# Digital tools for safeguarding and promoting cultural heritage: a case study of UNESCO World Heritage Sites in Romania

**Ionela Gavrilă-Paven**[1]

***To cite this article:***
*Gavrilă-Paven, I. (2026). Digital tools for safeguarding and promoting cultural heritage: a case study of UNESCO World Heritage Sites in Romania. Romanian Journal of Economics, 63(2), 22-38.*

***Abstract. Objective:*** *Digital technologies increasingly shape how cultural heritage is documented, interpreted, accessed, and protected. This study evaluates the contribution of digitalisation to the safeguarding and promotion of Romanian UNESCO World Heritage, focusing on the Churches of Moldavia, the Historic Centre of Sighișoara, and the Dacian Fortresses of the Orăștie Mountains.* ***Method****: A qualitative-descriptive case-study design combines structured content analysis, cross-site comparison, and an indicator-based assessment. Publicly accessible institutional websites, virtual tours, social media channels, educational materials, and policy documents were reviewed between March and May 2025. Digital performance was assessed across visibility, interactivity and innovation, educational value, community engagement, and security and preservation value.* ***Results****: Digital maturity differs markedly across the three sites. The Churches of Moldavia show the strongest combination of documentation, multilingual accessibility, and cultural storytelling; Sighișoara displays active digital promotion and community engagement but more limited immersive innovation; and the Dacian Fortresses remain weakly and fragmentedly represented online. The comparison indicates that institutional capacity, coordination, and integration with tourism and cultural networks shape digital outcomes. Digital documentation also offers important benefits for conservation, risk management, education, and virtual access.* ***Originality****: The article develops a replicable framework that connects digital heritage performance with identity, innovation, awareness, sustainability, and security. It also proposes an integrated national digital heritage platform and more coherent investment in interoperable data, participatory narratives, and immersive technologies.*

***Keywords****: digital heritage, UNESCO World Heritage Sites, cultural identity and awareness, heritage innovation and sustainability, heritage digitalisation strategies*
***JEL classification:*** *Z11, Z12, O33, H41, R11*

## 1. Introduction

Cultural heritage represents a fundamental component of societal development, collective identity, and long-term cultural continuity. In contemporary economic and social contexts, heritage is increasingly recognised not only for its intrinsic cultural value but also for its capacity to contribute to sustainable development, social cohesion, and regional competitiveness. The accelerating digital transformation of the 21st century has profoundly reshaped the mechanisms through which heritage is preserved, communicated, and valorised. Digital tools - ranging from virtual tours and 3D

[1] "1 Decembrie 1918" University of Alba Iulia, Romania, e-mail address: ionelapaven@yahoo.com. ORCID: https://orcid.org/0000-0002-9202-5285.

reconstructions to online archives and interactive platforms - have become essential instruments for ensuring accessibility, safeguarding, and participatory engagement in the management of cultural assets.

At European level, policies promoted by the European Commission and UNESCO highlight the pivotal role of digital technologies in supporting heritage governance, educational outreach, and risk management. The increasing emphasis on open access, digital documentation, and technological innovation positions digital heritage as a cornerstone of contemporary cultural policy. These developments are highly relevant for countries such as Romania, whose diverse cultural landscape includes 11 properties inscribed on the UNESCO World Heritage List, each representing unique historical, artistic, and symbolic dimensions. Among these, the Painted Churches of Northern Moldavia, the Historic Centre of Sighișoara, and the Dacian Fortresses of the Orăștie Mountains constitute emblematic examples of Romania's cultural legacy and its potential for sustainable socio-economic development.

Despite their significance, the degree of digital integration across Romanian UNESCO sites remains uneven. Some sites benefit from relatively well-developed digital platforms, multimedia resources, and international visibility, while others exhibit fragmented digital presence, limited online accessibility, and insufficient interpretative tools. This disparity raises critical questions regarding the capacity of digital strategies to support heritage conservation, identity reinforcement, and sustainable development in the Romanian context. At the same time, it underscores the necessity of rethinking heritage management practices through coherent national policies and coordinated technological investment.

In this context, the present study examines the extent to which digital tools contribute to the capitalisation of Romanian UNESCO heritage, focusing on the comparative evaluation of three representative sites. It investigates the digital resources available - ranging from websites and social media platforms to virtual exhibitions and digital archives - and assesses their effectiveness in enhancing visibility, educational value, innovation, and community engagement. By employing a mixed qualitative–quantitative methodological approach, the study provides empirical evidence on the current state of digitalisation in the Romanian heritage sector and identifies gaps that hinder the strategic development of digital cultural management.

The research is relevant for both academic inquiry and policy formulation. From an academic perspective, it contributes to the emerging field of digital heritage studies by integrating conceptual frameworks from critical heritage theory, digital humanities, and sustainable development. From a policy standpoint, it offers actionable insights for institutions responsible for heritage protection, proposing mechanisms for strengthening technological adoption, enhancing digital accessibility, and improving institutional coordination. Moreover, the study aligns with broader international agendas - such as the UNESCO (2015) Policy on Sustainable Development and the EU Digital Europe Programme (European Commission, 2021) - which emphasise the inseparable relationship between digital innovation, cultural resilience, and community well-being.

Overall, this article argues that digitalisation represents not merely a technological trend but a strategic vector for heritage capitalisation, capable of expanding public access, reinforcing cultural identity, and contributing to sustainable socio-economic development. The findings underscore the need for an integrated national digital heritage strategy, increased investment in immersive technologies, and broader community participation in digital storytelling and heritage interpretation. By addressing these aspects, the study contributes to a deeper understanding of how digital innovation can be harnessed to safeguard and promote Romania's cultural heritage in the digital age.

## 2. Literature review

### *2.1. Heritage capitalisation and identity*

The concept of heritage capitalisation has evolved from traditional notions of preservation toward a dynamic process of value creation, identity reinforcement, and sustainable development. Graham, Ashworth, and Tunbridge (2000) define heritage as a cultural construct that mediates between memory and place, highlighting its potential to strengthen both collective and individual identity. Smith (2006) further challenges the "authorized heritage discourse," arguing that heritage is not merely

inherited but constantly reinterpreted through social practices. In this view, heritage capitalisation implies not only economic valorisation through tourism or branding but also symbolic reinforcement through education, participation, and innovation. Complementary perspectives connect heritage value to place, tourism, and the cultural construction of meaning (Apostolopoulos & Gayle, 2002; Ashworth & Graham, 2005; Waterton & Watson, 2013).

Within the European context, heritage identity has been increasingly linked to sustainable regional development. The Council of Europe's Faro Convention (2005) emphasises the social value of cultural heritage and the right of every individual to participate in its interpretation and transmission. This participatory dimension underlines that heritage is not static but co-created, thus requiring new modes of communication and interaction. Digital technologies have become key instruments for facilitating this inclusive and dialogic process.

### *2.2. Digitalisation and innovation in heritage management*

Digital transformation has reshaped the way cultural heritage is documented, preserved, and communicated. Parry (2010) identifies the emergence of a "digital heritage ecosystem" that connects institutions, researchers, and the public through interactive tools, immersive experiences, and open-access databases. Giaccardi (2012) expands on this notion by introducing the concept of heritage 2.0, where users contribute to meaning-making via social media, digital storytelling, and online archives. Related studies on digital collections, open access, and participatory heritage likewise emphasise new models of access and public involvement (Bertacchini & Morando, 2013; Resta & Sormani, 2018; Terras, 2015).

These perspectives converge in recognising that digitalisation not only enhances accessibility but also redefines authenticity and participation. As Harrison (2013) argues, digital heritage generates new epistemologies of memory - fluid, collaborative, and multi-layered - thus challenging traditional hierarchies of expertise. Digital narratives can also reinforce urban identity by enabling communities to participate in heritage representation (van der Hoeven & van Nes, 2019).

Empirical studies support these theoretical frameworks. Projects such as Europeana, Google Arts & Culture, and the Virtual Museum of Romania illustrate how digitisation can democratise heritage access and foster transnational identity narratives. However, several scholars (Kalay et al., 2008; Champion, 2015) warn that digital innovation must be critically balanced with issues of technological obsolescence, data ethics, and representational integrity.

For countries with rich yet vulnerable heritage assets - such as Romania - digital tools can serve dual purposes: enhancing visibility and ensuring long-term documentation in contexts of environmental and socio-economic risk. Research on digital tools and design-led innovation further demonstrates their contribution to documentation, interpretation, learning, and public access (Liritzis et al., 2015; Luigini & Panciroli, 2018).

### *2.3. UNESCO and the digital heritage agenda*

UNESCO's Policy on the Integration of a Sustainable Development Perspective into the Processes of the World Heritage Convention (UNESCO, 2015) and its Digital Heritage Charter advocate for integrating digital documentation, 3D scanning, and online dissemination into heritage management strategies. The Organisation emphasises the role of technology in risk reduction, educational outreach, and intercultural dialogue. Digitalisation is not viewed solely as a technological innovation but as a means of fulfilling UNESCO's broader objectives—awareness, sustainability, and global cooperation.

In Romania, the National Institute of Heritage (INP, 2024) has undertaken digitisation projects such as Patrimoniu.gov.ro, Repertoriul Arheologic Național, and online inventories of historical monuments. Nonetheless, these initiatives remain fragmented and unevenly implemented across heritage sites. Studies conducted by the Romanian Academy (2019–2023) show that the gap between policy vision and local practice persists, largely due to limited financial and technical resources. These initiatives also relate to the strategic directions advanced by the Ministry of Culture, Romania (2024).

Consequently, the literature underscores a need for coherent digital policies, capacity building, and integrated communication platforms that align with European and UNESCO priorities.

### *2.4. Synthesis and research gap*

The reviewed literature establishes a strong conceptual link between heritage, identity, and innovation, while also highlighting the transformative role of digitalisation. However, few empirical studies have examined how these processes manifest within the Romanian context, particularly in relation to UNESCO World Heritage Sites. Existing analyses often focus on tourism potential or conservation challenges, without systematically assessing digital engagement or visibility indicators. At EU level, this need is also recognised in assessments of the place of cultural heritage across European policies (European Parliament, 2022).

This study seeks to bridge that gap by developing a framework for evaluating the digital performance of Romanian UNESCO sites, combining theoretical insights with measurable indicators. The objective is to determine how digital strategies contribute to heritage capitalisation and to identify best practices and areas for improvement.

## 3. Methodology and data

### *3.1. Case selection*

The research focuses on three Romanian UNESCO World Heritage Sites, selected for their cultural diversity, geographical distribution, and availability of public data: The selection and inscription years were checked against the country inventory published by the World Heritage Centre (2024).

*(1)* Painted Churches of Northern Moldavia (1993) – renowned for their exterior frescoes and strong religious symbolism; active in virtual tourism promotion.

*(2)* Historic Centre of Sighișoara (1999) – medieval urban settlement with tourism potential and digital presence through municipal and private platforms.

*(3)* Dacian Fortresses of the Orăștie Mountains (1999) – archaeological sites with limited physical accessibility and minimal digital visibility.

This selection ensures coverage of distinct heritage typologies - religious, urban, and archaeological - allowing a comparative perspective.

### *3.2. Data sources*

The analysis conducted in this study is grounded in a diverse set of data sources designed to ensure methodological rigor and comprehensive coverage of the digital presence of Romanian UNESCO World Heritage Sites. Given the multidimensional nature of digital heritage - spanning cultural, technological, institutional, and societal aspects - it was necessary to incorporate both qualitative and quantitative data types. Table 1 provides an overview of the categories of sources consulted, ranging from institutional documentation and digital media platforms to analytical metrics and scholarly literature. This structured approach allows for a nuanced understanding of each site's official status, digital tools, level of public engagement, and alignment with broader international policy frameworks.

**Table 1. Data sources used in the analysis**

| Source type | Specific sources consulted | Purpose |
|---|---|---|
| Institutional platforms | UNESCO World Heritage Centre, INP Romania, Ministry of Culture reports | Heritage background, official status |
| Digital media | Websites, virtual tours, YouTube channels, social media pages | Evaluation of digital tools and outreach |
| Quantitative data | Website analytics (where available), social media metrics | Measurement of engagement and visibility |
| Scholarly and policy literature | Academic articles, UNESCO and EU reports | Contextualisation and benchmarking |

Source: Author's compilation based on the World Heritage Centre (2024), National Institute of Heritage (INP, 2024), Ministry of Culture, Romania (2024), and public digital resources reviewed between March and May 2025.

Together, the sources presented in Table 1 form an integrated evidentiary base that supports a balanced evaluation of digitalization practices across the selected UNESCO sites. Institutional documents ensure the accuracy and authenticity of heritage information, while digital media and online analytics provide insight into current visibility and user interaction patterns. Complementary scholarly and policy literature situates the findings within broader theoretical and strategic contexts. The combination of these data types enhances the robustness of the analysis, enabling both cross-site comparison and informed conclusions regarding the strengths, limitations, and development potential of digital heritage strategies in Romania.

### *3.3. Analytical framework and indicators*

The analytical framework combines *qualitative evaluation* (content analysis) and *quantitative indicators* (visibility, engagement, educational content). Each indicator is assessed on a 5-point qualitative scale (1 = absent; 5 = highly developed) to facilitate comparative interpretation.

**Table 2. Indicators used in the analysis**

| Category | Indicator | Description | Measurement source |
|---|---|---|---|
| Visibility | Online presence | Existence of official or associated website | Institutional websites |
| | Web traffic / ranking | Estimated visits or site ranking | SimilarWeb / analytics reports |
| Engagement | Social media followers | Followers and interaction rate | Facebook / Instagram |
| | Multimedia content | Use of images, videos, virtual tours | Content analysis |
| Educational Value | Digital learning tools | Presence of online educational resources | Site content |
| | Multilingual accessibility | Availability in multiple languages | Site review |
| Innovation | Use of immersive technology | VR/AR, 3D models, digital reconstructions | Project documentation |
| Security & Documentation | Digital archiving | Availability of digitised inventories | INP / UNESCO data |

Source: Author's elaboration based on Kalay et al. (2008), Giaccardi (2012), Bonacini (2017), UNESCO (2015), and ICOMOS (2017).

The scoring system applied in the analytical framework was designed to ensure transparency and comparability between the selected heritage sites. Each indicator was evaluated using predefined qualitative criteria derived from digital heritage assessment practices discussed in the literature (Kalay et al., 2008; Giaccardi, 2012; Bonacini, 2017).

For the indicator-based assessment (Table 2), a five-point scale was used to measure the level of digital implementation:

1 – Very low presence: absence or extremely limited digital tools; minimal online information;
2 – Low presence: basic online visibility (e.g., simple informational pages) without interactive or multimedia features;
3 – Moderate implementation: functional digital presence including multimedia content or partial educational resources;
4 – Advanced implementation: diversified digital ecosystem with social media interaction, multimedia resources, and structured online content;
5 – Highly developed implementation: integrated digital platforms combining interactive technologies, multilingual resources, educational tools, and sustained online engagement.

For the qualitative content analysis, a three-level scale was employed to evaluate interpretative richness and usability of digital materials:

1 – Low level: limited contextual information, minimal interpretative narrative, poor visual or educational content;

2 – Moderate level: adequate historical description and basic multimedia integration;

3 – High level: comprehensive narrative interpretation, diverse digital media, and strong educational or participatory components.

This scoring system does not aim to produce strict quantitative rankings but rather to provide a structured qualitative comparison of digital heritage practices across the analysed sites.

To assess the degree of digitalisation across the selected UNESCO World Heritage Sites, the study employs a structured set of indicators designed to capture multiple dimensions of digital performance. As shown in Table 2, these indicators are grouped into four broad analytical categories - visibility, engagement, educational value, innovation, and security & documentation - each reflecting a key aspect of digital heritage development. The visibility category focuses on the accessibility and prominence of each site's digital footprint, evaluated through the existence of official websites and comparative web traffic data. Engagement-related indicators measure the extent to which digital platforms foster interaction with online audiences, including social media activity and the integration of multimedia content. Together, these indicators provide insights into the capacity of digital tools to enhance public awareness and strengthen identity-based communication.

In addition to assessing visibility and engagement, the analytical framework integrates indicators related to educational value, innovation, and digital documentation. Educational value is captured through the presence of digital learning resources and multilingual accessibility, both of which are essential for inclusive heritage communication and international outreach. The innovation category examines the use of advanced technologies - such as virtual reality, augmented reality, and 3D reconstructions - which serve as markers of digital sophistication and experiential enhancement. Finally, the security and documentation indicator evaluates the availability of digitised inventories and archival materials, reflecting the extent to which digital tools support heritage protection and long-term preservation. Collectively, the indicators outlined in Table 2 enable a comprehensive, multidimensional evaluation of digitalisation practices, facilitating systematic comparison across sites and contributing to the robustness of the study's methodological approach.

The selection of indicators presented in Table 2 reflects an effort to construct a robust analytical framework capable of capturing the multidimensional nature of digital heritage implementation. Given the complexity of heritage digitalisation - encompassing communication, education, innovation, preservation, and community engagement - the indicators were designed to provide both depth of analysis and cross-site comparability. Their structure aligns with international best practices and responds to the need for objective, measurable criteria in evaluating the performance of cultural institutions in the digital environment. The documentation and preservation dimensions also reflect established work on semantic platforms and heritage building information modelling (De Luca et al., 2011; Pocobelli et al., 2018).

### *3.4. Methodological approach*

The indicators used in this study are grounded in internationally recognised principles for digital heritage governance, ensuring conceptual alignment with the frameworks established by UNESCO, ICOMOS, and the European Commission. The visibility and engagement indicators reflect UNESCO's emphasis on inclusive access and public awareness as outlined in the *Policy on the Integration of a Sustainable Development Perspective into the World Heritage Convention* (UNESCO, 2015). By assessing website presence, web traffic, and social media interaction, the framework addresses the global shift toward openness, transparency, and participatory communication in heritage management. Authenticity and integrity were treated as essential criteria in the assessment of digital representations (Jokilehto, 2006).

Similarly, the inclusion of indicators related to educational value and multilingual accessibility corresponds to the UNESCO *World Heritage Education Programme* and aligns with EU objectives promoting digital literacy, cultural diversity, and cross-border visibility. These indicators recognise that

digital heritage platforms serve not only as information repositories but also as tools for learning, intercultural dialogue, and international engagement.

The innovation indicator- evaluating the use of VR/AR technologies, 3D models, and interactive reconstructions - is inspired by ICOMOS guidelines on digital documentation and the *Principles for the Conservation of Digital Heritage* (ICOMOS, 2017). These standards advocate for technological innovation as a means of enhancing interpretative quality, supporting conservation, and mitigating the effects of restricted physical access. Moreover, the security and documentation indicator corresponds directly to UNESCO's recommendations on risk preparedness and digital archiving, as well as the broader European strategy for cultural data preservation set forth by the *European Framework for Action on Cultural Heritage* (2018). This approach is consistent with virtual archaeology's emphasis on three-dimensional communication and interpretation (Forte, 2014).

By integrating these internationally accepted principles, the analytical framework ensures that the evaluation of Romania's UNESCO sites is not only methodologically consistent but also reflective of current global expectations in heritage digitalisation. This alignment strengthens the study's relevance and provides a solid foundation for comparative analysis, policy recommendations, and future research on digital heritage strategies.

The methodological framework adopted in this study combines *qualitative content analysis* with *a comparative, indicator-based assessment*, enabling an integrated evaluation of the degree of digitalisation and cultural valorisation across selected Romanian UNESCO World Heritage Sites.

This mixed analytical design ensures both *depth of interpretation* (through qualitative insights) and *cross-case comparability* (through structured indicators). The approach is descriptive-analytical rather than experimental, aligning with the exploratory objectives of heritage policy and digital transformation research.

*(1)* *Content analysis:* Systematic examination of digital materials to assess depth and quality of interpretation (texts, images, virtual tours).

The first methodological pillar - *content analysis* - was designed to examine systematically the *digital materials and online representations* associated with the selected sites. The main goal was to assess the *depth, accuracy, accessibility, and interpretative richness* of the digital heritage resources.

The content analysis followed the structured model proposed by Hsieh and Shannon (2005) for qualitative content analysis, adapted for digital heritage studies (Giaccardi, 2012; Bonacini, 2017). The process consisted of three phases:

1. *Data collection and corpus definition*: For each of the three selected UNESCO sites - the Painted Churches of Northern Moldavia, the Historic Centre of Sighișoara, and the Dacian Fortresses of the Orăștie Mountains - all relevant digital resources were identified and catalogued. These included:
   - Official websites (national and local heritage portals);
   - Online documentation available through the *UNESCO World Heritage Centre*;
   - Virtual tours or 3D reconstructions (if present);
   - Social media pages (Facebook, Instagram, YouTube channels);
   - Educational and promotional digital materials (brochures, interactive maps, digital exhibitions).

Data were gathered between March and May 2025, ensuring coverage of the most recent digital outputs. Screenshots and metadata were archived to allow verification.

2. *Analytical coding and thematic dimensions*: The materials were examined according to four *analytical dimensions,* each associated with a thematic criterion relevant to heritage digitalisation (Table 3).
3. Each dimension was assessed on a three-level ordinal scale (1 = low, 2 = moderate, 3 = high) to support comparative synthesis.
4. *Interpretation and synthesis:* The coded data were then interpreted through *contextual qualitative analysis,* linking the identified digital practices to the broader objectives of heritage capitalisation and public awareness. The results provided insight into how digital tools contribute to identity reinforcement and sustainable heritage management.

**Table 3. Analytical coding and thematic dimensions**

| Dimension | Analytical focus | Illustrative indicators |
|---|---|---|
| Content quality | Historical accuracy, narrative depth, interpretative richness | Level of contextualisation, citation of expert sources, availability of multilingual texts |
| Accessibility and usability | Ease of navigation, multilingual support, accessibility compliance | Number of available languages, user interface quality, mobile compatibility |
| Visual and media integration | Diversity and quality of digital media (images, videos, 3D models, VR) | Resolution, interactivity level, inclusion of immersive tools |
| Educational and community value | Integration of learning materials, citizen engagement, participatory initiatives | Existence of virtual exhibitions, educational kits, or crowdsourced contributions |

Source: Author's elaboration based on Hsieh and Shannon (2005), Giaccardi (2012), and Bonacini (2017).

The advantage of this approach lies in its capacity to reveal both *quantitative disparities* (such as lack of content or features) and *qualitative nuances* (such as interpretative richness or inclusiveness of narrative voice). In doing so, it aligns with the interpretative paradigms of heritage as a *living and communicative process* (Smith, 2006; Tilden, 2007).

*(2) Comparative assessment:* Cross-site comparison using the indicators table, identifying strengths and weaknesses.

The second methodological pillar—*comparative assessment*—aimed to synthesise findings from the content analysis and to identify *cross-site patterns, strengths, and weaknesses.* It employed a structured *indicator-based evaluation matrix,* ensuring consistency and objectivity in inter-site comparison.

### *a. Construction of indicators*

Based on previous European frameworks (European Commission, 2018; UNESCO, 2023; ICOMOS, 2017), five core indicators were established to measure the performance of digital heritage implementation (Table 4).

**Table 4. Performance of digital heritage implementation**

| Indicator | Operational definition | Data source/Measurement method |
|---|---|---|
| Digital Presence (DP) | Existence and visibility of official online platforms, including websites and social media | Identification and verification of official domains; search engine visibility |
| Interactivity and Innovation (II) | Degree of technological sophistication and interactivity (VR, AR, 3D models, digital mapping) | Review of digital tools integrated in official platforms |
| Educational Value (EV) | Extent to which digital tools provide learning materials or didactic engagement | Presence of educational content, virtual lessons, or downloadable materials |
| Community Engagement (CE) | Involvement of local communities, volunteers, or user-generated content | Analysis of social media engagement metrics and participatory projects |
| Security and Preservation Value (SPV) | Use of digital documentation for preservation, monitoring, or risk management | Presence of digital archives, GIS mapping, or environmental monitoring systems |

Source: Author's elaboration based on European Commission (2018), UNESCO (2023), and ICOMOS (2017).

Each site was scored on a scale from 1 to 5 (1 = minimal evidence, 5 = advanced implementation), resulting in a comparative table of average indicator values. This semi-quantitative approach enables both ranking and interpretive commentary.

### *b. Cross-site comparison*

Once the scores were established, the three sites were compared across indicators to identify relative strengths and deficiencies (Table 5).

**Table 5. Performance of digital heritage implementation – Study case**

| Site | DP | II | EV | CE | SPV | Overall level |
|---|---|---|---|---|---|---|
| Painted Churches of Northern Moldavia | 5 | 4 | 5 | 4 | 3 | High |
| Historic Centre of Sighișoara | 4 | 3 | 4 | 5 | 2 | Moderate–High |
| Dacian Fortresses of the Orăștie Mountains | 2 | 2 | 3 | 2 | 2 | Low–Moderate |

Source: Author's assessment of the public digital resources reviewed between March and May 2025.

This comparative structure highlights not only quantitative differences but also the qualitative contexts behind them - for instance, the limited institutional coordination affecting the Dacian Fortresses or the exemplary use of digital storytelling for the Painted Churches.

### *c. Interpretation*

The comparative assessment revealed a direct link between institutional capacity, digital maturity, and community visibility. Sites benefiting from stable governance and cultural tourism networks (e.g., Sighișoara, Moldavia Churches) show a higher degree of digital integration and outreach.

Conversely, sites located in less accessible or rural regions suffer from weaker digital representation and underdeveloped participatory frameworks.

These differences underline the importance of policy coherence and equal resource distribution for achieving national digital heritage objectives.

*(3) Contextual interpretation:* Integrating findings with national policy frameworks and global heritage management standards.

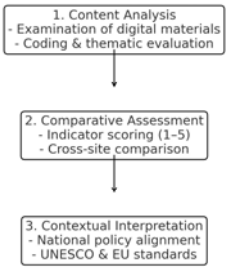
The third component of the methodological approach involves the contextual interpretation of the empirical findings by situating them within the broader landscape of national cultural policies and international heritage management standards. This step ensures that the evaluation of digitalisation practices across the selected UNESCO sites does not remain isolated at the site level, but is instead analysed in relation to the normative frameworks, institutional expectations, and strategic priorities that shape cultural heritage governance. Through this interpretive lens, the study examines the extent to which digital initiatives implemented at site level align with, support, or diverge from the objectives articulated by key regulatory bodies, including the Romanian Ministry of Culture, the National Institute of Heritage (INP), UNESCO, ICOMOS, and the European Commission.

At the national level, contextual interpretation focuses on the strategic directions outlined in Romania's cultural heritage policies, particularly those regarding digitisation, public access, and preventive conservation. Documents such as the National Strategy for the Digitalisation of Cultural Heritage (2024–2030) and policy reports issued by the Ministry of Culture and INP emphasise the need for coherent digital frameworks, interoperable data systems, and transparent communication platforms. By comparing site-level digitalisation practices with these policy guidelines, the study identifies gaps between institutional expectations and operational realities. This comparative process highlights where implementation challenges persist - such as insufficient technical expertise, inconsistent digital standards, or lack of coordinated national platforms - and where local initiatives successfully anticipate or exceed national priorities.

Complementing the national perspective, the interpretation draws extensively on international heritage standards. UNESCO's Operational Guidelines for the Implementation of the World Heritage Convention and the Policy on Sustainable Development underscore the pivotal role of digital technologies in documentation, risk management, educational dissemination, and participatory governance. Furthermore, the principles set out by ICOMOS - particularly the Principles for the Conservation of Digital Heritage (2017) - provide critical benchmarks for assessing the quality, authenticity, and reliability of digital documentation and virtual interpretation. These global standards guide the evaluation of whether the studied sites adopt appropriate digital tools, ensure the accuracy of digitised content, and engage in responsible technological innovation that respects heritage integrity.

The interpretation also acknowledges the connection between World Heritage governance and sustainable urban development (Roders & van Oers, 2011).

**Figure 1. Three-part methodological approach**




Source: Author's own elaboration.

The contextual interpretation also integrates the European Union's strategic framework, particularly the European Framework for Action on Cultural Heritage (2018) and the Digital Europe Programme (2021–2027). These documents foreground digital transformation as a catalyst for cultural accessibility, economic development, and cross-border cooperation. By aligning the study's findings with EU priorities, the analysis identifies opportunities for enhanced funding, capacity building, and participation in European digital heritage networks. This dimension is particularly relevant for Romania, where the integration of cultural heritage into broader digital strategies remains uneven and underutilised.

Overall, this interpretive process allows the study to move beyond descriptive assessment to a nuanced understanding of how each site's digitalisation practices reflect or diverge from national and international expectations. It also supports the development of grounded policy recommendations by relating empirical observations to recognised standards and strategic imperatives. Through this multilevel contextualisation, the study ensures that its conclusions are not only evidence-based but also aligned with the contemporary governance ecosystem that shapes digital heritage management in Romania and internationally.

### *3.5. Expected analytical outcomes*

The analytical approach adopted in this study is designed to generate a set of structured, evidence-based outcomes that contribute to a deeper understanding of the digitalisation landscape across Romania's UNESCO World Heritage Sites. First, the analysis is expected to support the identification of best practices among sites that demonstrate advanced levels of digital engagement, interpretative richness, and online visibility. In particular, the Painted Churches of Northern Moldavia represent a relevant benchmark, given their consistent use of multimedia resources, multilingual accessibility, and integration of cultural storytelling. By examining these positive examples, the study aims to highlight digital strategies that can be replicated or adapted by other heritage sites seeking to enhance their online presence and public outreach. These findings will also provide insights into how technological innovation can reinforce cultural identity and increase the attractiveness of heritage sites for both national and international audiences.

Secondly, the analysis is anticipated to yield a detailed documentation of critical gaps and vulnerabilities in sites with limited or fragmented digital representation. The Dacian Fortresses of the Orăștie Mountains, for example, illustrate structural constraints resulting from insufficient digital resources, minimal online visibility, and lack of interpretative materials. The study will explore how such gaps weaken the capacity of heritage sites to engage digitally with the public, diminish their visibility in international cultural networks, and potentially hinder their long-term preservation. By

systematically comparing these shortcomings with the strengths observed in other sites, the research will identify specific areas requiring intervention, whether technological, managerial, or policy-related.

Finally, the expected outcomes include the formulation of recommendations for the development of an integrated national digital heritage strategy, aimed at harmonising digitalisation efforts across the Romanian heritage sector. These recommendations will focus on improving accessibility through unified platforms, enhancing the educational value of digital content, and strengthening digital preservation mechanisms in line with UNESCO and EU standards. The insights derived from the comparative analysis will inform policy proposals encouraging coordinated investment in digital infrastructure, capacity building for heritage professionals, and broader institutional cooperation. This strategic perspective is intended to support the creation of a coherent and sustainable framework for digital heritage management in Romania, ensuring that cultural assets are preserved, communicated, and valorised effectively in the digital age.

## 4. Research results and discussion

### *4.1. Case study evaluation*

The empirical analysis focuses on three Romanian UNESCO World Heritage Sites representing distinct heritage typologies: the Painted Churches of Northern Moldavia (religious heritage), the Historic Centre of Sighișoara (urban heritage), and the Dacian Fortresses of the Orăștie Mountains (archaeological heritage). The evaluation was conducted using the analytical framework presented in Section 3, which combines qualitative content analysis with indicator-based assessment of digital heritage implementation.

*Painted Churches of Northern Moldavia*

The Painted Churches of Northern Moldavia constitute a unique ensemble of religious heritage monuments renowned for their exterior frescoes and theological symbolism. Unlike many heritage sites that function exclusively as tourist destinations, these churches continue to operate as active places of worship, preserving their spiritual role within local communities.

The digital presence of these monuments is relatively well developed. Several churches are represented on official heritage platforms, cultural tourism websites, and digital promotion portals dedicated to Romania's cultural routes. Digital tools include high-resolution photographic documentation, virtual tours, and social media visibility through tourism promotion initiatives. These platforms allow international audiences to explore the artistic and historical significance of the churches without physical travel.

The role of digitalisation in this context is primarily interpretative and educational. Digital platforms facilitate the dissemination of knowledge about iconography, religious symbolism, and medieval artistic traditions, thereby enhancing cultural awareness and promoting Romania's religious heritage internationally.

The evaluation indicates a strong level of digital visibility and effective integration between heritage interpretation and tourism promotion, although advanced technologies such as systematic 3D documentation for conservation purposes remain relatively limited. Consequently, the dominant model observed in this case is digital tools functioning as instruments of cultural promotion and interpretative mediation.

*Historic Centre of Sighișoara*

The Historic Centre of Sighișoara represents one of the best-preserved medieval urban settlements in Europe and continues to function as a living historic city. Its cultural identity is reinforced by continuous habitation, well-preserved architectural heritage, and a dynamic tourism sector supported by festivals and cultural events.

Digitalisation in Sighișoara benefits from a diversified ecosystem of online platforms. Municipal tourism websites, private tourism portals, and event promotion pages collectively contribute to the city's digital presence. Interactive maps, accommodation platforms, and cultural event websites

complement official municipal initiatives, creating a complex digital network supporting both tourism management and cultural promotion.

Digital tools therefore play an important role in shaping the city's cultural branding and economic visibility. Through coordinated online promotion, Sighișoara has successfully integrated heritage interpretation with tourism marketing strategies. Social media campaigns and digital promotion initiatives reinforce the city's international profile and encourage visitor engagement.

The evaluation suggests a high level of digital engagement and strong public–private synergy in the management of digital heritage resources. However, the intense focus on tourism promotion may also create risks of digital overcommercialisation, potentially shifting attention from heritage preservation to economic objectives. In this context, the dominant model can be characterised as digital tools acting as drivers of urban development and tourism governance.

*Dacian Fortresses of the Orăștie Mountains*

The Dacian Fortresses of the Orăștie Mountains represent an archaeological heritage ensemble of exceptional historical importance, associated with the political and military centre of the ancient Dacian civilisation. These sites are located in mountainous areas with limited physical accessibility and are exposed to multiple preservation challenges, including environmental degradation and archaeological poaching.

Despite their cultural significance, the digital presence of the Dacian Fortresses remains relatively limited. Existing digital initiatives mainly consist of isolated scientific digitisation projects, including partial 3D documentation conducted by academic institutions and archaeological research teams. However, these initiatives are rarely integrated into accessible public platforms or broader digital heritage strategies.

As a result, the educational and interpretative potential of digital technologies remains largely underutilised. Digitalisation could significantly improve public awareness, facilitate virtual access to remote archaeological sites, and strengthen conservation strategies through digital documentation.

The evaluation therefore indicates low digital visibility and fragmented implementation of digital tools, despite the high potential for technological innovation. The dominant model observed in this case can be described as underutilised digital heritage, where technological possibilities remain insufficiently integrated into heritage management strategies.

### *4.2 Comparative analysis of digital heritage implementation*

The comparative assessment highlights substantial differences in the level of digital maturity across the three analysed sites. Table 6 summarises the performance of each site according to the indicators defined in Section 3.

**Table 6. Comparative assessment of digital performance indicators**

(Scale: 1 = very low; 5 = very high)

| Category | Indicator | Painted churches | Sighișoara | Dacian fortresses |
|---|---|---|---|---|
| Visibility | Online presence | 5 | 4 | 2 |
| Visibility | Web traffic/ranking | 4 | 4 | 2 |
| Engagement | Social media followers | 4 | 5 | 2 |
| Engagement | Multimedia content | 5 | 4 | 1 |
| Educational value | Digital learning tools | 3 | 4 | 1 |
| Educational value | Multilingual accessibility | 5 | 4 | 2 |
| Innovation | AR/VR/3D technologies | 3 | 2 | 1 |
| Security | Digital archiving | 4 | 3 | 2 |

Source: Author's analysis based on institutional websites, INP data, and content review (2025).

The results demonstrate a clear hierarchy of digital development. The Painted Churches display the highest overall performance, reflecting strong integration between cultural promotion and digital communication. Sighișoara occupies an intermediate position, characterised by active digital

engagement but relatively limited technological innovation. The Dacian Fortresses register the lowest scores across most indicators, confirming their weak digital representation despite their historical importance.

### *4.3 Interpretation*

The empirical findings can be interpreted through the analytical lens of a framework which links digital heritage practices to broader dimensions such as identity, innovation, digitalisation, environment, awareness, and security.

First, the results indicate a strong relationship between digital visibility and cultural identity reinforcement. Sites with active digital storytelling - such as the Painted Churches and Sighișoara - benefit from greater international recognition and higher public engagement.

Second, the analysis highlights the uneven adoption of technological innovation across Romanian heritage sites. While digital promotion tools are increasingly used, immersive technologies such as virtual reality, augmented reality, and advanced 3D modelling remain relatively rare.

Third, the findings underline the importance of institutional capacity and governance structures in shaping digital heritage outcomes. Sites supported by active local administrations and tourism infrastructures tend to demonstrate higher digital maturity than remote archaeological sites with limited administrative resources.

Finally, the analysis confirms that digitalisation contributes not only to tourism promotion but also to heritage protection and awareness raising. Digital documentation, online archives, and virtual reconstructions can serve as valuable tools for risk management, conservation monitoring, and educational outreach.

### *4.4 Synthesis of findings*

The comparative analysis reveals three distinct models of digital heritage utilisation.

In the case of the Painted Churches of Northern Moldavia, digital tools primarily support cultural interpretation and virtual accessibility, enabling broader public engagement with religious heritage.

In Sighișoara, digitalisation functions mainly as an instrument of economic development and tourism governance, reinforcing the city's branding as a cultural destination.

Conversely, the Dacian Fortresses illustrate a context where digital technologies could potentially serve as the main mechanism for heritage protection and virtual accessibility, but where such potential remains largely underexploited.

Importantly, these differences are not determined by the intrinsic value of the heritage assets but rather by variations in institutional capacity, policy priorities, and integration of digital strategies into local development frameworks.

The Romanian case therefore illustrates a heterogeneous landscape of digital heritage practices, combining examples of successful digital promotion with areas where digital tools remain insufficiently implemented. This diversity positions Romania as a relevant case study for examining both good practices and structural gaps in the digital management of UNESCO heritage sites.

## 5. Conclusion

### *5.1. General conclusions*

This study examined the intersection between digitalisation, heritage capitalisation, and cultural identity through an analytical investigation of three Romanian UNESCO World Heritage Sites: the Painted Churches of Northern Moldavia, the Historic Centre of Sighișoara, and the Dacian Fortresses of the Orăștie Mountains.

By employing a mixed qualitative–quantitative framework, the research demonstrated that the degree of digital maturity and online visibility of heritage sites directly influences their cultural resonance, educational impact, and community awareness. The comparative results confirmed a clear

correlation between digital presence and identity visibility, illustrating that sites with a consistent and innovative digital profile tend to achieve higher levels of public engagement and international recognition.

The findings reveal significant discrepancies among the analysed sites. The Painted Churches of Northern Moldavia represent a positive model of heritage digitalisation, with comprehensive documentation, multilingual accessibility, and strong cultural storytelling. The Historic Centre of Sighișoara shows moderate advancement, supported by active tourism promotion and community participation, while the Dacian Fortresses exemplify structural and technical deficiencies in digital representation.

These disparities reflect broader systemic issues within Romania's heritage management framework—particularly the absence of an integrated digital policy, uneven resource distribution, and limited institutional coordination.

### *5.2. Theoretical contributions*

From a theoretical standpoint, the study contributes to the expanding field of digital heritage studies by bridging conceptual insights from critical heritage theory (Smith, 2006; Graham et al., 2000) with empirical assessment tools adapted to the Romanian context.

It proposes a structured analytical model linking five measurable categories - visibility, engagement, educational value, innovation, and security - to the overarching dimensions of identity, digitalisation, and sustainability.

This hybrid model demonstrates that heritage capitalisation is not confined to economic or touristic metrics but extends to symbolic and participatory value. The study thus advances the discourse on heritage as a dynamic cultural system, shaped by technological mediation and community involvement.

Furthermore, the research illustrates how digitalisation intersects with environmental awareness and risk management, expanding the traditional scope of heritage studies to include resilience and climate adaptation perspectives. This interpretation is consistent with UNESCO's climate-policy approach to World Heritage (UNESCO, 2021).

### *5.3. Practical and policy implications*

The results underscore the urgent need for a National Digital Heritage Strategy (NDHS) capable of uniting disparate initiatives under a coherent institutional umbrella. Such a strategy should promote standardisation of digital data, interoperability with European and UNESCO platforms, and inclusion of immersive technologies (AR/VR) in heritage interpretation.

Additionally, the study highlights the strategic role of community participation, advocating for digital storytelling initiatives and participatory platforms that transform citizens into active heritage custodians.

From a policy perspective, digital heritage must be treated not as a marginal innovation but as a core dimension of sustainable cultural governance, interlinked with educational reform, tourism, environmental protection, and creative industries. In this regard, Romania could draw upon funding and expertise offered through the EU's Digital Europe Programme (2021–2027), the Creative Europe framework, and UNESCO's Digital Heritage Initiatives.

By institutionalising digital transformation, Romania would align itself with European best practices and reinforce its international cultural presence.

### *5.4. Limitations of the study*

As with any exploratory research, certain limitations must be acknowledged. First, the availability of quantitative data was uneven, as some heritage sites do not publicly disclose digital traffic or engagement metrics. Consequently, part of the analysis relied on qualitative observation and secondary data sources.

Second, the study focused on three UNESCO sites, which - while representative - do not encompass the full diversity of Romania's heritage landscape. Future studies could expand the sample to include both UNESCO and national heritage sites to capture broader trends.

Lastly, technological innovation evolves rapidly, and digital strategies that appear advanced today may become obsolete within a few years. Continuous monitoring and periodic reassessment are therefore essential for maintaining relevance.

### *5.5. Final reflections*

In the context of the 21st century's accelerating digital transformation, heritage capitalisation can no longer be separated from technological innovation and participatory engagement.

Romania's UNESCO sites illustrate both the potential and the challenges of this transition: while digital tools offer unprecedented opportunities for visibility, education, and protection, they also demand coherent strategies, interdisciplinary collaboration, and sustained political commitment.

Digital heritage should thus be viewed not as a replacement for traditional conservation, but as its strategic complement - a means to ensure continuity, accessibility, and cultural resilience.

The findings of this study confirm that digitalisation, when guided by clear policy and inclusive vision, becomes an act of cultural empowerment: it extends the life of heritage beyond physical boundaries, connects local identity with global networks, and secures the transmission of memory for future generations.

In this sense, digital heritage embodies an integrated approach in which identity, innovation, digitalisation, environmental sustainability, awareness, and security converge within a comprehensive framework for sustainable cultural development.

*Funding: This research received no external funding.*

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