, the desire to destroy the cultural and historical achievements of the aggression's victim was linked to heritage being the material and most readily understandable evidence of a people's distinctiveness, demonstrating that a specific ethnic community has resided in a certain territory for a long time (Machado, 2016). Therefore, the aggressor developed a motivated desire to eliminate all information about their victim's rich past.

A. Akšamija became the creator of a large-scale art and architecture project titled Memory Matrix, which she realised in 2016 together with students on the Massachusetts Institute of Technology (MIT) campus (Fig. 1). Its goal was to address the problem of cultural heritage destruction in Syria, Iraq, Yemen, and other countries. The project became part of research on

preserving cultural heritage in conditions of conflict and destruction, and emphasised that memory can be preserved even, when physical objects disappear. Memory Matrix was a part of the broader Future Heritage Lab initiative, which A. Akšamija founded to work with refugees, preserve culture, and implement innovations in architecture. Memory Matrix took the form of a gigantic screen installation shaped like a large lattice structure made of chain, containing thousands of small plexiglass pixel elements. It reproduced the image of the Triumphal Arch in Palmyra (Syria), which was destroyed by ISIS (Islamic State of Iraq and Syria) terrorists in 2015. The backlighting made the structure appear virtual, as if hinting at the fragility of memory.

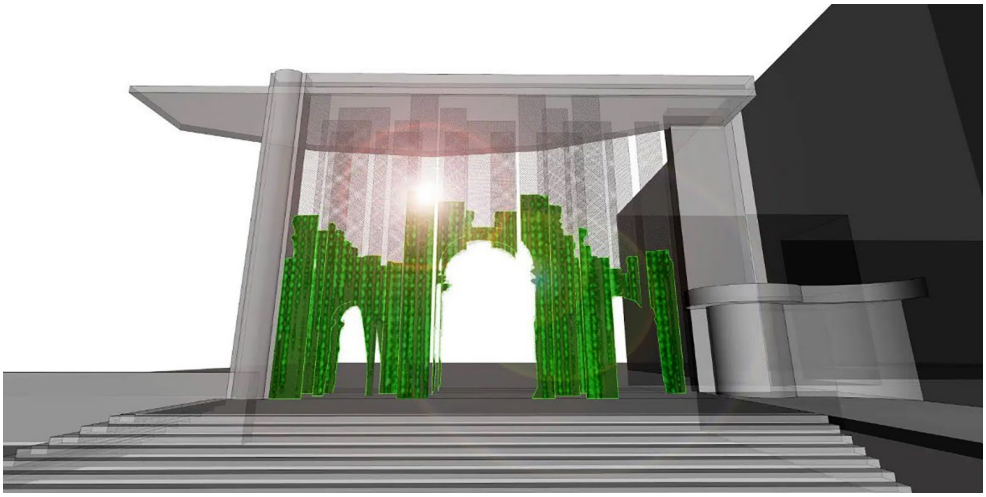

Figure 1. Project Memory Matrix
Source: based on S. Machado (2016)

The elements were cut in the middle using a laser so that they took the shape of fragments of cultural heritage (acrylic pixels resembling small amulets) that were under threat or have vanished due to wars and conflicts. The cut-out fragments have been transformed into jewellery and sold to fund educational workshops conducted by the institute's students for Syrian refugees in Jordan, Germany, and Austria. Each plexiglass ornament, positioned within the pixels, was inscribed into the "cultural memory of participants" and also encoded on the blockchain so that only the author can control it (Fig. 2). Thus, one of the innovative features of this project was the use of blockchain to preserve digital data about destroyed culture.

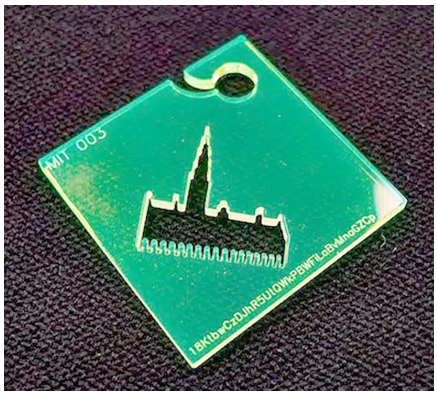

Figure 2. Acrylic pixel ornament
Source: based on S. Machado (2016)

Thanks to blockchain, each pixel (element, amulet) of the installation can be linked to a unique digital record that stores historical, cultural, or personal data. The owner of a pixel can confirm ownership of the ornament using a linked private key, which can also be used for signing and authentication (Fig. 3). Furthermore, the public can use the public key to encrypt messages that only the owner can decrypt. With a cryptographic heritage, the key owner can preserve cultural value, demonstrate ownership, transmit messages, and leave evidence about it in the world. The data recorded on the blockchain can be scanned or viewed via QR codes on the installation. This creates a connection between the physical space of the installation and digital memory, which exists independently of physical destruction. In addition to architectural data, the system was also able to accommodate the personal stories of refugees and testimonies about the loss of cultural heritage. They can add their stories or memories to this digital archive, creating a collective cultural resource. This project was not merely an artistic installation, but also an experiment in creating "digital memory" that existed independently of physical space. It combined architecture, art, technology, and the humanities to combat oblivion and losses resulting from war, effectively documenting crimes against cultural and historical memory. The project also demonstrated how blockchain can become a tool for preserving history and collective memory, serving as a foundation for new initiatives that used technology to protect and document crimes during military conflicts.

Figure 3. Stylised image of a key with digital elements
Source: based on S. Machado (2016)

Overall, within this technology, various scientific disciplines intersect, necessitating the development of fundamental algorithmic approaches, making them critically important areas of focus for artificial intelligence innovation (de Regt, 2020). Therefore, it was worth examining the main aspects of initiatives using blockchain for documenting crimes against cultural heritage more thoroughly, as blockchain and NFTs can help preserve and promote the visibility of important cultural artefacts, notably due to qualities such as non-fungibility and security. The greatest advantage of blockchain in a crisis situation was the secure signing of messages and the entry of immutable information into a global database (Machado, 2016). Blockchain provided a history for a monument, meaning protection of information about it from manipulation and interference, which was critically important in conflict conditions. Once information was recorded on a blockchain, it cannot be altered or deleted. Blockchain was also used for: authentication (verifying the authenticity of a work or its cultural value through digital authenticity as a guarantee that the digital resource was original and has not been altered), tracking (the ability to follow the origin and history of a cultural resource over time, as each transaction related to the heritage was recorded on the blockchain, creating its complete history), managing rights for digital cultural works, which increased transparency and reduces fraud, and the "non-fungible nature of blockchain ledgers significantly minimises the risk of counterfeiting" (Boiko & Maksymov, 2023).

A large database was replicated across thousands of computers (nodes) of varying power and capacity, which share the same software (protocol) to communicate with each other. The shared protocol verifies and confirms transactions, guaranteeing their integrity and permanence over time. Information related to a transaction was copied to thousands of nodes. As G. Bustos Pretel (2018) pointed out, this ensures the system's reliability, as it was possible to manipulate one or a few computers, but not thousands.

Through tokenisation, a cultural resource can be converted into digital non-fungible tokens (NFTs) – a unique digital asset, "a phenomenon of not only virtual, but also modern culture in general" (Machulin, 2022) – which represented ownership of a cultural work and through which it can be bought or sold, and its preservation conditions recorded and controlled. L. Krestyanpol *et al.* (2023) stated that NFTs "offer a promising solution for managing and authenticating digital assets. Cultural assets are transformed into unique digital items using NFT technology".

Improved access to cultural heritage contributes to the creation of verified digital platforms, where it can be securely accessed. As a result, everyone can become "a participant and manager of a new cultural and artistic reality, which is characterised by global trends and local features of the production, development, popularisation, and circulation of cultural values" (Ishchenko, 2024). In terms of contributing to restoration and renewal, blockchain can assist in the future recreation and rebuilding of destroyed sites, which not only facilitated efficient management of cultural resources, but also their long-term preservation. Blockchain provided shared access to data and resources, enabling the documentation and tracking of the restoration process, the formation of a set of rules and processes that defined how decisions were made within the network. This allowed multiple parties to work transparently and securely, facilitating communication and collaboration on projects. Thus, common methods and approaches can be developed for cataloguing procedures, methods of storing records, and metadata models used during the documentation, visualisation, and preservation of cultural heritage elements, which currently differ significantly from country to country (Zoannos *et al.*, 2023). Furthermore, blockchain facilitated fundraising through crowdfunding and the issuance of tokens. Importantly, transactions were conducted directly, without intermediaries (Blockchain in cultural heritage…, n.d.). F. Valeonti *et al.* (2021) indicated that this aspect was one of the main features of using the technology and has enabled the resolution of the increasingly growing financial problems of cultural heritage preservation.

Decentralised management was carried out by all connected computers rather than a single entity, ensuring data storage within the network and precluding the possibility of destruction or censorship by any organisation or state. This facilitated the creation of collective ownership and meaningful, linked digital objects, enabling the country or individual communities to play a significant role in cultural heritage management (Liddell, 2021). Scholars Y.-C. Wang *et al.* (2021) stated that digital rights management was a mechanism that protected digital content from misuse by controlling and managing its usage rights. Consequently, citizens can actively participate in the creation and management of records and rights, as there was no central authority controlling the network, and all participants have equal access. All of this has created a new memory

ecosystem, whereby communities were invited to contribute, participate, and share a greater proportion of what they were collectively interested in remembering, rather than simply accepting authoritative narratives from institutions (Burkey, 2021).

A. Akšamija's idea effectively initiated an innovative approach to documenting crimes against cultural heritage during military conflicts. Her initiative used blockchain technology to create a decentralised, immutable archive capable of storing data about cultural artefacts and other important evidence, including their destruction or damage resulting from military actions. However, among the crimes against cultural heritage, besides destruction and damage, there was another aspect that often accompanies military conflicts – the illegal displacement of cultural artefacts. Abu Dhabi scholar A. Khelifi and archaeologist M. Altaweel developed a blockchain tool for authenticating cultural artefacts called Salsal or Agur. It enabled museums and collectors to verify the authenticity and provenance of tangible cultural resources, which can protect collections and create an immutable database of historical objects. The service established a transparent and reliable history of a collection's origin and eliminated the risks associated with using items that have been removed (illegally displaced, stolen). Using Salsal, a global database of artefacts can be created, which would make it possible to track their journey from their initial location to a museum, auction house, or even a collector's home. Additionally, Salsal promoted the accessibility of cultural objects and information about them for a wide audience. Thus, this tool enabled objects, either individually or as part of broader collections, to be verified for compliance with ethical and legal requirements, while simultaneously providing users with relevant information. This can be used to incentivise or even pressure collectors or museums to verify their objects, which can benefit the public (Khelifi *et al.*, 2024). Overall, this could prevent the illegal sale or displacement of artefacts and encourage collectors to return stolen items. However, the success of Salsal was directly dependent on the collectors themselves, who need to be encouraged to use the platform.

During the Russian-Ukrainian war, blockchain can become a powerful tool for documenting crimes against cultural heritage thanks to its key properties, which were manifested in several functions (Table 1).

Table 1. Blockchain as a tool for documenting crimes against cultural heritage

Functions of blockchain technology	Features of the application	Consequences for recording crimes
Preservation of digital evidence	Photographs, videos, satellite images, and other evidence of heritage condition can be uploaded to the blockchain	Allows crimes to be time-stamped, preventing their forgery or destruction; the use of InterPlanetary File System (IPFS) in conjunction with blockchain enables decentralised storage of large files
Creation of a registry for lost heritage	NFTs can be created for each cultural heritage object, with its history stored on the blockchain, from initial state to destruction and restoration	Serves as evidence of war crimes and assists in subsequent reconstruction
Decentralisation of archival data	Blockchain technology can be used to create distributed databases	Ensures the preservation of information even in the event of the physical destruction of central servers and archives
International recognition of criminal destruction facts	Blockchain enables the creation of a public registry, accessible to researchers, forensic experts, UNESCO, the UN, and other organisations	Assists in documenting crimes for future legal proceedings
Crowdfunding and restoration financing	Smart contracts can be used for fundraising	Facilitates the reconstruction of destroyed monuments. For example, NFT projects can direct funds towards the restoration of specific objects

Source: compiled by the author

Such a comprehensive approach not only protected historical memory, but also made it more difficult for the aggressor to deny their crimes by documenting them on the blockchain. Ukrainian researcher A. Kravchenko (2023) emphasised the necessity of engaging all digital tools for culture creation and potential case studies to preserve national cultural and artistic heritage "…in conditions of hybrid threats and military interventions (similar to those currently experienced by Ukraine)". Furthermore, it was worth considering the blockchain initiatives Monuverse and Ukraine DAO, whose examples could be adapted for the tasks of documenting crimes against cultural heritage in Ukraine.

Monuverse was a blockchain project that preserved digital copies of cultural landmarks within the metaverse. Its primary objective was to provide access

to important architectural and cultural objects in the virtual world through interactive 3D models created using virtual and augmented reality technologies. Each landmark or architectural object was digitised in minute detail to preserve it for future generations. This included not only the exterior appearance of buildings, but also internal interiors, architectural elements, mosaics, and other important details. The digitisation of landmarks was a way to preserve them in the event of criminal damage or natural disasters. The initiative became accessible to the public through the Monuverse crypto art project. Monuverse's first NFT release of 7777 tokens across seven artefact levels focused on the 2021 Ouchhh Arch of Peace installation. Each release from Monuverse was termed an "episode", covering limited edition NFT instances with ongoing benefits for owners and institutions. Through the use of blockchain, Monuverse ensured the authenticity and security of the digital copy: each record about a landmark became immutable and transparent (Fig. 4).

Figure 4. 2021 Ouchhh Arch of Peace installation
Source: based on E. Kostina (2022)

Within Monuverse, tokens can be used for buying and selling digital assets, for example, to raise funds for the preservation or restoration of cultural heritage. Thanks to such innovations, Monuverse has the potential not only to make cultural landmarks accessible in the digital world, but also to contribute to the development of a global community that cares for them. The platform believed that sharing knowledge about both local and international landmarks was a means to help local institutions preserve or restore them, and through the sale of NFTs, to improve funding sources for relevant activities (Kostina, 2022).

In Ukraine, a blockchain initiative already existed for fundraising in support of the country – the decentralised autonomous organisation Ukraine DAO. Its main objective was fundraising and supporting various humanitarian initiatives and projects related to the war in Ukraine, including aid for refugees, those affected by the war, and contributing to the country's reconstruction (Ukraine DAO, n.d.). Ukraine DAO also actively used cryptocurrencies for fundraising and transferring aid. This reduced barriers for international donors and accelerated the process of transferring funds without relying on traditional banking systems. Funds raised from NFT sales and other activities were directed towards financing humanitarian missions, providing aid in the form of medical supplies and food, securing temporary housing for refugees, and supporting other initiatives.

Founded on 21 February 2022, Ukraine DAO utilised Web3 and an online community to counter Russian disinformation, promote Ukrainian culture, and document war crimes. The initiative assisted the Starling Lab (Stanford + USC) Project Dokaz in documenting Russian crimes collected by their team in Kharkiv. These were submitted by partners to the International Criminal Court as part of the world's first cryptographic dossier, preserving evidence of Russian war crimes in a manner that no one, not even Russia, can forge. This will help to ensure justice for Ukraine (Project Dokaz…, n.d.). Despite criticism regarding the community's activities concerning "organisational structure, opaque fund distribution, and centralised control over them" (Oliynyk, 2024), Ukraine DAO stands as an excellent example of how Web3 technologies such as blockchain, cryptocurrencies, and NFTs can be used for global support of humanitarian initiatives and aid in crisis situations, including in the context of crimes against cultural heritage. One of the most widely recognised elements of Ukraine DAO became its collection of NFTs for fundraising to support Ukraine. One of the initial NFT projects was the sale of a symbolic Ukrainian flag, which served as a sign of the global network supporting the country on the international stage during the war.

Thus, blockchain technologies opened up new possibilities for protecting cultural heritage, ensuring transparency, immutability, and shared access to data. They enabled the documentation of site destruction,

the tracking of artefact authenticity, and contributed to their preservation and restoration. Decentralised platforms encouraged public participation in heritage management processes, creating a new memory ecosystem. In the context of war, this was particularly crucial for recording crimes and preventing the illegal displacement of cultural property.

Conclusions

Blockchain is a distributed, decentralised database (ledger) consisting of a sequential chain of blocks, each containing data and a cryptographic link to the previous block. It ensured the security, immutability, and transparency of stored information without the need for centralised management. The advantages of using blockchain in the preservation, protection, and documentation of crimes against cultural heritage included: immutability and security, improved access to cultural heritage, facilitation of restoration and renewal, decentralised access, preservation of digital evidence of crimes, creation of a register of lost heritage, decentralisation of archives, international recognition of facts of crimes, and crowdfunding and funding for restoration.

The use of blockchain, NFTs, and digital archiving made it possible to create immutable databases that ensured the authenticity and accessibility of information about cultural artefacts, as well as to track the provenance and history of a cultural resource over time, since every transaction related to heritage was recorded on the blockchain. This increased transparency, reduced illegal displacement, and the recording of destruction preserves evidence of war crimes, which increased the country's chances of defending its rights in various international institutions. Therefore, the greatest advantage of this technology was not only its cryptographic tools and distributed system, but the decentralised immutability of data within a network, where users may often be distrustful of one another's actions. All these advantages of blockchain can be utilised in documenting crimes against cultural heritage during the Russian-Ukrainian war.

Existing blockchain technologies such as Salsal, Monuverse, and Ukraine DAO can become tools for documenting criminal damage with the aim of preserving data about cultural landmarks during the war. By transforming heritage into an interactive digital resource, they opened up new horizons for its protection, documenting crimes against it, and preventing the illicit trafficking of artefacts. The combination of cultural and artistic resources with modern technologies created a new form of documentary memory that was capable of actively resisting the destruction and forgetting of a people's history.

Future research should focus on in-depth thematic and empirical studies to understand the practical implications of using blockchain for documenting crimes against cultural heritage resulting from military conflicts, specifically within the realities of the Russian-Ukrainian war.

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Conflict of Interest

None.

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Блокчейн як цифрова пам'ять: документування злочинів проти культурної спадщини в умовах воєнних конфліктів

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Анотація. У сучасному світі збройні конфлікти загрожують не лише людським життям, а й культурній спадщині, яка є ключовим свідченням історії та ідентичності народів. Дослідження, визначення та обґрунтування можливостей технології блокчейну привертає увагу до її можливостей у збереженні доказів культурної спадщини та злочинів проти неї в умовах військових протистоянь, зокрема російсько-української війни. Мета дослідження – проаналізувати можливості використання технології блокчейн для документування злочинів проти культурної спадщини, зокрема в контексті довготривалого збереження, автентифікації цифрових свідчень, забезпечення відкритого доступу до них та підтримки цифрової пам'яті національного рівня. Методологія дослідження ґрунтувалася на поєднанні загальнонаукових – аналізу, синтезу, абстрагування, логічного викладу, узагальнення, та спеціальних методів дослідження – бібліографічного, контент-аналізу, критичного підходу. Блокчейн – це розподілений реєстр (або база даних), яка складається з ланцюжка блоків, які містять певну інформацію. Можливості блокчейн-технології можна використати для документування злочинів проти культурної спадщини, зокрема в умовах російсько-української війни. Це передбачало: збереження цифрових доказів злочинів, створення реєстру втраченої спадщини, децентралізацію архівних даних, міжнародне визнання фактів злочинних руйнувань, краудфандинг та фінансування відновлення. Наявні блокчейн-технології, як-от Salsal, Monuverse та Ukraine DAO, трансформуючи культурну спадщину в інтерактивний цифровий ресурс, можуть стати інструментом для документування злочинних руйнувань, збереження пам'яті, протидії незаконному обігу артефактів і створення нової форми стійкої цифрової документації в умовах війни. Практичне значення дослідження полягає у використані блокчейну для збереження спадщини України та інших країн, які зазнають культурних втрат через війну. Це важливо для забезпечення цифрової пам'яті, прозорості та юридичної достовірності інформації для подальшого правового переслідування та історичної відповідальності за злочини проти спадщини в Україні

Ключові слова: цифрове збереження доказів; захист культурних цінностей; цифрові технології; міжнародні стандарти документування; децентралізація даних

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Features of modern development of electronic document management in digital governance system

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Abstract. The development of electronic document management is becoming an integral part of digital governance and is significant in improving the efficiency of both individual institutions and the public administration system. The study aimed to analyse the modern trends in the development of electronic document management in Ukraine and the world, and to identify the problems and prospects for its future development under the influence of digitalisation. The impact of the digitalisation process on the evolution of electronic document management in the government system as well as on all aspects of public life in general was noticed in the study. The research emphasised Ukraine's accomplishments in the area of electronic document management digitisation. The study established that internal structure of digital governance was formed, citizens' access to public services was expanded, and the Trembita system was introduced to ensure effective data exchange between government agencies. To this end, the Diia platform was introduced to ensure digital interaction between the state and society. Significant progress was made in the development of the legal framework for the development of electronic document management in the field of digital governance. Even though electronic document management in Ukraine has shown encouraging trends, its continued development under the influence of digitalisation necessitated resolving a number of issues, such as the legal and regulatory framework's weakness, the low level of digital literacy among public servants and the interaction of state information systems, and the vulnerability to cyber threats. Other problems included resistance of government employees to the introduction of digitalisation in the field of electronic document management, a low level of funding and technical support of government agencies in the development of digital document management. The solution to these problems required not only finding effective ways to develop electronic document management in the digital governance system, but also borrowing foreign experience of successful practices of such development. The study that the experience of such countries as Estonia, Germany, Denmark and France was the most promising in this area. The practical value of the study is determined by the fact that the conclusions and recommendations obtained as a result of its implementation can be used to improve the process of development of electronic document management in the field of digital governance in Ukraine

Keywords: automation; digital transformation; information systems; e-government; cloud technologies; artificial intelligence; mobile access

Introduction

The research relevance was determined by the need for a further study of the processes of introducing electronic document management in the digital governance system, especially in the context of rapid technological transformations and increasing demands of citizens on the quality of public services. Following O. Hanyaylo *et al.* (2023) noted that electronic document management in Ukraine has gone through several stages: starting with systems of simple document accounting, the originals of which were necessarily in paper form,

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continuing with systems that were already able to operate electronic copies of paper originals, and ending with the formation of systems for which the existence of an electronic document was of primary importance, and its copy may also be in paper format. L. Prokopets *et al.* (2021) believed that it was determined by the preference for the electronic format of documents over paper that electronic document management at the present stage facilitates the operations with information resources and reduces the time spent on solving tasks related to document exchange. N. Kapitanenko (2024) emphasised that electronic document management saves material and human resources, which were previously used when printing, sending and storing documents. Given the remote advantages of electronic document management, it ensured mobility and convenience of sending documents through appropriate platforms or using e-mail. Modern document management systems have made it possible to create electronic archives for more efficient document storage. In addition, according to L. Malanchuk & Yu. Zhakun (2021), the digitalisation of electronic document management saved space, as an electronic document in digital format took up much less space than its paper version. Moreover, the digital format of electronic documents simplified the process of creating a backup copy and guaranteed their safety in the face of natural and unnatural negative influences, while the paper version became more vulnerable in this regard.

According to T. Kurus (2024), the creation of an information society and the modernisation of Ukraine's public administration system were significantly influenced by the growth of e-government. Enhancing the effectiveness of public service delivery and guaranteeing the openness, transparency, and accountability of public authorities were two benefits of incorporating information and communication technologies into the interactions between state institutions, civil society, and business. As noted by S. Vashchenko *et al.* (2024), electronic document management has become a key mechanism for implementing the main directions of information and communication technologies in the activities of public authorities, which determined its establishment as one of the basic elements in the development of the public administration system. V. Shkolnikova (2024) noted that since 2019, Ukraine has embarked on a course of comprehensive digitalisation and a "state in a smartphone", which has led to new trends in the field of document management. S. Yakovlev (2023) highlighted that, within the context of modern challenges, digital tools have become key components of e-government, aimed at optimising decision-making processes, achieving greater efficiency in administrative services and developing e-democracy. According to A. Yasinska (2022), since digitisation included both the conversion of paper documents into digital form and the methodical integration of digital technology into the e-government space, it has grown to be a far more comprehensive process than merely adding electronic document management. However, R. Zinko (2024) highlighted that the absence of standardised standards and laws, organisational challenges, and security and data protection issues have prevented Ukraine from completely developing its national electronic document management system. Thus, no comprehensive study of the development of electronic document management in the field of digital governance has yet been conducted by any researcher, and the topic of the peculiarities of the modern development of electronic document management in the digital governance system has become important.

The study aimed to analyse the modern state of development of electronic document management in Ukraine and the world, to outline the main trends and challenges faced by the process of development of electronic document management at the present stage during digitalisation, and to formulate recommendations for optimising document management processes in digital governance. Following the stated goal, the following tasks were identified: 1) to analyse the modern state of development of electronic document management in Ukraine and the world; 2) to identify the main trends and challenges in the development of electronic document management in public administration; 3) to formulate recommendations for improving electronic document management processes in the field of digital governance.

Scientific novelty of the study: for the first time, a comprehensive study of managing documents electronically in the digital governance system was conducted, problems and challenges were outlined, and recommendations for optimising document management processes in digital governance were formulated.

Materials and Methods

An extensive examination of the particulars of the evolution of electronic document management within the framework of digital governance was conducted using a combination of general scientific and specialised methodologies in order to accomplish the stated goal and address the research objectives. It was described the evolution of electronic document management in Ukraine and around the world, as well as modern tendencies in this development, using the historical method. It was noted that electronic document management has been widespread in the world since the end of the 20th century, while in Ukraine, although its legislative regulation took place in 2003, electronic document management has become widespread only since 2020, when amendments to Law of Ukraine No. 2155-VIII (2024) were adopted. The study also analysed the data from Law of Ukraine No. 851-IV (2003), Resolution of the Cabinet of Ministers of Ukraine No. 798 (2023), and Law of Ukraine No. 2155-VIII (2024). It was analysed Resolution of the Cabinet of Ministers of Ukraine No. 357 (2018), which

defined the list of electronic information resources, and Resolution of the Cabinet of Ministers of Ukraine No. 764 (2024), which regulated several organisational, methodological, technical and technological conditions. Other documents that formed the basis of the study were Resolution of the Cabinet of Ministers of Ukraine No. 55 (2018) and Order of the State Agency for E-Governance of Ukraine No. 60 (2018). The study of the data from Order of the State Agency for E-Governance of Ukraine No. 51 (2018) analysed the formats of electronic messages, as well as the formats of data exchange using these electronic message formats.

The concept, content and significance of electronic document management as an important component of the digital governance system were investigated using the analysis method. This contributed to the establishment of a common understanding of the concepts of "electronic document management", "digital governance", and "digital governance system" within the framework of this study. The comparative legal method was used to analyse the specifics of the functioning of electronic document management systems in different European countries (in particular, Estonia, Germany, Denmark, and France). The method of synthesis provided new knowledge about the main purpose of modern electronic document management systems – to achieve maximum automation of work with documents: the processes of their entry, registration, distribution, editing, saving, searching, viewing, controlling execution, and differentiating access.

In addition, the application of the analysis method studied the modern state of development of electronic document management in Ukraine and abroad in the context of digital governance, to outline its main advantages, and to identify existing problems of implementation and improvement in the context of dynamic technological changes and growing public expectations regarding the quality of public services. The method of explanation was used to formulate the author's innovative legal definition of the concept of "digital governance system". The systemic method established that the introduction of electronic document management achieves greater efficiency and quality of management decision-making based on a more accurate reflection of the real situation in the management model. The generalisation method contributed to the formulation of conclusions about the need for further development of electronic document management in the field of digital governance in Ukraine, incorporated the existing problems of its implementation and the best practices of its improvement in European countries.

Results and Discussion

The introduction of digital governance in the majority of information-driven nations was made possible by the notable acceleration of the processes of informatisation of society and the introduction of information technologies in all spheres of governance that occurred since the 1980s and 1990s of the 20th century. At the same time, the effectiveness of its implementation directly depended on the level of informatisation of the public sector in each country. Therefore, most developed countries have developed effective regulatory and legal frameworks in this area that define relevant aspects of the information society, digital governance and electronic document management as its integral part. As a result, states were striving to increase the pace of economic, technological and information development, strengthen their competitiveness to reach the world's leading positions, and improve the quality of life of their citizens. In this regard, since 2017, Ukraine has been actively working to develop electronic document management as an integral element of digital governance. The introduction of modern digital solutions in the field of electronic document management facilitated the integration of various state registers and systems, which ensured efficient data exchange between government agencies and minimised duplication of information. The digitisation of document management processes has also significantly improved cybersecurity, reduced the risk of document loss or forgery, and facilitated the introduction of electronic identification and digital signatures.

In 2003, Law of Ukraine No. 851-IV (2003) came into force in Ukraine, but it was only in 2020, with the amendment of Law of Ukraine No. 2155-VIII (2024), that electronic document management became widespread. This was since the updated Law of Ukraine No. 2155-VIII (2024) terminated the electronic digital signature and introduced a qualified electronic signature, equating the latter with its legal equivalent to a handwritten signature without any additional conditions. Ukraine has taken steps forward in its digital transformation with these changes. The development of electronic document management was still in progress, despite the clear benefits of doing so, particularly, when considering digital governance.

It would be wise to define the term "electronic document management" in order to examine the unique features of this system in the modern digital governance framework. According to Ukrainian legislation, electronic document management was a set of processes aimed at creating, processing, sending, transmitting, receiving, storing, using and destroying electronic documents, the implementation of which took place with the integrity check and, if necessary, with confirmation of the fact of their receipt (Law of Ukraine No. 851-IV, 2003). In the context of this study, addressing the aspects of digital transformation, electronic document management should be regarded as a set of legal, organisational and technological processes aimed at ensuring the creation, processing, transfer, storage and use of documents between document management entities in the digital environment using modern information and communication technologies, electronic

signatures and cybersecurity mechanisms. Given the ongoing digital transformation, the electronic document management system was an integral part of digital governance aimed at optimising management processes, reducing the number of paper procedures, achieving more transparent interaction between government agencies, citizens and businesses, and integrating with national and international electronic data exchange systems. In turn, digital governance was understood as a way of organising public administration using digital technologies, the main purpose of which was to satisfy the rights, freedoms and interests of a person and citizen at all levels of their interaction with the state (Mikhrovska, 2020). In other words, digital governance has completely overturned the concept of "governance for the sake of governance" and moved into the realm of "governance to meet the needs of citizens". Therefore, digital governance was not only the next stage of e-government development, but also its qualitative transformation. This was evidenced by the steps to be taken by the state in implementing the concept of digital governance following UN documents (Fig. 1).

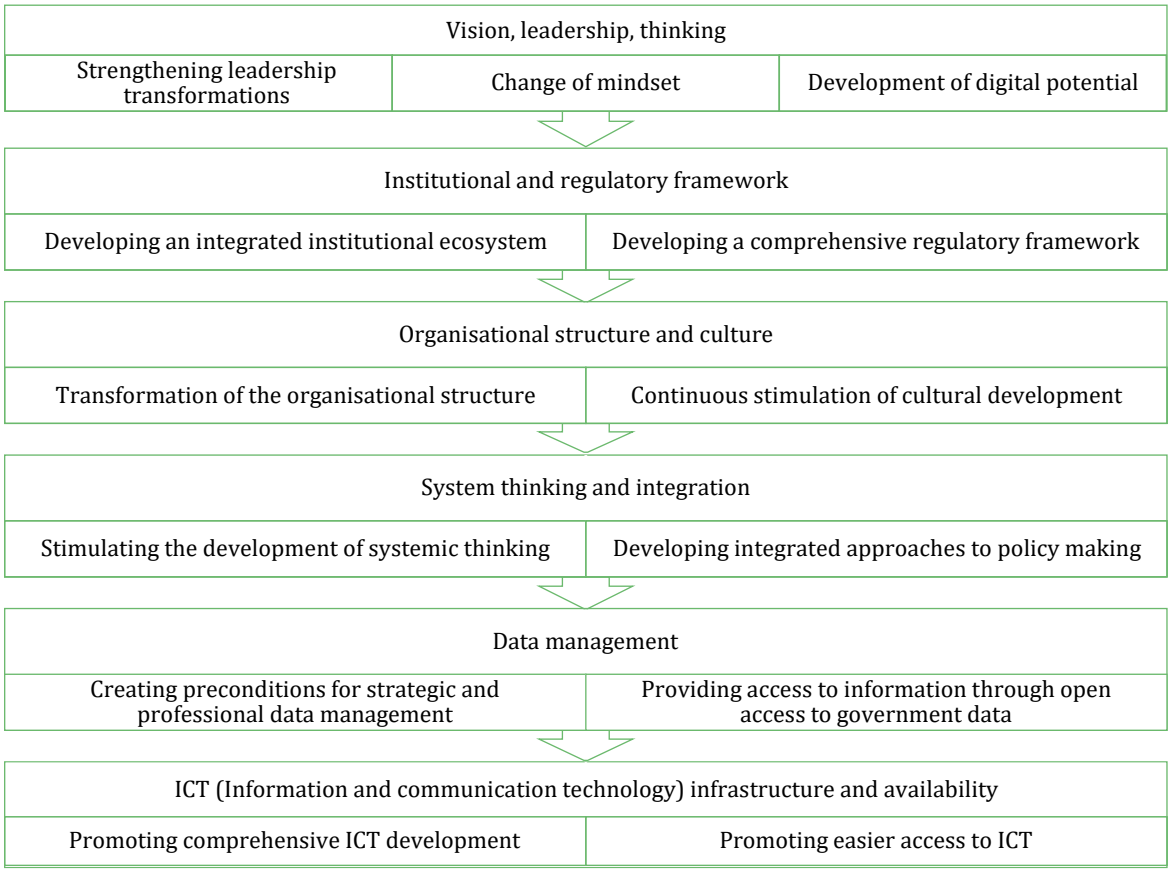

Figure 1. UN recommendations for implementing the concept of digital governance at the state level
Source: United Nations e-government survey 2020. Digital government in the decade of action for sustainable development (2020)

The analysis of these steps determined that, contrary to e-government, digital governance involved a comprehensive approach that focused on improving quality rather than quantity. This applied equally to the provision of public services, bridging the existing digital divide, and training highly qualified specialists in this area.

The notion of a digital governance system was uncertain in Ukrainian and foreign legal doctrine, although its use was increasing. Given that digital governance was a new stage in the development of e-government, and that the concept of an e-government system was defined, it was worth deriving the understanding of the concept of "digital governance system" from it, given the existing definition of "digital governance". Therefore, the e-government system was generally understood as a system of public administration based on the use of modern information and communication technologies, which aimed to achieve greater efficiency and transparency of government, as well as establish public control over it (Tkachenko, 2020). Given this, it was advisable to understand the digital governance system as a system of public administration that involved the use of digital technologies to achieve a specific goal of satisfying the rights, freedoms and interests of a person and citizen at all levels of their interaction with the state.

Since the beginning of the Russian full-scale invasion of Ukraine in 2022, the digitalisation of electronic document management has accelerated, driven by the need to maintain the state's stability in the most difficult conditions faced by Ukraine. At the same time, it was worth noting Ukrainian achievements in the development of electronic document management in the field of digital governance. A internal digital governance structure has been formed, which significantly contributed to the development of electronic document management in Ukraine. This referred to the functioning of the Ministry of Digital Transformation of Ukraine, whose activities were aimed at developing digital governance and electronic document management as its important component. In particular, the development of electronic document management in the context of digitalisation was becoming one of the priority areas of Ukraine's development, which simplified and increased the efficiency of document circulation. In 2017-2024, the scope of electronic document management was significantly expanded to include public services that were available to every citizen of Ukraine. The introduction of information and communication technologies in public administration was not only a way to simplify and improve the interaction between society and the state, but also an important step towards achieving transparency, equality, non-discrimination and accountability of information at all levels of communication between government agencies. All of this was facilitated by the Ministry of Digital Transformation of Ukraine, which has developed and implemented the Trembita system to ensure secure data exchange between government agencies, as well as the Diia platform to guarantee digital interaction between the state and society.

Significant progress was made in developing the legal framework for electronic document management in digital governance. In addition to Law of Ukraine No. 851-IV (2003) and Law of Ukraine No. 2155-VIII (2024), several other regulatory acts were adopted and updated in this area. Resolution of the Cabinet of Ministers of Ukraine No. 798 (2023) was designed to define the basic requirements for the use of qualified electronic trust services by state authorities and local self-government bodies, as well as state-owned enterprises, institutions and organisations. Resolution of the Cabinet of Ministers of Ukraine No. 764 (2024) regulated a set of organisational, methodological, technical and technological conditions that must be complied with by providers of electronic identification services and electronic trust services. Resolution of the Cabinet of Ministers of Ukraine No. 357 (2018) defined the list of electronic information resources that were a priority in the context of establishing electronic interaction between state authorities, local self-government bodies, as well as state-owned enterprises, institutions and organisations. Another document, Resolution of the Cabinet of Ministers of Ukraine No. 55 (2018), defined all important aspects of documenting management activities, from the moment of creation or receipt of the relevant document to the time, when such a document was sent or transferred to the archive department of the public administration entity. Order of the State Agency for E-Governance of Ukraine No. 60 (2018) defined the requirements for the mandatory details of electronic documents and their data formats. The last important document for analysis, Order of the State Agency for E-Governance of Ukraine No. 51 (2018), established the relevant formats for electronic messages, as well as the formats for data exchange using these electronic message formats.

In 2021-2024, Ukraine also took the following significant steps in the digitalisation of electronic document management (Fig. 2).

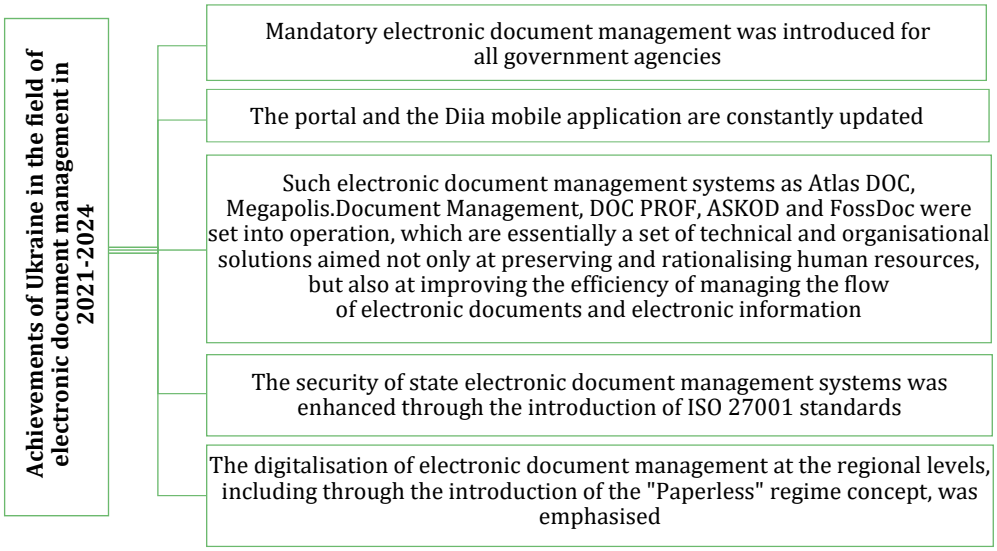

Figure 2. Achievements of Ukraine in the field of electronic document management in 2021-2024
Source: based on O. Bilyk (2023)

At the modern stage, electronic document management in the digital governance system continues to evolve, adapting to the realities of modernity and using new technologies. Innovations not only made it easier to manage document management, but also created new opportunities for its implementation. Therefore, in the future, electronic document management in the digital governance system in Ukraine should take advantage of the following technologies (Table 1).

Table 1. Promising technologies for improving electronic document management within the framework of digital governance in Ukraine

Technology	Prospects from implementation
Artificial intelligence and machine learning technologies	Achieving a higher level of automation of similar tasks, classification and sorting of electronic documents. Machine learning technologies will increase the adaptability of document management systems to the specifics of the activities of various public authorities
Blockchain technologies	The achievement of an unprecedented level of security and transparency in the implementation of electronic document management will tracked entire path without fear of loss or alteration of the latter
Natural language processing technologies	Achieving a higher level of automation by creating conditions for understanding and processing human language by electronic document management systems. This may be necessary, when automatically generating annotations or searching for specific information in large volumes of electronic documentation
Mobile applications	Simplification of electronic document management, as mobile applications can be used to exchange electronic documents from any mobile device and any place in the world. The Megapolis.DocNet system, created by Intecracy Group, is a good illustration of how mobile applications may be included into an electronic document management system because it works with both iOS and Android smartphones

Source: based on V. Misko (2022)

As electronic document management in the digital governance system became more widespread, it was necessary to integrate it with other IT systems to maximise the effect of such integration. The development of electronic document management was particularly important in the context of digital governance and in relation to other elements of digital transformation, including the construction of digital infrastructure, the development of citizens' digital skills, and the establishment of favourable conditions for creative projects. Only with a comprehensive approach to the digitalisation of electronic document management in public administration can effective implementation of modern information and communication technologies in public administration be achieved. At the same time, it was necessary to emphasise the existing problems in the development of electronic document management within the framework of digital governance in Ukraine:

- insufficient technical integration between state registers and electronic document management systems;
- lack of unified data exchange standards;
- existing legal conflicts and gaps in the regulation of certain issues of electronic document management in the field of digital governance;
- low level of cybersecurity, which endangers state document management systems in Ukraine;
- low level of digital literacy among public servants;
- resistance of government employees to the introduction of electronic document management;
- insufficient financial and technical support.

All these problems prevent electronic document management in digital government from developing properly, thereby hindering its progress. Given this, the experience of leading European countries could be relevant in finding effective ways to overcome the existing problems. In particular, the experience of Estonia, where almost all document management will be digital by 2025, could be useful in this regard. At the same time, thanks to the early digitisation of data in Estonia and the creation of a reliable data infrastructure called X-Road, the exchange of documents between government agencies and between government agencies and citizens was secure and transparent (Saputro *et al.*, 2020). This level of exchange guarantees interaction that ensures a unified standard, according to which an electronic document was requested "only once", if it was already in the database and can be accessed by both public and private entities. In other words, Estonia's experience can be useful in the context of improving the level of technical integration between public registers and electronic document management systems.

The experience of Germany, where significant efforts at both the legislative and organisational levels of e-documentation development were focused on cybersecurity, can be used as a best practice for improving

the security of e-documentation systems in digital government. The Danish experience can also be effectively applied in Ukraine. In Denmark, every citizen and business created their account, which enabled interaction with government agencies and conduct electronic document management in real time. Notably, since 2015, the interaction of government agencies with citizens and businesses has been conducted exclusively in digital format. All government agencies and municipalities were connected in a single network, which enabled interaction with all state and municipal institutions through a single personal account. In addition to the possibility of interaction and document flow with government agencies, businesses were also able to conduct transactions online, receive statements, pay taxes and submit reports. Sending and receiving documents in electronic format takes only a few minutes, as opposed to the several days required to send paper documents. Such a system can save 10-20% of the budget funds allocated for public administration annually (Yesimov, 2024). As a result, Ukraine can benefit from the Danish experience in terms of establishing uniform data interchange guidelines and enhancing the degree of technical integration among all government agencies' electronic document management systems.

Additionally, civil workers in European nations were becoming more digitally literate, which was important given the successful growth of electronic document management in the field of digital governance. Ukraine can take as an example the successful experience of France, which has implemented comprehensive government programmes to develop digital literacy among civil servants. Mastery of new information technologies has become an integral part of the curricula for training officials in higher education institutions (Nikitenko *et al.*, 2024).

Therefore, the modern development of electronic document management was an important component of the digitisation process in the public administration system. By analysing the research of various scientists, it was possible to identify the main directions of its development, as well as common and distinctive features. Most scientists noted the need for continuous improvement of the regulatory and legal framework for electronic document management. S. Vashchenko *et al.* (2024) emphasised the importance of expanding the regulatory and legal framework for electronic document management in the digitalisation process, focusing on issues of legal security and protection of data in the context of constant threats. A similar position on the need to improve the regulatory framework was expressed by N. Kapitanenko (2024), who emphasised that the Ukrainian regulatory framework for electronic document management in the field of digital governance needs to be adapted to international standards in this area. The legal aspect was highlighted in the work of O. Hanyaylo *et al.* (2023), where the authors emphasised the need for legal regulation of issues related to the development of digital mechanisms for document control and verification. A similar position was expressed by L. Shymchenko (2021), who noted that the effectiveness of electronic declaration was significantly dependent on the existence of a clear, consistent and adapted regulatory framework.

The research substantially addressed the development of electronic document management in the process of digitalisation. L. Prokopets *et al.* (2021), analysing the modern level of development of electronic document management in Ukraine, noted a positive developments and prospects in the introduction of digital technologies in the field of document management. S. Yakovlev (2023) addressed e-government as a complex process that included not only document management, but also the introduction of digital and mobile platforms for better interaction between government agencies. This approach was reflected by L. Malanchuk & Yu. Zhakun (2021) that examined the potential for enhancing the electronic document management system by incorporating blockchain and artificial intelligence technology to boost security and guarantee more openness in the document exchange procedure. N. Rapa (2022) emphasised the significance of implementing services for the advancement of electronic document management. The importance of digitalisation of electronic document management was also emphasised by T. Korolyuk & N. Rapa (2021), mentioning the following elements that will contribute to the more successful digitalisation of electronic document management: lowering the price of technical and organisational support, implementing a single document management system, accelerating document exchange, and bolstering document management control.

The focus of the works was on addressing the issues of system and technical support for this process, legal support for the development of electronic document management in the context of digital governance, and the introduction of the newest technologies in the field of electronic document management in the government system, according to a comparative analysis of scientific studies. At the same time, this study focused on both positive developments in the development of document management in the context of digitalisation of governance and problematic aspects of this process. International experience, as well as the prospects for its adoption and adaptation in the Ukrainian context, were emphasised.

Conclusions

The digital transformation in modern public administration has marked a transition to a new level of electronic document management, a new stage in its development, and at the same time has become an essential component of effective information and economic development of the state in wartime. An analysis of the

modern state of electronic document management within the framework of digital governance has shown that significant changes have taken place in this area in Ukraine, including: the updating and adoption of several regulatory and legal acts, the creation of a specialised structure for the implementation of policy in the field of electronic document management, the development and implementation of various electronic document management systems in the activities of public administration bodies, and the strengthening of the protection of electronic document management systems against cyber threats. In the future, electronic document management in Ukraine's digital governance system will continue to develop as an integral part of it. Ukraine, which has demonstrated rapid progress in this area during the war, will be able to gradually integrate into the global information and economic space. However, the development of electronic document management in the digital governance system required addressing several challenges, including: existing gaps and conflicts in the regulatory framework for electronic document management in the digital governance system, weak integration of state document management systems with each other and with state registers, increased cyberattacks on state document management systems during the war, financial and technical problems in the development of electronic document management, and low digital literacy among civil servants. To overcome these challenges, it was worth adopting the best practices of digital development of electronic document management in European countries, in particular Estonia, Germany, Denmark and France, which have been successful in introducing unified digital ecosystems in the field of electronic document management, significantly improving cybersecurity and achieving effective interaction between state structures and with society. Given the results of the study, further optimisation of electronic document management in the digital governance system should be based on a comprehensive approach and cover all aspects of the existing problems in its development. Lastly, only flexibility and the ability to respond to change will ensure the effective development of electronic document management in Ukraine's digital governance.

Prospects for further research on the development of electronic document management in the digital governance system are determined by the need for a more detailed study of certain aspects of this development.

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Conflict of Interest

None.

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Особливості сучасного розвитку електронного документообігу в системі цифрового врядування

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Анотація. Розвиток електронного документообігу стає невід'ємною частиною цифрового врядування і відграє вагому роль у контексті підвищення ефективності діяльності як окремих установ, так і системи публічного управління в цілому. Мета статті – проаналізувати сучасні тенденції розвитку електронного документообігу в Україні та світі, визначити проблеми та перспективи його майбутнього розвитку під впливом цифровізації. Відзначено вплив процесу цифровізації на всі сфери суспільного життя в цілому та на процес розвитку електронного документообігу в системі урядування. Наголошено на досягненнях України у сфері цифровізації електронного документообігу. Встановлено, що було сформовано внутрішньодержавну структуру цифрового врядування, розширено доступ громадян до державних послуг, запроваджено систему «Трембіта», що мала на меті забезпечити ефективний обмін даними між державними органами. Для цього було запроваджено платформу «Дія» з метою забезпечення цифрової взаємодії держави з суспільством. Значні зрушення простежувалися у розвитку правової основи розвитку електронного документообігу в сфері цифрового урядування. Незважаючи на позитивні тенденції розвитку електронного документообігу в Україні, його подальший розвиток під впливом цифровізації вимагав вирішення низки проблем, зокрема слабкість нормативно-правової регламентації цифровізації електронного документообігу, низький рівень цифрової грамотності публічних службовців та взаємодії державних систем інформаційного забезпечення, незахищеність перед впливом кіберзагроз. Також, до проблем належав опір працівників системи урядування впровадженню цифровізації у сферу електронного документообігу, низький рівень фінансування та технічного забезпечення урядових структур в ході розвитку цифрового документообігу. Вирішення цих проблем вимагало не тільки пошуку дієвих шляхів розвитку електронного документообігу в системі цифрового урядування, а й запозичення зарубіжного досвіду успішних практик такого розвитку. Наголошено, що саме досвід таких країн як Естонія, Німеччина, Данія та Франція є найбільш перспективним у цій сфері. Практична цінність дослідження зумовлюється тим, що отримані в результаті його здійснення висновки та рекомендації можуть бути використані для вдосконалення процесу розвитку електронного документообігу в сфері цифрового урядування в Україні

Ключові слова: автоматизація; цифрова трансформація; інформаційні системи; електронне урядування; хмарні технології; штучний інтелект; мобільний доступ

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Value categories of archival documents in Ukrainian archival science

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Abstract. The study addressed the issue of identifying the key stages in the research of value categories of archival documents in Soviet times and during the period of Ukraine's independence. The purpose of this study was to highlight the major events in the history of Ukrainian archival research on the problem of defining and studying the value categories of documents of the National Archive Fund. The study determined priorities in the identification and study of value categories of archival documents by Ukrainian archivists at various stages of its history. The activities of Ukrainian state archives to identify and record the value category of archival documents – especially valuable ones – have been carried out since the early 1980s as a result of the adoption of regulatory documents on this archival technology by the all-Union archival leadership. In independent Ukraine, with the adoption of laws concerning the National Archive Fund and archival institutions, the priority in identifying and organising work was given to another valuable category of archival documents – unique ones. It was vital to analyse the methodology of monetary evaluation of documents of the National Archive Fund. Based on monetary evaluation of documents of the National Archive Fund, the study determined their value categories, describing the procedure of such evaluation step by step. Specifically, the study considered an approximate scale of documents' evaluation by various characteristics and features, an indicative scale of documents' value, as well as forms of reporting documentation on the results of monetary evaluation. The approximate scale of prices was correlated with value categories of archival documents, but they were not outlined in this regulatory document. In addition, by analysing regulations, the study examined the government-approved procedure for classifying documents of the National Archive Fund as unique, their accounting and storage, the methodology for classifying documents of the National Archive Fund as unique, as well as amendments to this document. It was this document that became the basis for organising the identification of unique documents and compilation of their annotated lists. The practical significance of this study lies in the fact that its findings can be used to recreate the history of studying archival documents by Ukrainian archivists from the standpoint of their differentiation by value categories as a new area in the development of the theory of expert valuation of these documents

Keywords: particularly valuable archival documents; unique archival documents; monetary valuation of documents; examination of the value of documents; archival institutions

Introduction

Modern world archival science lacks a classification of archival documents by value categories. The relevance of the study of the history and differentiation of archival documents by value categories in Ukraine is conditioned by the new situation in the organisation of archival affairs in connection with the full-scale armed aggression of Russia against Ukraine, which began on 24 February 2022. Specifically, the issue of planning the evacuation of the most valuable part of archival documents in state archives has emerged. However, despite the total number of archival documents in the National Archive Fund of 86 mln. storage units,

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archival science in Ukraine operated with only two value categories of archival documents – valuable and unique. Unique documents included in the State Register of National Cultural Heritage (SRNCH) in some state archives numbered from three to five. Therefore, it became vital to investigate a differentiation of archival documents by value categories in greater depth. At the same time, the basis for such study was the historiography of identifying and recording value categories of archival documents in Ukraine, starting in the 1980s in the Ukrainian SSR and during the years of Ukraine's independence.

Among the researchers, who dedicated their publications to this problem, which helped to establish a general research picture on the issues of identifying unique documents and entering them into the State Register of National Cultural Heritage; presentation of unique documents in the State Register of National Cultural Heritage in comparison with other unique objects; legal certainty of unique archival documents; historiography of studying value categories of documents in Soviet archival studies and substantiation of classification of documents of the National Archive Fund by value categories according to their monetary value, it was worth mentioning V. Boiko (2023b), who analysed the principal approaches to determining the value categories of archival documents in Soviet archival studies in different periods. V. Boiko (2023a) investigated the monetary valuation of archival documents as a method of determining their value categories. The researcher noted that apart from unique and valuable documents, it was necessary to identify additional value categories of archival documents, specifically those related to evacuation plans under martial law. V. Boiko & S. Kuleshov (2023) carried out a comparative analysis of the sections containing movable monuments in SRNCH and identified problems with their existence. The researchers also noted that there were problems related to the clarification of the term "unique document of the National Archive Fund" from the standpoint of legal certainty. L.M. Popova & A.V. Khromov (2021) outlined the problems of legal certainty of unique documents of the National Archive Fund. The researchers concluded that it took more than two years to adopt a specialised archival law that defined a separate category of unique documents of the National Archive Fund. S. Kuleshov (2008) started a discussion on the problems of classification of documents of the National Archive Fund as unique, considered methods of monetary evaluation of documents. L.A. Kyselyova (2011) identified the problems of formation of the State Register of Unique Documents of the National Archive Fund. Since the issue was related to national problems of forming the register of unique documents, foreign researchers did not raise these issues.

The purpose of this study was to analyse the key stages of studying the issue of defining and researching the value categories of documents of the National Archive Fund by Ukrainian archivists. The objectives of the study were: 1) to investigate the reporting archival documents of Ukrainian state archives on their activities on identification and organisation of work with value categories of archival documents; 2) to analyse the regulatory documents adopted in Ukraine on identification and organisation of work with value categories of archival documents; 3) to review scientific publications on identification and organisation of work with value categories of archival documents and to determine the evolution of changes in the identification and organisation of work with value categories of archival documents.

Scientific originality of this study lies in the fact that it was the first to present the findings of research on the key events in the identification and organisation of work with value categories of archival documents in Ukrainian archival science.

Materials and Methods

Since the work on identification, registration, description, and storage of especially valuable documents in the Ukrainian SSR began in 1980, at the initial stage of the study examined the content of reporting documents of archival institutions of the republic, stored in the 14th fund "Main Archival Directorate of Ukraine" of the Central State Archives of Higher Bodies of Power and Administration of Ukraine on the implementation of this work. The historical and source method helped to outline the quantitative characteristics of the identified particularly valuable documents. In addition, information on the creation of insurance copies of especially valuable documents in state archives was analysed. Subsequently, the historical and source research method of processing archival documents was implemented during the study of documents on this issue of the said fonds in 1990-1995, as well as during the processing of relevant regulations and subordinate legislative acts adopted by the Main Archival Department at the Cabinet of Ministers of Ukraine. The application of historical and comparative analysis helped to draw a conclusion about reorientation of state archives' work to identify and organise work with another valuable category of documents of the National Archive Fund – unique ones. Subsequently, the content of regulations adopted by the central executive body of Ukraine in the field of archival affairs and record keeping was aimed at improving this work. In addition, the study focused on changes in the content of the wording of definitions of valuable, especially valuable and unique document in Ukrainian regulatory and reference sources, which helped to apply the method of conceptual analysis. The analysed regulations included the Law of Ukraine No. 3815-XII (1993), the Order of the State Committee on Archives of Ukraine, State Property Fund of

Ukraine No. 34/683 (2005), the Order of the State Committee on Archives of Ukraine No. 34 (2008).

It was not reasonable to define a higher value category of archival documents through a lower one. The analysis of conceptual problems led to the conclusion that the term "unique documentary monument" was unlawful to use. The creation of the Ukrainian people's national identity and its contribution to the global cultural legacy were both influenced by the phrase "unique document", which was used to describe a document of the National Archive Fund that had extraordinary cultural significance. As a result, the characteristic of unique cultural worth gained importance.

Results and Discussion

Active work on identifying particularly valuable documents in the state archives of the Ukrainian SSR began in 1980-1981. For example, according to the appendix to the report on the work of archival institutions of the Ukrainian SSR for 1981, according to the "Instruction on the identification, accounting, description, and storage of especially valuable documents", the Order of the Main Archival Department under the Council of Ministers of the Ukrainian SSR of 03.10.1980 No. 75 was submitted, according to which state archives should clarify the methods of organisation of identification and accounting of especially valuable documents during 1980-1981, and prepare perspective plans for the creation of an insurance fund of copies of especially valuable documents (Instruction on the..., 1980). The report stated that in 1981 the work on creation of the insurance fund and the fund for use of especially valuable documents was intensified, consolidated perspective plans for the republic were created, 42666 thousand files of paper documents, 0.35 thousand units of storage of photographic documents, 27.5 thousand metres of film negatives were copied (TSDAVO of Ukraine, 1981).

The report on the work of archival institutions of the Ukrainian SSR for 1982 stated that a perspective plan of work of state archives was developed to create an insurance fund of copies of especially valuable documents and scientific and reference apparatus to them by 1990. Methodological manuals, including working instructions, memos on identification, accounting, storage of especially valuable documents, and creation of their insurance fund of copies were prepared, specifically by state archives of Lviv, Ternopil, Chernihiv regions. A special mention should be made of the "Instruction on Identification, Registration and Storage of Particularly Valuable Film, Photo and Audio Documents" prepared by the Central State Archive of Film, Photo and Audio Documents of the Ukrainian SSR (TSDAVO of Ukraine, 1982).

The 1983 report on the work of archival institutions noted the effectiveness of the implementation of the "Instruction on Identification, Accounting, Description and Storage of Particularly Valuable Documents" and the "Regulation on the Creation and Organisation of an Insurance Fund for Copies of Particularly Valuable Documents". The same report informs that the State Archives of Dnipropetrovsk region conducted an economic analysis on the creation of an insurance fund for copies of especially valuable documents and in 1983, 50403 files of especially valuable documents were microphotographed, an insurance fund was created for 1739 units of especially valuable photographic documents, and an insurance fund was created for 312 units of especially valuable magnetic records (TSDAVO of Ukraine, 1983).

The 1984 report on the implementation of the plan for the development of archival affairs in the Ukrainian SSR stated that according to the decision of the board of the Main Archival Department under the Council of Ministers of the Ukrainian SSR of 13 March 1980, 133000 files were reviewed, 77.3 thousand especially valuable documents, 1791 units of phonodocuments and 36 units of photographic documents were identified, and inventories were made for 270 fonds with a total volume of 27665 files. The same report stated that during 1984, 42664 files on particularly valuable documents were copied for the purpose of creating an insurance fund (TSDAVO of Ukraine, 1984).

As the USSR continued to work on methodological support for the organisation of work with especially valuable documents (Regulations on the creation..., 1981), Ukrainian archives paid considerable attention to this valuable category of archival documents. For example, the explanatory note to the report on the implementation of the plan for the development of archival affairs in the Ukrainian SSR in 1985 stated that this area of work was one of the principal activities of state archives in 1985. Specifically, 45.5 thousand especially valuable files were included in the inventories, 2.02 thousand units of storage of especially valuable film, photo, and phonographic documents were identified, and isolated storage of files containing especially valuable documents was organised in a series of state archives (TSDAVO of Ukraine, 1985).

In the late 1980s and since 1991, documents on the work of archival institutions on especially valuable documents made fewer and fewer references to them. The explanatory note to the report on implementation of the plan for development of archival affairs in Ukraine for 1993 stated that the failure to fulfil the plan on creation of the insurance fund of copies of especially valuable paper-based documents and photographic documents was explained by unsatisfactory supply of state archives with film and chemicals for its chemical and photographic processing (specifically, the Central State Archive-Museum of Literature and Art of Ukraine, state archives of Zakarpattia region, Sevastopol city). The report of the Central State Scientific and Technical Archive of Ukraine stated that the total insurance fund for especially valuable scientific and technical documents

was created for 810069 storage units, including 679 storage units in 1993 (TSDAVO of Ukraine, 1993). However, the work on identifying particularly valuable documents in state archives continued. This was evidenced by the 1996 file "Information on the State of Work on Creation of the Insurance Fund of Copies of Especially Valuable Documents in State Archives as of 1 October 1996", which was kept in the Central State Archives of Higher Authorities and Governments of Ukraine (TSDAVO of Ukraine, 1996).

From 1992 to June 1996, the Main Archival Directorate at the Cabinet of Ministers of Ukraine was in correspondence with the Library of Congress of the United States of America on cooperation in the field of preservation of rare and damaged archival materials, which was also evidenced by a draft protocol between them (TSDAVO of Ukraine, 1992). Notably, the American designation of the value category of archival documents – rare documents – was used, which was suitable for particularly valuable documents.

At the same time, the attention of the archival community was reoriented to another value category of archival documents – unique ones. The Resolution of the Cabinet of Ministers of Ukraine No. 466 (1992), which stipulated that the State Register of National Cultural Heritage should include "documentary monuments – unique acts of statehood, other significant archival materials, film, photo, and audio documents, ancient manuscripts, and rare printed publications", was a significant factor in the development of regulations concerning the value categories of archival documents in independent Ukraine.

In the first version of the Law of Ukraine No. 3815-XII (1993), Article 20 "Unique Documentary Monuments" defined unique documentary monuments as documents of the National Archive Fund that have special historical and cultural value. On 1 June 1995, DSTU 2732-94 (1994) came into force in Ukraine, defining three principal value categories of archival documents: valuable document, especially valuable document, and unique document. The definitions of valuable document and especially valuable document are identical to those in the Soviet GOST 16487-83 (1983). The primary drawback of the definition of particularly valuable documents was that it was defined through a valuable document. The Soviet standard did not define a unique document, as the leadership of the Union Archival Administration directed state archives to identify and work with particularly valuable documents. In DSTU 2732-94 (1994), a unique document was also defined as a particularly valuable document. The same definitions as in the Soviet standard (without presenting the wording of a unique document) were repeated in the "Short Russian-Ukrainian dictionary of archival terms" published by the Kyiv State Institute of Culture in 1993 (Short Russian-Ukrainian dictionary of archival terms, 1993).

On 20 October 1995, Resolution of the Cabinet of Ministers of Ukraine No. 853 (1995) was issued, which approved a series of regulatory documents on the organisation of archival affairs in Ukraine. These included "Regulations on the Procedure of Classification of Documents of the National Archive Fund as Unique Documentary Monuments", which entailed their inclusion in the State Register of National Cultural Heritage, as well as their storage, "Regulations on the Main Archival Directorate at the Cabinet of Ministers of Ukraine", which stated that the Main Archival Directorate at the Cabinet of Ministers of Ukraine organised work related to classification of documents of the National Archive Fund as unique documentary monuments and their inclusion in the State Register of National Cultural Heritage. In addition, "Regulation on Principles and Criteria for Determining the Value of Documents, the Procedure for Creation and Activity of Expert Commissions on the Issues of Classification of Documents to the National Archive Fund" was valuable for the analysis, which defined the tasks of expert review commissions, including approval of annotated lists of documents classified as unique documentary monuments.

In 1995, the first All-Ukrainian Conference of Archivists was held, but it hardly considered the experience of identifying and working with especially valuable documents, tasks, and methods for identifying unique documentary monuments. A. Kentiy's report (1996) suggested the expediency of creating a list of fonds containing especially valuable documents in archival institutions. In 1998, the Ukrainian Research Institute of Archival Affairs and Documentation published a terminological dictionary "Archival Studies" (Novokhatskyi, 1998), where the definition of valuable, especially valuable, and unique document repeated their formulation in DSTU 2732-94 (1994). In addition, in 1998, the Ukrainian Research Institute of Archival Affairs and Documentation published Methodological Recommendations on Identification and Inclusion in the State Register of National Cultural Heritage, Organisation of Accounting and Storage of Unique Documentary Monuments of the National Archive Fund of Ukraine (Zakharchenko *et al.*, 1998).

In 1999, "Methodology and Criteria for Identification and Inclusion of Unique Documentary Monuments of the National Archive Fund of Ukraine in the State Register of National Cultural Heritage" was published, approved by the Order of the Main Archival Directorate under the Cabinet of Ministers of Ukraine and the National Academy of Sciences of Ukraine No. 73/298 (Zakharchenko *et al.*, 1999). In the presence of this document, the State Committee on Archives of Ukraine sent to state archives the letter No. 02-689 of 17 July 2001 on the status of the National Archive Fund of Ukraine's efforts to identify and add special documentary monuments to the State Register of National Cultural Heritage. This letter guided state archives until 2008 in

their work on identifying and providing annotated lists of unique documents. Almost all state archives have developed their methodological recommendations in this area of work. Annotated lists of unique documents were sent to the State Committee on Archives of Ukraine, where they were analysed to improve methodological support on this issue (TSDAVO of Ukraine, 2000-2007).

The Resolution of the Cabinet of Ministers of Ukraine No. 1739 (2002) approved the "Procedure for Classification of Documents of the National Archive Fund as Unique, their Inclusion in the State Register of National Cultural Heritage and Storage". Paragraph 5 of this document stated that unique documents were stamped with the stamp "UD" according to the procedure established by the State Committee on Archives of Ukraine. In 2012, the Verkhovna Rada of Ukraine adopted the Law of Ukraine No. 2888-III (2012), which included Article 14 "Specific Features of Accounting and Storage of Unique Documents of the National Archive Fund". Notably, fixation of the term "unique documents of the National Archive Fund" instead of the term "unique documentary monuments of the National Archive Fund" was caused by the fact that the famous Ukrainian archivist K.Ye. Novokhatsky (1999) wrote about the inexpediency of using the phrase "monument", since the documents of the National Archive Fund were cultural monuments, and the term "documentary monument" should be removed from the archival terminology.

In 2003, "Methodological Recommendations on Creation and Organisation of the Insurance Fund of Unique and Especially Valuable Paper-Based Documents" were issued, approved by the Order of the State Committee on Archives of Ukraine No. 6 (2003). Specifically, these methodological recommendations defined the processes of preparing unique and especially valuable paper-based documents for insurance copying, technical control of the insurance collection, restoration, and conservation and preventive treatment of the insurance collection, conditions of storage and accounting of the insurance collection.

In 2004, the "Basic Rules of Work of State Archives of Ukraine" were published (Boriak *et al.*, 2004), which specified the specific features of work with unique documents and specific features of work with especially valuable documents. Item 3.3.4.2 of this document stated that according to the degree of value documents of the National Archive Fund were divided into valuable, especially valuable and unique; Item 4.2.9.3 – based on the results of the examination of value annotated lists of documents and lists of especially valuable documents were compiled; Item 6.6 – fixed procedures for accounting of especially valuable documents and unique documents; Item 7.3.1.3 – indicated separate storage of unique and especially valuable documents. On 1 July 2005, DSTU 2732:2004 (2005), developed by the Ukrainian Research Institute of Archival Affairs and Documentation, came into force, defining the terms "valuable archival document", "especially valuable archival document", and "unique archival document".

From 1 March 2024, the national standard of Ukraine DSTU 2732:2023 (2024) came into force, which defined only one value category of archival documents – "unique archival document", which was identical to the wording in the Law of Ukraine No. 3815-XII (1993). This standard stated that "unique documentary monument" as a term not allowed for use. DSTU 2732:2023 (2024) lacked a definition of the term "valuable document". Of particular significance for the subject matter of this study was the adoption in 2005 of the Order of the State Committee on Archives of Ukraine, State Property Fund of Ukraine No. 34/683 (2005). It was based on the monetary valuation of documents of the National Archive Fund that the value categories of archival documents can be determined (Boiko, 2023a). This document described the procedure of monetary evaluation of documents of the National Archive Fund by stages. Specifically, it provided an approximate scale of document evaluation according to various characteristics and features, an approximate scale of document prices and forms of reporting documents of the monetary evaluation. The approximate scale of prices to some extent correlates with value categories of archival documents, but they were not defined in this document. In 2007, Resolution of the Cabinet of Ministers of Ukraine No. 1004 (2007) approved the "Procedure for Classification of Documents of the National Archive Fund as Unique, their Accounting and Storage", and in 2008, Order of the State Committee on Archives of Ukraine No. 34 (2008) was approved, as well as amendments to this document, defined in Order of the State Committee on Archives of Ukraine No. 237 (2008). This document became the basis for organising the identification of unique documents and creating their annotated lists.

In 2016, the Ministry of Justice of Ukraine approved and registered an updated version of Order of the Ministry of Justice of Ukraine No. 2505/5 (2016) as a regulation. It differed from the previous one by minor changes, specifically, the term "State Committee on Archives of Ukraine" was replaced by "State Archival Service of Ukraine", the provisions of the Methodology were generalised, particularly in the list of funds' collectors, and editorial adjustments were made. In 2020, the Order of the Ministry of Justice of Ukraine No. 4553/5 (2020) approved amendments to this Methodology, which concerned amendments to the State Register of National Cultural Heritage to clarify the descriptive and search characteristics of a unique document, which was carried out by the decision of the Central Expert Review Commission of the State Archival Service of Ukraine based on a reasoned submission of the expert review commission of the state archive.

The rejection of Russian culture by Ukrainian society, exacerbated by Russia's large-scale armed aggression

against Ukraine, led to the decision of the Central Expert Review Commission of the State Archival Service of Ukraine on 27 July 2023 to remove documents related to Lev Tolstoy and Fyodor Shaliapin from the section "Unique Documents of the National Archive Fund" of the State Register of National Cultural Heritage. In addition, unique documents of the State Archives of Chernihiv region were removed from this section of the State Register of National Cultural Heritage, namely: a receipt for passports for boys, who were elected to the court singing chapel dated 25 May 1838 signed by M. Hlynka (f. 679, op. 2, p. 5116) (Meeting of the central expert review..., 2023).

On 14 September 2023, a meeting of the Central Expert Review Commission of the State Archival Service of Ukraine was held, at which it was again decided to withdraw the documents from the State Archives of Dnipropetrovsk region – letter from D.I. Mendeleev to Olexandr Pavlovych (unknown author) about sending drawings and a book for printing dated 15 December 1900; Central State Archives of Public Associations and Ukrainian Studies – transcripts of the I-III, IX congresses, IV-VIII conferences and Minutes of the IX Congress of the Central Committee of the CP(b)U for 1918-1925, a total of 11 documents in 19 files (f. 1, op. 1, pp. 2, 4, 15, 32-33, 35, 42-43, 59, 97, 98-99, 118, 131, 134-138) (Meeting of the central expert review..., 2023).

The American archivist T.R. Schellenberg (1956) investigated the specific features of the examination of the value of archival documents, which was distinguished by the concepts of primary – administrative, political, economic, and secondary – inherent in certain types of documents – value of documents. Archivist T. Cook (1992) addressed the value of document functions and processes in which it was created. Among Ukrainian researchers, who have thoroughly studied the modern foundations of the American theory of document examination, it was worth mentioning L. Levchenko (2013), who investigated the development of archival affairs and organisation of archives in the United States from the colonial period to the present. V. Bezdrabko (2019) identified the key traditions and current trends in the field of document value assessment in international archival experience. Using the examples of North America and Europe, the researcher identified two opposing approaches to this practice.

L. Prykhodko (2013) examined the scientific principles and criteria for assessing the value of archival documents developed by archivist H. Jenkinson. O. Volkotrub (2013) reviewed the publications of foreign archivists published in "The American Archivist" in 1940-2002, which concerned the evaluation of documents for archival storage. I. Matiash (2012) made conclusions on the development of the theory of expertise in Western European archival studies. S. Selchenkova & K. Seliverstova (2011) analysed the history, theory, and methodology of value appraisal of management documents and focused mainly on the Ukrainian practices. K. Pontek (2006) investigated the specific features of audiovisual documents value examination and criteria for assessing their value. T. Yemelianova (2024) analysed the state of development of the key theoretical, methodological, and practical principles of evaluation and selection of audiovisual documents in contemporary North American historiography, identified their problems and further prospects for study.

Thus, the State Archival Service of Ukraine continues to work on identifying documents included in the section "Unique Documents of the National Archive Fund" of the State Register of the National Cultural Heritage and related to Russian culture. The analysis of foreign and Ukrainian publications revealed that the subject of value categories of archival documents has not been studied in detail and was innovative, including in Ukrainian archival studies.

Conclusions

Active work on identifying the valuable category of archival documents – especially valuable ones – in the state archives of the Ukrainian SSR began in the 1980s. During this period, a considerable number of particularly valuable documents were identified and recorded, and an insurance fund for them was created. With the adoption of regulations, specifically laws, the attention of archivists was reoriented to another valuable category of archival documents, namely unique documents. However, according to archival sources, the work on creating insurance copies of especially valuable documents continued and the last mention of records of especially valuable documents was recorded in the early 2000s. Of particular significance for the issue of value categories of archival documents was the adoption of the methodology concerning monetary evaluation of documents of the National Archive Fund. The value categories of archival documents were determined based on monetary evaluation of documents of the National Archive Fund. This document described in detail the stages of such evaluation. During 1990-2000, several versions of regulatory documents were published on classification of documents of the National Archive Fund as unique, their accounting and storage. In addition, the analysis of regulations concerning the classification of documents of the National Archive Fund as unique was also significant for this study. Due to the rejection of Russian culture by Ukrainian society, exacerbated by Russia's full-scale armed aggression against Ukraine, in 2023 a series of archival documents previously recognised as unique were removed from the State Register of National Cultural Heritage.

Promising areas for further research are to substantiate improvements to the methodology of monetary valuation of documents of the National Archive Fund in connection with strengthening its role in assessing the loss of documents of the Fond as a result of Russia's full-scale

armed aggression against Ukraine. It is also advisable to analyse the opinions of foreign archivists on the value categories of archival documents in greater detail and to identify practical ways to implement the findings of the study in the organisation of Ukrainian archival affairs.

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Conflict of Interest

None.

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Ціннісні категорії архівних документів в українській архівістиці

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Анотація. У дослідженні актуалізовано питання виокремлення основних етапів у вивченні ціннісних категорій архівних документів за радянських часів та у період незалежності України. Метою дослідження було висвітлення основних подій в історії дослідження українською архівістикою проблеми визначення та вивчення ціннісних категорій документів Національного архівного фонду. У дослідженні було визначено пріоритети у виявленні та вивченні українською архівістикою ціннісних категорій архівних документів на різних етапах її історії. Діяльність українських державних архівів із виявлення та обліку ціннісної категорії архівних документів – особливо цінних, здійснювалося з початку 1980-х років у результаті прийняття загальносоюзним архівним керівництвом нормативних документів щодо цієї архівної технології. У незалежній Україні з прийняттям законів, які стосуються Національного архівного фонду та архівних установ, пріоритет із виявлення та організації роботи надавався іншій ціннісній категорії архівних документів – унікальним. Важливим був аналіз методики грошової оцінки документів Національного архівного фонду. На основі грошового оцінювання документів Національного архівного фонду було визначено їхні категорії цінності, поетапно описано процедуру проведення такого оцінювання. Зокрема, розглянуто зразкову шкалу оцінок документів за різними характеристиками та ознаками, орієнтовну шкалу вартості документів, а також форми звітної документації за результатами грошового оцінювання. Примірна шкала цін корелювалася з ціннісними категоріями архівних документів, але у цьому нормативно-правовому документі вони не були окреслені. Також, у роботі, за допомогою аналізу нормативно-правових актів, було вивчено затверджений урядом порядок віднесення документів Національного архівного фонду до унікальних, їх обліку та зберігання, методику віднесення документів Національного архівного фонду до унікальних, а також зміни до цього документа. Саме він став основою для організації процесу виявлення унікальних документів та складання їх анотованих списків. Практичне значення дослідження полягає в тому, що результати можна використати для відтворення історії вивчення українською архівістикою архівних документів із позицій їх диференціації за ціннісними категоріями як новітній напрям у розробленні теорії експертизи цінності цих документів

Ключові слова: особливо цінні архівні документи; унікальні архівні документи; грошове оцінювання документів; експертиза цінності документів; архівні установи

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