



RESEARCH ON THE STATUS AND POSSIBILITIES FOR DIGITIZATION OF WRITTEN CULTURAL AND HISTORICAL HERITAGE*

Radoslav Kostev ^{1*}, Boyko Mladenov ²

^{1*,2} Technical University of Sofia, Management and Business Information Systems Department, Kliment Ohridsky blv St 8, Sofia, Bulgaria

E-mails: ^{1*}rkostev@tu-sofia.bg (Corresponding author)

Received 11 August 2025; accepted 30 October 2025; published 30 March 2026

Abstract. The digitization of written cultural and historical heritage is a key process for the preservation, access and promotion of the documentary memory of society. This study examines the status, challenges and prospects for the digitization of written cultural and historical heritage in Bulgaria. A survey was conducted among leading institutions in the field of management and preservation of written historical resources - libraries, museums, archives and others, to identify the main factors influencing digitization. The study was conducted from May to September 2025 and includes the opinions of 53 employees/experts in the field of written cultural and historical heritage. The aim of the study is to assess the status and opportunities for digitization of written cultural and historical heritage by identifying the main factors influencing successful digitization. From the analysis made, based on the data from the study, it can be concluded that at present the digitization of written historical resources in Bulgaria is at a relatively low level, caused by multiple factors. As a result of the analysis, it can be concluded that digitization is currently ineffective – limited access to digitized resources, incomplete digitized content, gaps in legislation, problems with ensuring copyright protection, etc. Based on the analyses performed, some recommendations have been made to improve the process of digitization of written cultural and historical heritage.

Keywords: digitalization; documents; archives; cultural and historical heritage

Reference to this paper should be made as follows: Kostev, R., Mladenov, B. 2026. Research on the status and possibilities for digitization of written cultural and historical heritage. *Entrepreneurship and Sustainability Issues*, 13(3), 69-84. <http://doi.org/10.9770/a6867379537>

JEL Classifications: H40, O33, Z19

1. Introduction

The digitization of written cultural and historical heritage is a key process in modern society, aimed at the preservation, accessibility and long-term preservation of historical memory. The development of modern information and communication technologies, including high-resolution scanning systems, optical character recognition (OCR), 3D modeling and cloud storage solutions, creates new opportunities for digital reproduction,

* The research presented in this publication was funded by the Research and Development sector of the Technical University of Sofia, project "Research into applicable models of archive digitization when using business information systems in Bulgarian conditions", contract No 252Π/0013-15.

cataloguing and analysis of archival documents, manuscripts and rare editions. At the same time, digitization is not only a technological, but also a cultural, organizational and ethical process that requires concerted efforts between institutions, specialists and legislators.

In the context of the growing digital transformation, written heritage is becoming a strategic resource for education, science and cultural identity. Digital collections and online archives expand public participation and provide new forms of interaction with cultural content through open access and shared platforms. However, the digitization process in Bulgarian institutions still faces several challenges related to insufficient funding, lack of standards and limited human resources. Researching these aspects is essential for the formulation of effective models and policies that will ensure the sustainable development of digital cultural and historical heritage in a national and international context.

This study attempts to reveal the opportunities for digitization of cultural and historical heritage in Bulgaria, considering the main factors and their manifestation. In this regard, the study seeks to answer the following questions:

RQ 1: What is the level and status of digitized written cultural and historical heritage in institutions in Bulgaria?

RQ 2: What factors influence the degree of digitization and what are the opportunities for using digitized written historical sources?

RQ 3: What are the opportunities for improving the process of digitization of written cultural and historical heritage and what would be the effects of digitization?

In response to the defined research questions, basic guidelines for developing effective models of digitization of written cultural and historical heritage can be revealed. On the other hand, this would also serve as a guideline for developing national and local policies, as well as updating the regulatory framework in the field of cultural and historical heritage in Bulgaria.

2. Literature review

There are numerous studies in the field of digitization of cultural and historical heritage in scientific literature (Nawaz et al., 2024; Lutfullayeva et al., 2025; Khatoon, 2025; Hadi et al., 2025). Different models and tools are used for the digitization of such resources. The main tool for digitization of archives and historical documents is information and communication technologies (ICT). Sabarrijaan et al. (2024) examines the application of management information system (MIS) technologies to improve techniques for digital archiving and preservation of cultural heritage. The article outlines the problems that arise in relation to the maintenance and accessibility of historical documents and artifacts, focusing on digitization and data management.

Khan et al. (2018) examines the concept of digitization of cultural and historical heritage and opportunities for improving the management and dissemination of digitized historical resources. This study outlines the main challenges associated with initiatives for digital preservation of cultural heritage, including financial, technical, policy guidelines, legal aspects and metadata issues.

The main technology for digitizing cultural and historical heritage is 2D and 3D models. This technology creates new opportunities for the storage, distribution, research, documentation and analysis of cultural heritage. Three-dimensional digitization allows to produce a digital 3D model that can be virtually processed and recreated in any historical period, which allows for the preservation and protection of cultural heritage. Numerous publications are focused on this topic (Di Filippo et al., 2018; Milkova et al., 2019; García-Molina, 2021), as well as the development towards 4D (Bruno et al., 2022). Using 3D technologies, the main method for digitizing cultural and historical sources is scanning, which is used in various fields, even the digitization of clothing from historical

periods (Montusiewicz et al., 2021). Recent research also highlights the managerial and technological aspects of digital transformation processes in Bulgarian organisations, emphasizing the importance of strategic alignment between digital transformation and corporate sustainability models (Koprinkova-Noncheva, & Dimitrov, 2022). The use of 3D technologies opens the opportunity to establish a workflow for digitization and management of cultural heritage that details staffing requirements, implementation processes, and quality control (Nguyen et al., 2022).

The construction of a 3D model is possible through modeling in Geographic Information Systems (GIS), which creates a suitable environment for remote sensing and preservation of cultural and historical heritage. Many authors (Trizio, Savini & Giannangeli, 2018; Pepe et al., 2021) have explored the possibilities of creating 3D-GIS models of tangible cultural and historical heritage, mainly buildings, but GIS can also be used in the digitization of written historical sources (archives, documents, books, etc.). In this way, GIS becomes a major tool for the digitization of cultural and historical heritage.

The effective digitization of cultural and historical heritage is dictated by the creation of a multimodal database – digital archives for various cultural heritage sites. The construction of a digital archive for data storage will help improve access and retrieval of digital assets of cultural and historical heritage for the necessary purposes (Batjargal, et al., 2023).

The digitization of written cultural and historical heritage aims to ensure sustainable access and preservation, but the specific nature and complex structure of written sources often make it difficult to apply conventional OCR (optical character recognition) technologies. Modern approaches based on advanced algorithms for segmentation, context recognition and machine learning offer effective solutions for the precise digitization and analysis of such archival sources.

The digitization of historical documents aims to provide easy access to archives for researchers and the public, which triggers citizen engagement in the management of cultural and historical heritage. The implementation of new technologies in the management of cultural and historical heritage gives rise to new forms of civic participation (Daga et al., 2022) and even new business models.

The advent of new technologies has also opened new opportunities for the digitization of cultural and historical heritage. Donghui et al. (2019) examine the possibilities of applying virtual reality technology in cultural heritage (Kassahun Bekele et al., 2018). Buragohain et al. (2024) explores the possibilities of applying the metaverse in the digitization of cultural heritage, covering various aspects of it to ensure sustainable accessibility to cultural resources. The effectiveness of the project for the digitalization of cultural and historical heritage is also determined by adhering to various constraints related to the management approaches used with IT teams. In this regard, it is necessary to apply the appropriate methodologies (Anguelov & Angelova, 2016).

Artificial intelligence (AI) has also prompted a new look at the management and accessibility of cultural and historical values. Sánchez-Martín et al. (2025) examine the impact of AI on the management, personalization of services, accessibility, and preservation of both tangible and intangible cultural heritage assets. In their study, the authors also highlight the main ethical, technical, and epistemological challenges associated with this transformation, including algorithmic surveillance, data protection, interoperability between platforms, and the reconfiguration of knowledge production processes for cultural heritage. Similar challenges in implementing AI are also observed in the service sector, where managers express hesitation, low trust, and the need for clearer regulation and organizational preparation (Dimcheva & Stoyanov, 2023).

The digitization of cultural and historical heritage is strongly represented in the development of the concept of the Smart City. D'Angelo et al. (2018) emphasizes Crowdsourcing as a means to achieve sustainability of the use of

cultural and historical heritage, as a key element of the smart city. The digitalization of cultural and historical heritage is in line with the European policies for the creative industries (Angelova & Stoyanova, 2018).

In addition to the technological side, the successful digitization of cultural and historical heritage also depends on the legislative framework and the adopted strategies and methodologies for digitization in different countries and regions. Neikova (2024) emphasizes the construction of a sustainable legal framework for the effective digitization of cultural and historical heritage, as well as the creation of a unified international legal framework for the protection and regulation of digital resources.

Siliutina et al. (2024) examine the opportunities that digital tools create for the documentation, archiving and accessibility of cultural artifacts, while at the same time considering the challenges encountered in the digitization process, including issues related to digital obsolescence, accessibility, copyright, data security and resource constraints. On the other hand, digitization helps to conserve cultural and historical heritage and preserve it in an authentic form for long periods. A few techniques, methods and technologies for the conservation of written cultural and historical heritage can be applied here, which will allow for future research and analysis of this type of cultural heritage (Braeden et al., 2020).

The effectiveness of the digitization of cultural and historical heritage depends on many factors that need to be considered. In this regard, it is necessary to develop a system of indicators that determine the effective level of digitization (Anguelov & Stoyanova, 2025). In this direction, an important factor is also the level of digitalization of municipalities, including cultural institutions with municipal budget and thus their better functioning (Tsonkov, Petrov & Berberova-Valcheva, 2022).

The digitization of cultural heritage, similar to the digital transformation of industry, requires a strategic approach to risk management – including cybersecurity, data resilience, and protection from information loss – because cultural resources, although intangible, are part of national economic and identity security (Ivanov et al., 2025). At the same time, measuring the success of the digitization of cultural and historical heritage depends on the perceptions of people - employees and users of such digitized resources, as in business organizations. Significant challenges to digitization and the implementation of new technologies in organizations are the high costs and ensuring the security of sensitive data, which also applies to the digitization of cultural and historical heritage.

Attention is also paid to the digitalization of documentation related not only to cultural and historical heritage, but also to the security of storage of this digital data in the relevant databases. Vambol et al. (2024) pay attention to the storage of this data under normal conditions, paying attention to storage when deviations from usual conditions occur.

The use of new technologies for digitization and presentation of cultural and historical heritage reveals a few challenges and problems related to security, the right to use and ways to access these resources. All this requires in-depth studies of the state and factors leading to successful models of digitization. There is significantly little research in the field of written cultural and historical heritage.

3. Research methodology

This study is based on the results of a survey conducted to explore the opinions of employees in various institutions in the field of cultural and historical heritage on the effects of the digitization of written archives and documents. The study is part of a research project on "Research into applicable models of archive digitization when using business information systems in Bulgarian conditions". This project examines the application of various established models, as well as the opportunities and challenges in the digitization of cultural and historical

heritage. This article presents the results related to the status, obstacles and opportunities for the digitization of written historical sources in Bulgaria.

The study covers several institutions preserving and managing written cultural and historical heritage at national, regional and local levels, such as community centers, museums, libraries and archives (State Agency "Archives"). The study was conducted from May to September 2025. The aim is to assess the status and effects of the digitization of archival documents and written historical sources by assessing the opinions of employees in various institutions in the country. The selection of institutions included in the study is random, but the study does not claim to be representative of the sample.

The purpose of the study is to assess the status and opportunities for digitization of written cultural and historical heritage by identifying the main factors influencing successful digitization.

To achieve the main goal, the following research tasks must be completed:

- To analyze the current state of digitization of written cultural and historical heritage in Bulgarian institutions.
- To identify the main factors influencing successful digitization.
- To assess the opinion of employees (experts) on the effects of digitization of written cultural and historical heritage.
- To identify the main challenges and difficulties in the digitization process.
- To assess the impact of the degree of digitization on the accessibility and popularization of written cultural and historical heritage.
- To identify opportunities for improving the processes of digitization of written cultural and historical heritage.

The present study focuses on the perceptions of employees working in institutions related to written cultural and historical heritage regarding the level of digitization of this heritage. The aim is to assess how employees perceive the effects of the digitization of written cultural and historical heritage, as well as what are the main problems and challenges for successful and effective digitization. In this regard, the following two research hypotheses are defined:

H1: The adoption of a clearly defined methodology and internal rules for digitization in the institution has a significant impact on the level of achieved digitization of cultural and historical heritage.

H2: The level of digitization of written cultural and historical heritage has a positive impact on its accessibility, popularization and practical application.

This study is based on a qualitative approach, based on a survey among specialists engaged in the digitization of written cultural and historical heritage in Bulgaria. The developed questionnaire is structured into several thematic sections: basic information about the respondent; current status and experience with digitization; legislative and regulatory framework; challenges and problems; perspectives and recommendations. The survey contains both closed and open questions, which allows for a combination of quantitative and qualitative analysis, considering the individual views of the specialists. The possible values of each measure used in the study are arranged on a standardized Likert scale from 1 to 5 (from “very low” to “very high”). The aim is to assess the opinion of the employees about the degree of digitization of written historical sources, as well as the main factors influencing their successful digitization.

The survey was conducted in the period May - September 2025, and was distributed among numerous institutions - community centers, museums, libraries and archives (State Agency "Archives"). The survey guarantees anonymity and voluntariness of participation and reflects the opinion of specialists in the field of written cultural and historical heritage. A sample of 53 respondents (answers) was formed, which guarantees the correctness and comprehensiveness of the study.

The study follows a defined methodological sequence, including the following stages:

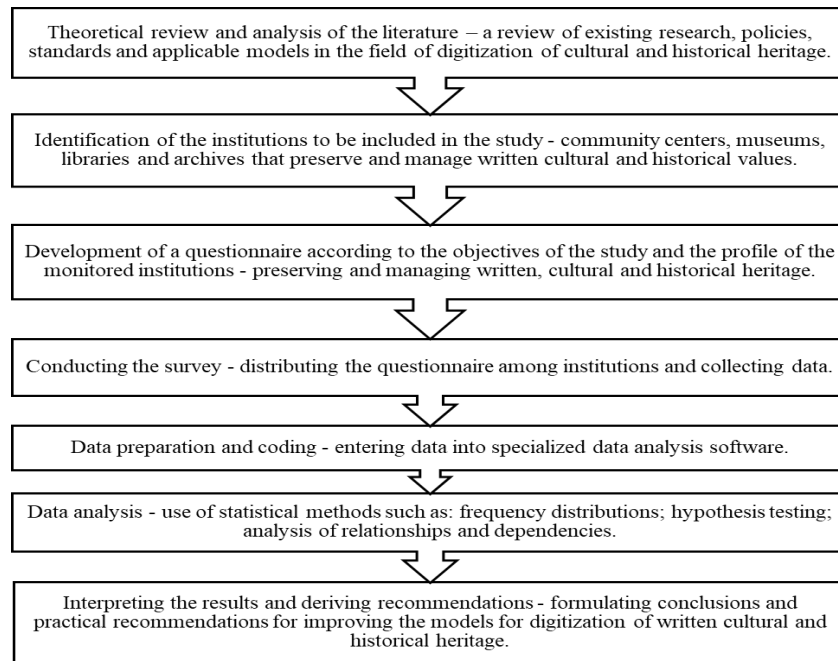


Figure 1. Methodological framework of the study

Source: own elaboration

Data processing and analyses were carried out using the IBM SPSS Statistics v19 software product. At this stage, the data collected from the survey were imported and coded in SPSS, prepared for statistical processing. To analyze the data and present the survey results, some statistical methods were used, such as frequency distributions; hypothesis testing; analysis of relationships and dependencies. Since the data extracted from the survey questions included in the analysis are qualitative, the statistical methods used for hypothesis testing are non-parametric. To prove the first hypothesis, the Mann-Whitney U test was used, which is used to compare the differences between two independent groups when the dependent variable is ordinal or continuous, but is not normally distributed. The Mann-Whitney U test checks for equality of the two distributions (McKnight & Najab, 2010; Laerd Statistics, 2018).

Since the values of the main questions included in the study (the respondents' ratings) are located on a Likert scale, the data in the model are located on an ordinal (rank) scale. For the purposes of analysis (detection of dependence), a non-parametric criterion for testing hypotheses based on Spearman's rank correlation (Spearman's ρ) is used. Spearman's coefficient ρ takes values from -1.00 to +1.00 and is interpreted as follows: ρ of +1 indicates a perfect association of ranks, ρ of zero indicates no association between ranks, and ρ of -1 indicates a perfect negative association between ranks. The closer ρ is to zero, the weaker the association between ranks (Zar, 2005).

The results are interpreted in the context of the results of the data analysis. The emphasis is placed on revealing the challenges and opportunities for effective digitization of the written cultural and historical heritage. Based on the results of the analysis, conclusions and practical recommendations for improving the models for digitization of the written cultural and historical heritage are formulated.

4. Results

The survey includes the opinions of employees in some major institutions preserving, managing and promoting written cultural and historical heritage. The survey covers institutions such as museums, archives, libraries and community centers operating at national, regional and local levels in Bulgaria. The total number of respondents included in the survey (employees who responded to the survey) is 53, and their distribution is presented in Figure 2.

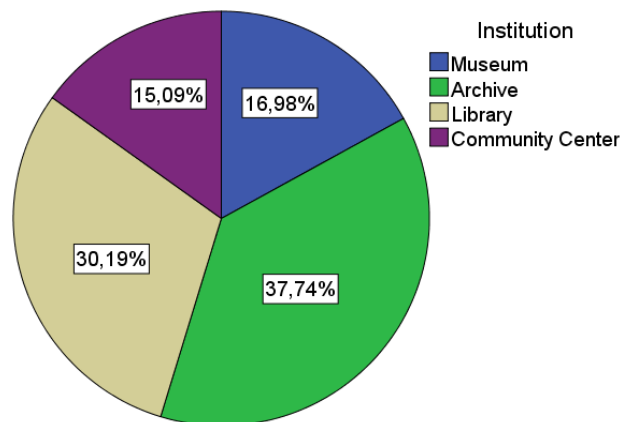


Figure 2. Distribution of respondents by institution, 2025

Source: own elaboration

The largest share of participating employees was from the Archives State Agency – 20 employees. Next in number of participants were employees from national and regional libraries – 16 people and 9 people from national and regional museums. The smallest share was from employees working in community centers – about 15% or 8 of the respondents. Most respondents were employees in institutions with the largest volume of written cultural and historical heritage, namely libraries and archives.

All employees who took part in the survey were involved in some kind of digitization of written cultural and historical heritage. This gives us reason to claim that these institutions have taken measures for digitization and we can refer to the results of the survey as a plausible assessment of the state of digitization of written documents and the possibilities for their use.

Figure 3 presents the age structure of respondents distributed by the relevant institutions. The overall picture presents us with a strongly aging structure of employees in cultural and historical institutions, with community centers and museums being the most affected – most employees in them are over the age of 50. The situation is better in libraries and archives, with about 25% of employees being under the age of 30.

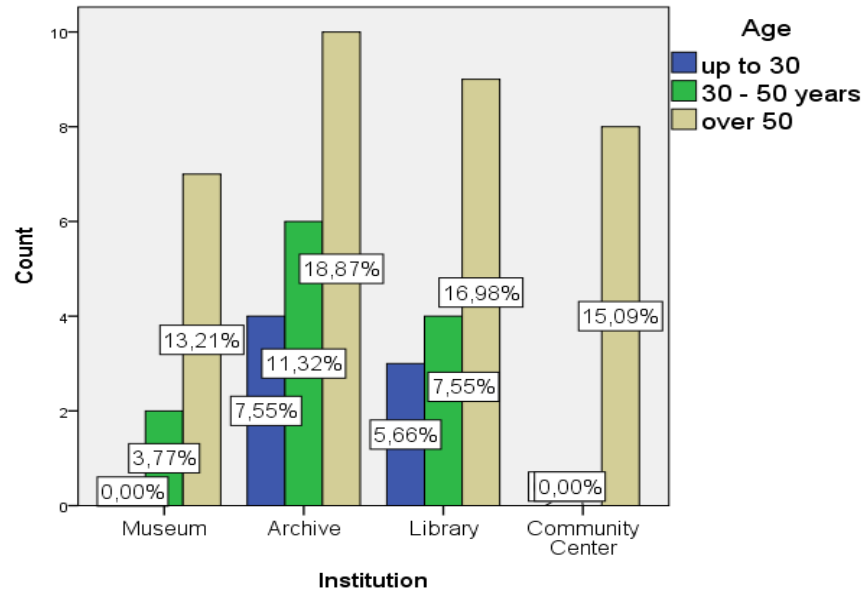


Figure 3. Distribution of respondents by age group and institution, 2025. Source: own elaboration

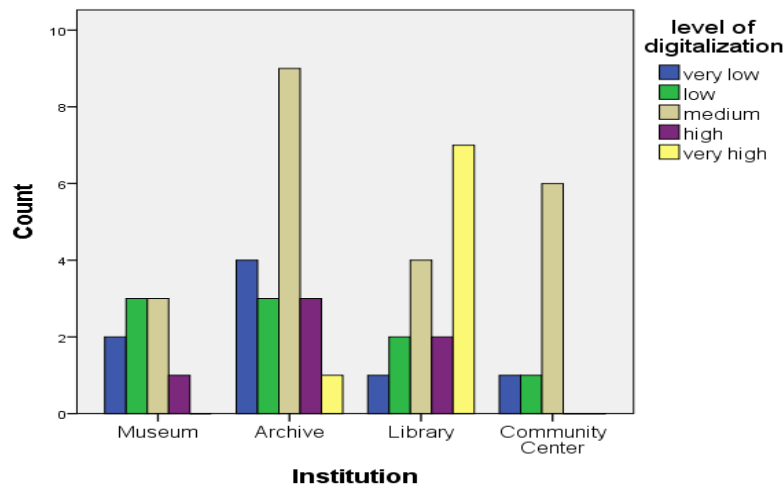


Figure 4. Assessment of the level of digitalization of institutions. Source: own elaboration

Figure 4 presents the distribution of employees' assessments of the level of digitization of the institution in which they work. According to the respondents' answers, libraries have the highest level of digitization. According to half of the library employees, the level of digitization is high and very high. This suggests that libraries have a high level of digitized units of written cultural and historical heritage. Next in line with the respondents' assessments is the State Archives Agency, with the overall picture showing us an average to low level of digitization, with about 50% assessing digitization as average. Average levels of digitization are also observed in community centers, considering the employees' opinions. However, the levels of digitization in community centers remain significantly low. The lowest level of digitization is observed in museums, with over 50% of the employees assessing the level of digitization as low and very low. Only 1 employee assessed the level of digitization as high.

The respondents' answers to the question "Would you participate in other forms of digitization in your organization", where Figure 5 presents the distribution by institution, are impressive. The answer to this question is mostly also related to the age structure of the employees, with 80% of those who took part in the survey answering "No". 100% of museum workers answered that they would not participate in other forms of digitization. The opinion of employees in community centers is similar. About 45% of employees in archives and libraries are inclined to participate in other forms of digitization in their organization.

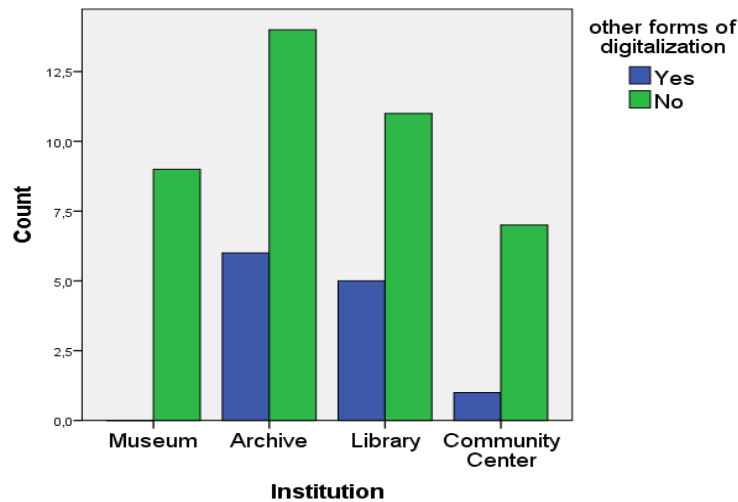


Figure 5. Distribution of respondents' answers regarding their willingness to participate in various forms of digitalization in their organization, 2025.

Source: own elaboration

In response to the research questions raised and the factors influencing the digitization of written cultural and historical heritage, 5 main groups of factors can be distinguished, based on the respondents' answers (see Table 1). The most significant factor indicated by employees in various institutions is financial constraints. Significantly few funds are allocated specifically for digitization, including resource provision for the digitization process (people, infrastructure, technologies, etc.).

The next significant factor is the technological factor, with nearly 80% of respondents determining it as having a high and very high impact. This factor is largely predetermined by the financial factor. Significantly little for the technical assets of the institutions - infrastructure, information and communication technologies, equipment, machines, etc. All this is related to the provision of financial resources and a clear digitization policy.

The employees' assessment of the manifestation of organizational and institutional factors is impressive, as this factor is assessed as having a medium to high impact. This includes internal organizational plans and measures for digitization, as well as organizational culture. In this regard, given the low level of digitization, it can be said that institutions in Bulgaria that manage written cultural and historical heritage do not have a clear vision and culture for digitization. At the same time, employees also consider the influence of the legislative framework on the digitization process, assessing this impact as significant and pointing out problems and discrepancies in the legislation. However, experts believe that this is the factor with the lowest impact on digitization.

Respondents also assess the influence of the "human resources" factor, which is the basis for achieving digitization. As can be seen in Figure 5, employees are not willing to participate in the digitization process, which is a significant limitation.

Table 1. Evaluation of factors by employees, 2025. Source: own calculations via SPSS.

Factors/Constraints	Rating	Frequency	Percent %	Mean	Median	Mode
Financial	Very low	0	0	3,89	4	4
	Low	3	5,7			
	Medium	13	24,5			
	High	24	45,3			
	Very high	13	24,5			
Human resources	Very low	0	0	3,51	3	3
	Low	6	11,3			
	Medium	22	41,5			
	High	17	32,1			
	Very high	8	15,1			
Technological	Very low	0	0	4,02	4	4
	Low	2	3,8			
	Medium	9	17,0			
	High	28	52,8			
	Very high	14	26,4			
Strategic and Legislative	Very low	0	0	3,06	3	3
	Low	13	24,5			
	Medium	27	50,9			
	High	10	18,9			
	Very high	3	5,7			
Organizational and Institutional	Very low	0	0	3,28	3	3
	Low	4	7,5			
	Medium	35	66,0			
	High	9	17,0			
	Very high	5	9,4			

To prove the first research hypothesis “The adoption of a clearly defined methodology and internal rules for digitization in the institution has a significant impact on the level of achieved digitization of cultural and historical heritage”, the Mann-Whitney U test distribution of the scores was used. This includes the answers to the questions from the survey “Does your organization have an adopted methodology (plan/strategy) for digitization of cultural and historical heritage” – the variable “digitalization methodology” and “Evaluate the level of digitization of cultural and historical heritage in your organization” – “level of digitalization”.

The statistical hypotheses are:

H_0 : There is an equal distribution between the respondents’ scores in terms of the adopted methodology for digitization and the level of digitization of cultural and historical heritage in the organization.

H_1 : There is no equal distribution between the two groups of scores.

Ranks				
	digitalization methodology	N	Mean Rank	Sum of Ranks
level of digitalization	Yes	26	36,08	938,00
	No	27	18,26	493,00
	Total	53		

Figure 6. Ranks

Source: own calculations via SPSS

The results of the Mann-Whitney U test in SPSS show that the average rank of “Yes” is 36.08 and is significantly higher than the second group “No” (see Figure 6). Both samples are ≥ 20 units and the test is statistically significant (Asymp. Sig. (2-tailed) = 0.00 $< \alpha$), which allows us to reject H_0 and conclude that there is a difference in the two groups – the adopted methodology (plan/strategy) for digitization by the institutions and the level of digitization of the cultural and historical heritage, according to the assessments of the employees. This confirms the research hypothesis (H1) that the adoption of a clearly defined methodology and internal rules for digitization in the institution has a significant impact on the level of achieved digitization of the cultural and historical heritage.

Once it is established that institutions with a clear plan and vision for digitization have higher levels of digitization of cultural and historical heritage, it is necessary to investigate how effective this digitization is and whether it makes sense at all. This is related to the second research hypothesis, in which “The degree of digitization of written cultural and historical heritage has a positive impact on its accessibility, popularization and practical application”. This includes the assessments of the respondents related to the questions: “Estimate the level of digitization of cultural and historical heritage in your organization” and “Do you think that the digitization of written cultural and historical heritage contributes to its popularization, accessibility and usability”. The values of the two variables in the model are placed on a Likert scale and the Spearman rank correlation model was applied. In this case, the research question is: “Is there a statistically significant monotonic association (relationship) between the accessibility (including popularization and usability) of digitized written cultural historical heritage (the variable “level of digitalization”) and the level of digitization of institutions preserving and providing access to such heritage (the variable “accessibility of digitized documents”)?”.

The statistical hypotheses that are tested are the following:

H_0 : There is no monotonic relationship between the two variables.

H_1 : There is a monotonic relationship between the two variables.

The result of the implemented Spearman rank correlation in SPSS shows that there is no reason to reject H_0 since the significance coefficient is greater than the 5% error risk (Sig. (2-tailed) $\geq \alpha = 0.05$), i.e., there is no monotonic relationship between the two variables (see Figure 6). As a result of the analysis, it cannot be claimed that the level of digitization leads to the popularization and increase in the accessibility of the written cultural and historical heritage, compared to the assessments of specialists.

Correlations

		level of digitalization	accessibility of digitized documents
Spearman's rho	Correlation Coefficient	1,000	-,179
	Sig. (2-tailed)	.	,201
	N	53	53
	Correlation Coefficient	-,179	1,000
	Sig. (2-tailed)	,201	.
	N	53	53

Figure 6. Correlations

Source: own calculations via SPSS

As a result of the analysis, the second research hypothesis (H2) is not proven. In this case, it can be argued that the effect of digitization does not lead to greater accessibility, popularization and usability of digitized written cultural and historical resources in Bulgaria.

From the analyses carried out in SPSS, as a result of testing the two research hypotheses, it can be concluded that institutions that have a clear vision and implement planned digitization of written historical sources have significantly better results and a higher level of digitization is observed. Naturally, they also observe the manifestation of the same factors (listed in Table 1), but rather the managements of these organizations perceive digitization as a necessary process.

Next, it is established that all institutions have taken measures for digitization of cultural and historical heritage and although some institutions have a higher level of digitization, the results are insignificant. This largely renders digitization activities meaningless, since written cultural values are inaccessible and cannot be used rationally by the public.

The results of the analysis show that in Bulgaria, although all institutions are acting on digitization, the level of digitization is relatively low. This is dictated by numerous factors and their manifestation. These factors can be structured into several main groups: financial, human resources, technological, legislative and organizational. All these factors have their impact on the level of digitization of the written cultural and historical heritage in the country. On the other hand, the digitization of written sources does not lead to significant benefits related to their accessibility and popularization. The answers to the open questions are of interest, especially those related to the recommendations made by the employees. The main problem indicated by the respondents is the legislation and, more precisely, the regulation and protection of copyright. Determining the rights for publication, distribution and commercialization of digitized content is extremely complex, especially in the case of written cultural and historical heritage. On the other hand, questions arise related to ensuring the authenticity of digital copies, as well as the emergence of other ethical risks related to the distribution of digitized copies.

Next, respondents point to a problem with coordination between different institutions. When institutions work independently, without a common vision, the result is a fragmented digital heritage. Users and researchers must search multiple different platforms to find related information. On the other hand, there is a lack of a unified national strategy for the digitization of cultural and historical heritage.

Other obstacles to the digitization of cultural and historical heritage that are indicated are: lack of complete content or elements of the digitized units; limited access and limited reuse of resources; lack of a unified platform for providing resources, etc. From a resource perspective, the most significant are the problems related to financing and human resources, indicating that there is an acute lack of experts who can combine knowledge in cultural preservation with information technologies. Many institutions do not have enough trained personnel to carry out digitization and manage digital repositories. Perhaps one of the most significant problems in effective digitization is the incompatibility of data (interoperability) - lack of uniform standards for metadata and file formats. Each institution chooses for itself what file format the digitized copies should be in, which creates serious technical barriers to interoperability and is a major problem that hinders the construction of unified digital repositories. All this predetermines the effectiveness and real benefit of the digitization of the written cultural and historical heritage in Bulgaria. In this regard, in response to the third research question, several main recommendations can be identified for improving the process of digitization of the written cultural and historical heritage in the country:

- Development of a national strategy and a unified methodology for digitization. This will define the priorities, standards and minimum technical and organizational requirements for digitization of written cultural and historical heritage.
- Ensuring sustainable financing and access to technological resources. Creation of targeted programs for financing digitization activities and investments in modern equipment, software, hardware and infrastructure to increase the capacity of institutions.
- Increasing expert and human resource capacity. Development of systematic programs for training and qualification of personnel and exchange of good practices between different institutions.
- Improving the regulatory and administrative environment. Updating the current legislation to facilitate the digitization, sharing and reuse of digital resources, as well as introducing clear procedures for managing copyright and institutional rights.
- Development of open digital platforms and public access to resources. Construction of unified platforms (applications) that would unite digital funds and make them accessible to citizens, researchers and educational institutions. This will increase the interest of the general audience and the engagement of specialists working in the field of cultural and historical heritage.

The proposed measures outline the need for a strategic and coordinated approach to the digitization of written cultural and historical heritage. The implementation of these guidelines would contribute to the building of an effective and sustainable digital ecosystem in the field of cultural and historical heritage in the country.

Conclusions

The purpose of this article was to examine the status and opportunities for digitization of written cultural and historical heritage. The present study demonstrates the fundamental role of a group of factors influencing the effective digitization of written historical sources. The analyses conducted and the proof of the two research hypotheses prove that the adoption of a clearly defined methodology and internal rules for digitization in the institution has a significant impact on the level of achieved digitization of cultural and historical heritage. According to the assessments of the employees, the digitization of written cultural and historical heritage is influenced by many factors - financial, technological, legislative, organizational and human resources factors. The study concludes that the degree of digitization does not have a positive impact on the accessibility, popularization and practical application of written cultural and historical heritage, which calls into question the success and real results of digitization. Naturally, employees' perceptions of the effects, problems, and opportunities for digitization of cultural and historical heritage are also influenced by other factors, which raises the need for additional research on the issue.

In the context of the presented results, it can be concluded that the successful digitization of written cultural and historical heritage requires not only technological solutions, but also strategic management, inter-institutional cooperation and a long-term vision for sustainable development. To overcome the discrepancy between the degree of digitization and the real social effect, it is necessary to develop and integrate a national methodological framework, update the regulatory framework, provide targeted funding and train personnel. From a technical point of view, there is a need to build unified platforms that unite digital historical resources, which would improve their accessibility and popularization. All this is a prerequisite for sustainable development of written cultural and historical heritage in the digital age.

References

- Anguelov, K., & Angelova, M. (2016). Methodology for evaluation effectiveness and efficiency in management of IT-projects. 2016 19th International Symposium on Electrical Apparatus and Technologies (SIELA), 1-4. <https://doi.org/10.1109/SIELA.2016.7542972>
- Anguelov, K. & Stoyanova, T. (2025). Assessment of Factors Influencing Market Leadership and Innovation of FinTech Companies in the Digital Economy. *Economics Ecology Socium*, 9, 93-109. <https://doi.org/10.61954/2616-7107/2025.9.3-7>
- Angelova, M., & Stoyanova, T. (2018). Cultural and creative business through Investment Plan for Europe. In 2018 International Conference on High Technology for Sustainable Development (HiTech) (pp. 1–4). IEEE. <https://doi.org/10.1109/HiTech.2018.8566247>
- Batjargal, B., Pan, J., Ji, S., Li, L., Yamaguchi, H., Hasegawa, K., Nishibayashi, T., Maeda, A., Sarjiati, U., Thufail, F. I., Brahmantara, & Tanaka, S. (2023). Developing A Multimodal Database of Digital Archives for Cultural Heritage Sites – A Case of Digitally Preserving the Borobudur Temple of Indonesia, *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLVIII-1/W2-2023, 713-720, <https://doi.org/10.5194/isprs-archives-XLVIII-1-W2-2023-713-2023>
- Braeden, B., Dunn, M., Ang, A., & Villis, C. (2020). The application of the state-of-the-art technologies to support artwork conservation: Literature review. *Journal of Cultural Heritage*, 44, 13, 239-259. <https://doi.org/10.1016/j.culher.2020.02.010>
- Bruno, S., Musicco, A., Fatiguso, F., & Dell'Osso, G. R. (2021). The Role of 4D Historic Building Information Modelling and Management in the Analysis of Constructive Evolution and Decay Condition within the Refurbishment Process. *International Journal of Architectural Heritage*, 15(9). <https://doi.org/10.1080/15583058.2019.1668494>
- Buragohain, D., Meng, Y., Deng, C. et al. (2024). Digitalizing cultural heritage through metaverse applications: challenges, opportunities, and strategies. *Herit Sci* 12, 295. <https://doi.org/10.1186/s40494-024-01403-1>
- Daga, E. et al. (2022). Integrating Citizen Experiences in Cultural Heritage Archives: Requirements, State of the Art, and Challenges. *ACM Journal on Computing and Cultural Heritage (JOCCH)*, 15(1), Article No. 11, 1-35. <https://doi.org/10.1145/3477599>
- D'Angelo, A., Ricciardi, L., & Gugliermetti, L. (2018). Smart City and Cultural Heritage: Resilience Through Crowdsourcing Involvement. Proceedings - 2018 IEEE International Conference on Environment and Electrical Engineering and 2018 IEEE Industrial and Commercial Power Systems Europe, IEEEIC/I and CPS Europe 2018. <https://doi.org/10.1109/EEEIC.2018.8494355>
- Di Filippo, A., Sánchez-Aparicio, L. J., Barba, S., Martín-Jiménez, J. A., Mora, R., & González Aguilera, D. (2018). Use of a Wearable Mobile Laser System in Seamless Indoor 3D Mapping of a Complex Historical Site. *Remote Sensing*, 10(12), 1897. <https://doi.org/10.3390/rs10121897>
- Dimcheva, G., & Stoyanov, I. (2023). Challenges to the Application and Decision-Making using Artificial Intelligence (AI): Analysis of the Attitudes of Managers in Bulgarian Service Companies, 4th International Conference on Communications, Information, Electronic and Energy Systems (CIEES), Plovdiv, Bulgaria, 2023, 1-5, <https://doi.org/10.1109/CIEES58940.2023.10378811>
- Donghui, C., Guanfa, L., Wensheng, Z. et al. (2019). Virtual reality technology applied in digitalization of cultural heritage. *Cluster Comput* 22(Suppl 4), 10063-10074. <https://doi.org/10.1007/s10586-017-1071-5>

- García-Molina, D., López-Lago, S., Hidalgo-Fernandez, R., & Triviño-Tarradas, P. (2021). Digitalization and 3D Documentation Techniques Applied to Two Pieces of Visigothic Sculptural Heritage in Merida Through Structured Light Scanning. *Journal on Computing and Cultural Heritage (JOCCH)*, 14(4), Article 43, 1-19. <https://doi.org/10.1145/3427381>
- Hadi, S., Darsa, U. A., Paulus, E., Suryani, M., & Burie, J. C. (2025). Digital Handling Procedure for Digitalizing and Indexing Ancient Manuscripts. *IEEE ACCESS*, 13, 181799-181812. <https://doi.org/10.1109/ACCESS.2025.3621551>
- Ivanov, M., Martseniuk, L., Angelova, M., & Faifer, S. (2025). Strategic Risk Management of Digital Transformation in the Economic Security of Industrial Enterprises. *Economics Ecology Socium*, 9, 124-141. <https://doi.org/10.61954/2616-7107/2025.9.2-9>
- Kassahun Bekele, M., Pierdicca, R., Frontoni, E., Savina Malinverni, E., & Gain, J. (2018). A survey of augmented, virtual, and mixed reality for cultural heritage. *Journal on Computing and Cultural Heritage*, 11, 2. <https://doi.org/10.1145/3145534>
- Khan, N. A., Shafi, S. M., & Ahangar, H. (2018). Digitization of Cultural Heritage: Global Initiatives, Opportunities and Challenges. *Journal of Cases on Information Technology (JCIT)*, 20(4), 1-16. <https://doi.org/10.4018/JCIT.2018100101>
- Khatoon, A. (2025). Manuscript Heritage and Contemporary Discourse in India. *Graduate Journal of Interdisciplinary Research, Reports and Reviews*, 3(01), 48-61. <https://doi.org/10.34256/gjir3.v3i01.52>
- Koprinkova-Noncheva, N. & Dimitrov, I. (2022). Increasing the Investment Attractiveness of SMEs by Applying the Drop-Shipping Supply Chain Model in Context of Environmental, Social and Corporate Governance. 2022 V International Conference on High Technology for Sustainable Development (HiTech), Sofia, Bulgaria, pp. 1-5. <https://doi.org/10.1109/HiTech56937.2022.10145526>
- Laerd Statistics (2018). Mann-Whitney U Test using SPSS Statistics. Available at: <https://statistics.laerd.com/spss-tutorials/mann-whitney-u-test-using-spss-statistics-2.php>
- Lutfullayeva, D., Jabbarov, U., Rashidova, M., Saidov, J., Kan, V., Matkarimov, N., & Matkarimov, I. (2025). Textual, Linguistic, and Historical Examination of Rare Manuscripts. *Indian Journal of Information Sources and Services*, 15(2), 236-244. <https://doi.org/10.51983/ijiss-2025.IJISS.15.2.31>
- McKnight, P. & Najab, J. (2010). Mann-Whitney U Test. The Corsini Encyclopedia of Psychology. <https://doi.org/10.1002/9780470479216.corpsy0524>
- Milkova, E., Chadimova, L., & Manenova, M. (2019). 3D Technology in the Sphere of Cultural Heritage and Serious Games. In: Ntalianis, K., Vachtsevanos, G., Borne, P., Croitoru, A. (eds) Applied Physics, System Science and Computers III. APSAC 2018. Lecture Notes in Electrical Engineering, vol. 574. Springer, Cham. https://doi.org/10.1007/978-3-030-21507-1_28
- Montusiewicz, J., Miłosz, M., Kęsik, J. et al. (2021). Structured-light 3D scanning of exhibited historical clothing – a first-ever methodical trial and its results. *Herit Sci*, 9, 74. <https://doi.org/10.1186/s40494-021-00544-x>
- Neikova, M. (2024). Digitalization and Protection of Cultural Heritage by Establishing a Sustainable Legal Framework. *Digital Presentation and Preservation of Cultural and Scientific Heritage*, 14, 197-204. <https://doi.org/10.55630/dipp.2024.14.18>
- Nawaz, M., Akhtar, M. N., Tariq, D. M., Batool, S., & Ali, S. (2024). Digitization Process of Archives: A Case Study of the Punjab Archives, Lahore. *Qlantic Journal of Social Sciences and Humanities*, 5(1), 240-247. <https://doi.org/10.55737/qjssh.391567320>
- Nguyen, T. A., Do, S. T., Le-Hoai, L., Nguyen, V. T., & Pham, T. A. (2022). Practical workflow for cultural heritage digitalization and management: a case study in Vietnam. *International Journal of Construction Management*, 23(13), 2305-2319. <https://doi.org/10.1080/15623599.2022.2054268>
- Pepe, M., Costantino, D., Alfio, V.S., Restuccia, A.G. & Papalino, N.M. (2021). Scan to BIM for the digital management and representation in 3D GIS environment of cultural heritage site. *Journal of Cultural Heritage*, 50, 115-125. <https://doi.org/10.1016/j.culher.2021.05.006>
- Sabarirajan, A., Reddi, L. T., Rangineni, S., Regin, R., Rajest, S. S., & Paramasivan, P. (2024). Leveraging MIS Technologies for Preserving India's Cultural Heritage on Digitization, Accessibility, and Sustainability. In S. Singh, S. Rajest, S. Hadoussa, A. Obaid, & R. Regin (Eds.), *Data-Driven Intelligent Business Sustainability* (pp. 122-135). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-0049-7.ch009>

Sánchez-Martín, J.-M., Guillén-Peñafiel, R., & Hernández-Carretero, A.-M. (2025). Artificial Intelligence in Heritage Tourism: Innovation, Accessibility, and Sustainability in the Digital Age. *Heritage*, 8(10), 428. <https://doi.org/10.3390/heritage8100428>

Siliutina, I., Tytar, O.V., Barbash, M., Petrenko, N., & Yepyk, L. (2024). Cultural preservation and digital heritage: challenges and opportunities. *Amazonia Investiga*, 13(75), 262-273. <https://doi.org/10.34069/AI/2024.75.03.22>

Trizio, I., Savini, F. & Giannangeli, A. (2018). Integration of three-dimensional digital models and 3D GIS: The documentation of the medieval burials of amiternum (L'Aquila, Italy). *Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci.*, XLII-2, 1121-1128, <https://doi.org/10.5194/isprs-archives-XLII-2-1121-2018>

Tsonkov, N., Petrov, K., Berberova-Valcheva, T. (2022). Adoption of information technologies for black sea region municipalities' smart development. *International Journal on Information Technologies and Security*, 14(1), 87-96. <https://doi.org/10.1109/InfoTech58664.2023.10266892>

Vambol, S., Alqahtani, M. F., Dolchinkov, N. T., Ilyas, M., Yeremenko, S., Sydorenko, V., Mishchenko, I., Melnyk, V., & Dzhulai, O. (2024). Investigation of the transfer radioactive contamination from the Chernobyl zone and its impact on radiation in the environment. *Ecological Engineering & Environmental Technology*, 25(12), 70-84. <https://doi.org/10.12912/27197050/193261>

Zar, J. H. (2005). Spearman Rank Correlation. *Encyclopedia of Biostatistics*. <https://doi.org/10.1002/0470011815.b2a15150>

Funding: The research presented in this publication was funded by the Research and Development sector of the Technical University of Sofia, project “Research into applicable models of archive digitization when using business information systems in Bulgarian conditions”, contract No 252ΠД0013-15.

Data Availability Statement: More primary data be obtained from the corresponding author on a reasonable request.

Author Contributions: The authors contribute equally. All authors have read and agreed to the published version of the manuscript.

Radoslav KOSTEV is a Chief Assistant, PhD of the Management and Business Information Systems Department, Technical University of Sofia, Bulgaria. Research interests: IT Management; Business Information Systems; Public Sector Management; Regional Development; Smart Cities.

ORCID ID: <https://orcid.org/0000-0003-1209-4705>

Boyko MLADENOV is a PhD student of the Management and Business Information Systems Department, Technical University of Sofia, Bulgaria. Research interests: digitization of cultural and historical heritage, in particular historical written archives and literary sources.

ORCID ID: N/A

Copyright © 2026 by author(s) and VsI Entrepreneurship and Sustainability Center

This work is licensed under the Creative Commons Attribution International License (CC BY),

<http://creativecommons.org/licenses/by/4.0/>



Open Access