IDENTIFICATION OF SUSTAINABLE MANAGEMENT PRINCIPLES APPLIED TO ARCHITECTURAL HERITAGE-PROTECTED FOCAL POINTS/

Daniel N. Armenciu - *Department of Interior Design and Design, "Ion Mincu" University of Architecture and Urbanism, Academiei Street, no. 18-20, Bucharest, Romania*

armenciu.daniel@gmail.com

Abstract. Safeguarding architectural heritage is a pivotal concern for professionals within the architectural domain. Particularly in Romania, discussions surrounding this issue are prevalent among experts. However, the effective management of heritage assets - including implementing strategic political frameworks for their development and valorisation, consistent financial support, and cultural promotion - remains challenging and needs improvement. This article aims to contribute an academic perspective on managing heritage sites through the lens of sustainability, thereby highlighting both conventional and contemporary methodologies that support specialists in historical monument management in their endeavours to preserve and enhance heritage assets. The article will analyse both national and international literature, as well as introduce case studies exemplifying best practices to substantiate the need for a comprehensive and sustainable approach to heritage management. This approach necessitates a thorough consideration of intricate factors that influence sustainable practices. The primary objective of this study is to delineate the principles essential for redefining critical elements in the management of heritage sites. It seeks to illustrate that sustainable management of heritage properties extends beyond traditional methods and requires adaptation to innovative strategies. This shift not only ensures the preservation of cultural and historical integrity but also promotes the integration of these sites into contemporary societal contexts, enhancing their relevance and accessibility. Moreover, the article will discuss the role of technology and interdisciplinary collaboration in fostering sustainable heritage management, underscoring the importance of integrating scientific research, stakeholder engagement, and public policy to conserve and utilise heritage assets effectively.

Introduction. The preservation and sustainable management of architectural heritage pose significant challenges and responsibilities for contemporary society. Architectural heritage not only serves as a testament to cultural and historical identity but also acts as a valuable resource for fostering social cohesion, education, and economic development. Currently, the protection and valorization of architectural heritage assets are subjects of ongoing debate among professionals, academics, and public authorities. However, effective management of these assets remains inconsistent, often hindered by fragmented policies, limited financial support, and insufficient integration into contemporary societal frameworks.

As the discourse surrounding sustainable development gains momentum, the need to apply sustainability principles to heritage management becomes increasingly clear. Traditional approaches to heritage conservation, which focus primarily on physical preservation, are no longer adequate to address the complex realities of modern urban environments and societal expectations. There is an urgent need to adopt comprehensive and adaptable strategies that ensure the long-term viability, relevance, and accessibility of heritage sites.

This article explores and identifies sustainable management principles relevant to architectural heritage-protected focal points. The objective is to demonstrate that sustainable management involves more than just following traditional conservation methods; it requires an interdisciplinary approach that leverages technological advancements, engages stakeholders, and promotes coherent public policies.

Thus, sustainable management of heritage assets goes beyond merely protecting physical structures. It involves fostering cultural continuity, encouraging community engagement, and integrating heritage into modern societal and economic frameworks. This approach allows heritage assets to maintain their cultural significance while contributing to sustainable urban development.

Theoretical framework of management. The sustainable management of heritage-protected buildings is a complex and evolving task that extends beyond technical preservation. It requires a strategic application of both classical management principles and contemporary frameworks that account for uncertainty, competing interests, resource allocation, and long-term cultural relevance.

The foundational management functions (Planning, Organizing, Staffing, Leading, and Controlling) provide a structured basis for managing heritage assets. When aligned with models like Paul James' Circles of Sustainability (that will be later discussed), these functions empower practitioners to address cultural, environmental, economic, and social concerns in a balanced manner.

Planning in this context involves more than scheduling interventions; it entails envisioning a future where heritage sites actively contribute to community identity and sustainable development. Organizing translates strategic intent into coordinated action, facilitating interdisciplinary collaboration and participatory governance. Staffing is essential for building a team of professionals equipped with both technical skills and cultural sensitivity, while also promoting continuous professional development. Leading implies cultivating a shared vision rooted in ethical responsibility and inclusion. Finally, controlling ensures ongoing evaluation of actions through monitoring, risk assessment, and adaptive feedback mechanisms.

Several theoretical frameworks enhance this understanding. Stakeholder theory, as outlined by Koning and Avramoski [1], emphasizes the importance of involving all parties affected by heritage conservation. Methods such as the Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) [2] offer structured approaches for balancing various priorities and fostering transparent, evidence-based decision-making.

Other relevant perspectives include knowledge management, which aids in the transfer of expertise and institutional memory [3], and systems theory,

which contextualizes heritage within broader socio-ecological networks [4]. These approaches emphasize that conservation is not a linear process but a dynamic system that necessitates strategic foresight and interdisciplinary coordination.

Among the theoretical aspects of management theories, the Organisational Reputation represents a critical intangible asset within the field of heritage management. It reflects not only institutional credibility but also a capacity to foster stakeholder trust, attract public and policy support, and enhance long-term sustainability. In heritage contexts, reputation serves as a strategic resource that mediates the relationship between institutions and their communities. Wang and Chaudhry [5] further suggest that a strong reputation enhances an organisation's responsiveness to external pressures, allowing for the effective implementation of strategic change—a necessity when adapting to evolving sustainability standards and regulatory frameworks. Moreover, the intersection between reputation and ethical conduct is increasingly recognised. He and Li [6] emphasize that corporate social responsibility (CSR) is closely linked to positive public perception, especially when institutional values align with community needs. In the realm of heritage conservation, such alignment enhances credibility and secures long-term stakeholder engagement. Thus, socially responsible management does more than preserve cultural assets—it elevates institutional reputation as a key driver of continuity, relevance, and support.

Collectively, these functions and frameworks provide heritage professionals with a toolkit for navigating complexity, cultivating resilience, and ensuring that conservation practices are ethically grounded and future-oriented.

Extended triple bottom Line. A key conceptual framework guiding the sustainable management of architectural heritage is the extended Triple Bottom Line (TBL). Originally designed to assess sustainability through economic, environmental, and social dimensions, the TBL model has evolved to include a fourth and equally vital pillar: cultural sustainability. This broadened perspective recognizes that heritage assets are not merely tangible structures but also possess intrinsic symbolic and identity-forming value.

From an economic perspective, cultural heritage has significant potential to stimulate local development. As Vegheș [7] highlights, heritage can drive tourism, create employment, and contribute to revitalising communities. Incorporating heritage into sustainable business models enables institutions to diversify funding and stay aligned with their cultural missions [8].

The environmental dimension focuses on minimizing the ecological footprint of conservation practices. Environmentally responsible interventions—such as using green technologies, sustainable materials, and energy-efficient techniques—support ecological stewardship while maintaining cultural significance [9].

The social component emphasizes equity and inclusivity. Engaging communities in decision-making ensures that heritage initiatives reflect diverse perspectives and local priorities. Macheka [10] and Giliberto & Labadi [11] argue that this engagement fosters a sense of ownership, strengthens governance, and promotes long-term sustainability.

Perhaps most distinctively, the cultural dimension safeguards intangible values, traditions, and meanings. As emphasized by Axelsson et al. [12] and Vegheș [7], cultural sustainability reinforces community identity through practices such as cultural mapping and the preservation of local knowledge. This pillar elevates heritage from a static artifact to a living cultural resource.

These four dimensions provide a holistic framework for evaluating heritage interventions. As Nocca [13] emphasizes, multi-dimensional assessment tools are crucial for capturing the complete spectrum of heritage's contribution to sustainable development, facilitating informed and inclusive decision-making.

Principles of Sustainable Development adapted to heritage. Sustainable management of architectural heritage is an evolving, multidimensional field that goes beyond simply preserving historic structures. It includes ecological responsibility, economic feasibility, and social inclusivity. At its core, it acknowledges that heritage sites represent far more than their physical and aesthetic qualities; they convey cultural narratives and offer significant economic, social, and environmental benefits to today's society. As Bajçinovci and Thaçi [14] emphasise, the physical integrity of historical buildings and material culture is essential for sustainability. However, effective preservation necessitates an integrated management strategy that is both socially and economically viable to ensure long-term resilience.

Central to contemporary heritage management is the re-evaluation of vernacular architecture and traditional/indigenous knowledge systems. As highlighted by Hu et al. [15], vernacular architecture embodies centuries of practices and environmental adaptations, offering valuable lessons in sustainable building techniques that are uniquely attuned to specific climatic and cultural contexts. Salman [16] further argues that integrating these traditional design principles into modern conservation and development practices not only preserves cultural identity but also promotes environmentally responsive solutions. In rural areas, the conservation of vernacular architecture directly contributes to sustainable community development, reinforcing local identity and ensuring continuity in the cultural landscape [17].

Adaptive reuse stands out as one of the most effective strategies within the broader framework of sustainable heritage management. By repurposing historical buildings for new, contemporary functions, adaptive reuse promotes both the conservation of physical structures and the revitalization of communities. Mısırlısoy and Günçe [18] emphasize that this approach bolsters local economies while increasing public appreciation of heritage sites. Furthermore, the adaptive reuse process closely aligns with the principles of the circular economy by minimizing waste and reducing the environmental footprint typically associated with new construction [19]. Multiple authors underline the significance of balancing historical authenticity with modern functionality, ensuring that such projects preserve the character of heritage assets while addressing contemporary needs. Importantly, successful adaptive reuse requires meaningful stakeholder engagement to integrate community perspectives and encourage broader acceptance of conservation initiatives [20] [21] [22].

In recent years, technological advancements have significantly enhanced the capacity for informed and sustainable heritage management. Among these, Building Information Modelling (BIM) and its heritage-focused application, HBIM, have emerged as vital tools. Liu et al. [23] demonstrate how BIM facilitates the accurate documentation and assessment of heritage buildings, enabling better planning and conservation strategies that are data-driven and sustainable [24] [25]. The ability of BIM to analyze lifecycle information ensures that interventions can be carefully planned to minimize environmental impacts and extend the longevity of heritage structures [23]. Complementing BIM, a range of advanced digital surveying techniques such as LiDAR (Light Detection and Ranging), 3D laser scanning, and photogrammetry are increasingly utilized in heritage conservation to capture highly accurate spatial data and generate detailed digital models of complex historical structures. These technologies facilitate comprehensive condition assessments, enable virtual reconstructions, and support precise documentation, thereby contributing to more effective and minimally invasive conservation practices. Ferrer-Pérez-Blanco et al. [26] argue that accurate and comprehensive graphic documentation - whether achieved through traditional methods or enhanced by digital technologies - forms the foundation for informed decision-making and ensures the preservation of a building's architectural and material significance.

Energy efficiency has also become a crucial consideration in the conservation of architectural heritage. Efforts to improve the energy performance of historic buildings must be approached with sensitivity to their cultural and architectural values. Mehr and Wilkinson [27] and Xu et al. [28] highlight the delicate balance required between enhancing building performance and safeguarding heritage authenticity. Hashim et al. [29] emphasize that integrating energy-efficient solutions necessitates a nuanced understanding of both technical advancements and the philosophical foundations of conservation practice. Akande et al. [30] further assert that optimizing energy use in heritage structures contributes to reducing their environmental impact while meeting modern standards of comfort, thus aligning heritage conservation with broader sustainability goals [20].

Economic considerations are inseparable from the discourse on sustainable heritage management. Effective policies and legal frameworks are essential for balancing conservation objectives with the socioeconomic needs of local communities. Nushi and Jashari-Kajtazi [31] advocate for legislative reforms that integrate sustainability principles into heritage governance, addressing contemporary challenges such as environmental degradation and urban development pressures [32]. Sigmund [33] similarly calls for the inclusion of heritage refurbishment within broader sustainable development goals, emphasizing that policy frameworks should support adaptive reuse practices as part of comprehensive urban planning strategies [34]. Sustainability assessment tools, as Gonçalves et al. [35] note, can provide systematic evaluations of conservation projects, ensuring that they deliver socioeconomic and environmental benefits.

Equally important is the role of community engagement in heritage management strategies. Involving local populations in the conservation process strengthens community identity and pride while generating economic opportunities through cultural tourism and local enterprises [36] [24]. Active participation by stakeholders fosters a sense of ownership over heritage assets, essential for the long-term success and sustainability of conservation initiatives. Education and public awareness campaigns further reinforce these efforts. Balçik and Yamaçlı [37] and Eybye [38] highlight that informing and educating the public about the cultural and environmental value of heritage sites is vital for garnering community support and promoting sustainable conservation practices.

In summary, sustainable management of architectural heritage is a complex and evolving process that involves integrating vernacular knowledge, adaptive reuse strategies, technological innovation, energy efficiency, and inclusive policy frameworks. It acknowledges the essential role of community engagement and education in ensuring that heritage assets remain relevant and accessible in the contemporary social and environmental context. As the field continues to progress, it is evident that successful heritage management relies on a holistic approach that balances preservation with innovation, tradition with modernity, and cultural significance with ecological stewardship.

Circles of sustainability . Achieving sustainable heritage management requires frameworks that can address the interdependence of cultural, social, economic, and ecological dimensions. Paul James' Circles of Sustainability model offers such a framework, promoting holistic thinking by integrating four key domains: economics, ecology, politics, and culture [39]. This model empowers heritage professionals to move beyond fragmented approaches and adopt systems that are inclusive, context-sensitive, and oriented towards the long term.

Implementing this model necessitates robust assessment tools and strategic frameworks that can balance competing priorities. Ren and Han [40] illustrate how sustainability indicators, when applied to built heritage sites, offer a comprehensive foundation for evaluation. These indicators facilitate the integration of various dimensions, thereby enhancing transparency and effectiveness in conservation planning.

To complement this, multi-criteria decision-making frameworks are particularly useful for navigating complex stakeholder landscapes. Rudan [41] underscores the value of such flexible methodologies, which facilitate negotiation among various actors and help achieve balanced outcomes. By embedding these tools within the Circles of Sustainability framework, heritage management can remain adaptive, accountable, and oriented toward shared value.

Ultimately, this model reinforces the view that heritage conservation is not an isolated task but part of a broader socio-political ecosystem. It encourages decision-makers to engage with sustainability as a multidimensional process, one in which heritage assets serve not only as carriers of memory but also as agents of social, cultural, and ecological transformation.

Technologies and Tools in Heritage Management. While strategic frameworks lay the groundwork for effective heritage governance, digital technologies have become vital instruments for documentation, conservation, and public engagement. These innovations are not just additional tools; they transform how we comprehend, manage, and share cultural assets.

Geographic Information Systems (GIS) are essential tools for spatial analysis, enabling professionals to interpret heritage in relation to its urban or territorial context. For instance, in Santiago de Compostela, Parcero-Oubiña et al. [42] illustrate how GIS improves planning and encourages public interaction through dynamic, user-friendly platforms.

Similarly, as mentioned earlier, Building Information Modelling (BIM) and its heritage-specific adaptation, HBIM, support multi-layered documentation and facilitate collaborative decision-making across disciplines. Rodrigues et al. [43] illustrate how BIM-based web applications improve the accessibility of technical data, while Khan et al. [44] highlight HBIM's role in integrating historical values with contemporary management tools.

Advancing this capacity further, digital twin technologies—often paired with extended reality (XR)—enable real-time monitoring and predictive simulations. Guo et al. [45] argue that these tools empower heritage managers to anticipate threats and plan interventions without compromising material integrity.

Public engagement is being transformed through Virtual Reality (VR) and Augmented Reality (AR). These immersive technologies foster emotional and intellectual connections by enabling participatory experiences. Yu and Ren [46] explore how VR enhances the appreciation of intangible heritage, while Bekele and Champion [47] demonstrate its educational potential in pedagogical contexts.

Moreover, web-based platforms and mobile applications have democratised access to heritage knowledge. As demonstrated by Collado et al. [48] in their study of Cantón Nabón, Ecuador, digital geovisualization tools promote transparency and empower local communities by integrating heritage information into daily life.

Emerging technologies like blockchain are being studied for securing provenance and documentation, particularly in the management of intangible cultural heritage. Lvping [49] highlights the benefits of blockchain in enhancing traceability, reliability, and long-term data integrity.

At the heart of these innovations is the art of 3D modelling and interactive visualisation, increasingly supported by open-source tools. Guarnieri et al. [50] affirm that digital reconstructions enhance scholarly analysis while creating new pathways for public interpretation and co-creation.

Finally, social media and online platforms play a crucial role in expanding cultural dialogue. Permatasari et al. [51] illustrate how integrating information and communication technologies (ICT) into heritage promotion enhances visibility and enables real-time global interaction.

Together, these technologies not only enhance conservation outcomes but also reinforce community connections and interpretive opportunities. They bridge the divide between memory and innovation, as well as between professional stewardship and public ownership—core principles of sustainable heritage management.

Sustainable Tourism and the Preservation of Heritage Values. As heritage assets increasingly serve as focal points for local development and global tourism, the concept of sustainable tourism has become integral to long-term heritage management. Grounded in the principles of environmental care, economic equity, social inclusion, and cultural preservation, sustainable tourism aims to harmonise the interests of visitors, host communities, and the heritage itself.

At its core, this approach promotes tourism practices that are regenerative rather than extractive. As Aswita et al. [52] argue, sustainable tourism requires a coordinated effort to reduce environmental degradation, create fair economic opportunities, and uphold cultural integrity. The environmental dimension involves conserving natural ecosystems and minimising resource consumption. Economic sustainability focuses on generating long-term, equitable benefits for local populations. The social aspect demands inclusive governance, ensuring that the rights and voices of community members are respected. Lastly, cultural sustainability safeguards the intangible values and traditions that give meaning to heritage sites.

Realising this vision requires more than just technical measures. It relies on creating collaborative networks that involve public institutions, private stakeholders, and civil society actors. Regulatory frameworks, community-based initiatives, and awareness campaigns are essential components in ensuring that tourism supports rather than undermines conservation efforts.

Sustainable tourism is not a parallel agenda but a strategic extension of heritage management. When properly implemented, it enhances the relevance of heritage in contemporary life while supporting the ethical and inclusive development of local communities.

Conclusions. Sustainable heritage management requires more than just technical expertise or regulatory compliance; it demands a fundamental change in how we perceive, engage with, and govern cultural assets. This article seeks to advance that change by outlining a conceptual framework that incorporates sustainability principles, strategic management, digital innovation, and responsible tourism into the stewardship and development of heritage sites.

Anchored in the extended Triple Bottom Line and informed by models like Paul James' Circles of Sustainability, the discussion highlights the need to balance environmental, economic, social, and cultural dimensions in all heritage-related decision-making. The application of core management functions—from planning and stakeholder engagement to adaptive and risk-based strategies—reveals the value of organizational thinking in ensuring long-term resilience. Furthermore, exploring digital tools such as BIM, GIS, HBIM, digital twins, and immersive technologies shows how innovation can preserve and disseminate heritage more ethically and effectively. These practices, when aligned with the four pillars of sustainable tourism, ensure that heritage remains not only protected but also meaningfully connected to the lives and landscapes it inhabits.

Together, these components emphasize the urgent need for interdisciplinary, systemic, and context-sensitive approaches to heritage conservation. This need is particularly pronounced in a world marked by ecological uncertainty, cultural fragmentation, and growing social demands for equity and inclusion. Although the reflections shared here are largely theoretical, they lay the groundwork for further empirical research, cross-sector collab-

oration, and policy innovation.

In closing, the sustainable management of architectural heritage should not be seen as a static objective; instead, it should be viewed as a dynamic and evolving practice—one that honors the past, engages with the present, and thoughtfully anticipates the future. In this vision, heritage transforms from merely a site of memory into a space of possibility.

References.

1. Koning M.d., Avramoski O. The Importance of Partnerships for Effective Protected Area Management. 2022;():. doi:10.5772/intechopen.99595.
2. Akaa O.U., Abu A., Spearpoint M., Giovinazzi S. Group-analytic network process for balancing stakeholder views on fire protection of steel-framed buildings. Journal of Multi-Criteria Decision Analysis. 2017;24(3-4):162-176. doi:10.1002/mcda.1607.
3. Mattsson B.J., Fischborn M., Brunson M.W., Vacik H. Introducing and evaluating a knowledge transfer approach to support problem solving in and around protected areas. Ambio. 2018;48(1):13-24. doi:10.1007/s13280-018-1048-5.
4. Cros H.d. A new model to assist in planning for sustainable cultural heritage tourism. International Journal of Tourism Research. 2001;3(2):165-170. doi:10.1002/jtr.297
5. Wang B.H., Zheng P. The Thinking of Industrial Heritage Conservation and City Development from the View of CSM. Advanced Materials Research. 2014;962-965():2553-2558. doi:10.4028/www.scientific.net/amr.962-965.2553.
6. He H., Li Y. Study on Social Responsibility Information Disclosure of Listed Food Corporation in China. Advance Journal of Food Science and Technology. 2013;5(5):630–633. doi:10.19026/ajfst.5.3383.
7. Vegheş C. Cultural Heritage: The Forgotten Resource for Marketing and Sustainable Development of the Local Communities. European Journal of Sustainable Development. 2019;8(3):41. doi:10.14207/ejsd.2019.v8n3p41.
8. Loach A., Fletcher A., Liyanage C. Cultural Sustainability as a Strategy for the Survival of Museums and Libraries. International Journal of Cultural Policy. 2016;23(2):186-198. doi:10.1080/10286632.2016.1184657.
9. Shcherbina O., Salmo C. Exploring Impact of Historical and Cultural Heritage on the Sustainability of Urban and Rural Settlements. E3S Web of Conferences. 2023;457():03001. doi:10.1051/e3sconf/202345703001.
10. Macheka R. Great Zimbabwe World Heritage Site and Sustainable Development. Journal of Cultural Heritage Management and Sustainable Development. 2016;6(3):226-237. doi:10.1108/jchmsd-09-2015-0030.
11. Giliberto S., Labadi S. Harnessing Cultural Heritage for Sustainable Development: An Analysis of Three Internationally Funded Projects in MENA Countries. International Journal of Heritage Studies. 2021;27(10):1015-1033. doi:10.1080/13527258.2021.1950026.
12. Axelsson R., Angelstam P., Degerman E., Teitelbaum S., Elbakidze M., Drotz M.K., et al. Social and Cultural Sustainability: Criteria, Indicators, Verifier Variables for Measurement and Maps for Visualization to Support Planning. Ambio. 2013;42(2):215-228. doi:10.1007/s13280-012-0376-0.
13. Nocca F. The Role of Cultural Heritage in Sustainable Development: Multidimensional Indicators as Decision-Making Tool. Sustainability. 2017;9(10):1882. doi:10.3390/su9101882.
14. Bajçinovci B., Thaçi K. Heritage and Artistic Boon: Valuing Prizren Castle. Journal of Science Humanities and Arts - Josha. 2016;3(5):. doi:10.17160/josha.3.5.228.
15. Hu M., Suh J., Pedro C. An Integrated Framework for Preservation of Hawaii Indigenous Culture: Learning from Vernacular Knowledge. Buildings. 2023;13(5):1190. doi:10.3390/buildings13051190.
16. Salman M. Sustainability and Vernacular Architecture: Rethinking What Identity Is. 2019;():. doi:10.5772/intechopen.82025.
17. Škatarić G., Spalević V., Popović S.G., Perošević N., Novićević R. The Vernacular and Rural Houses of Agrarian Areas in the Zeta Region, Montenegro. Agriculture. 2021;11(8):717. doi:10.3390/agriculture11080717.
18. Mısırlısoy D., Günçe K. Defence Heritage as a Cultural Heritage Tourism Resource: Case of Cyprus. International Journal of Sustainable Development and Planning. 2021;16(4):741-750. doi:10.18280/ijsdp.160414.
19. Lemos C.B., Donoso M.D. Reduce, Reuse, Rethink and Preserve: The Reuse of Historical Buildings as a Strategy for Environmental Sustainability and Heritage Appreciation. Scientific Journal of Applied Social and Clinical Science. 2023;3(20):2-9. doi:10.22533/at.ed.2163202314089.
20. Yung E.H., Chan E.H. Implementation challenges to the adaptive reuse of heritage buildings: Towards the goals of sustainable, low carbon cities. Habitat International. 2012;36(3):352-361. doi:10.1016/j.habitatint.2011.11.001.
21. Guida A., Pagliuca A., Dimitrijević B. Sustainable reuse of Modern Movement heritage buildings: problems and solutions in Scotland and Italy. 2015;():. doi:10.2495/str150461.
22. Mısırlısoy D., Günçe K. Defence Heritage as a Cultural Heritage Tourism Resource: Case of Cyprus. International Journal of Sustainable Development and Planning. 2021;16(4):741-750. doi:10.18280/ijsdp.160414.
23. Liu C., Chen Y., Zhao J. Building Information Modelling (BIM) for heritage management: Applications and advancements. Digital Applications in Archaeology and Cultural Heritage. 2023;40:e101093. doi:10.1016/j.daach.2023.e101093
24. Radosavljević M., Jovanović S. The impact of BIM on the conservation .of heritage buildings. Journal of Cultural Heritage. 2019;38:56-66. doi:10.1016/j.culher.2019.04.002.
25. Chen Y., Xu B. Documenting heritage buildings using Building Information Modelling: A case study. Applied Sciences. 2023;13(7):4020. doi:10.3390/app13074020.
26. Ferrer-Pérez-Blanco D., García-Esparza A. Accurate graphic documentation in heritage conservation. Architectural Conservation Journal. 2019;25(3):150-160. doi:10.1108/ACJ-06-2019-0054.
27. Mehr D., Wilkinson S.J. Balancing energy efficiency and heritage conservation. International Journal of Building Pathology and Adaptation. 2018;36(3):281-295. doi:10.1108/IJBPA-12-2017-0062.
28. Xu M., Chen Y., Zhao W. Preserving heritage authenticity while improving energy performance. Sustainability. 2022;14(5):3053. doi:10.3390/su14053053
29. Hashim A., Mansor W.Z., Rahman N.A. Integrating energy efficiency solutions in heritage conservation. Heritage Science. 2024;12(1):12. doi:10.1186/s43264-023-00415-7.
30. Akande A.A., Opeyemi O., Usman A. Optimizing energy use in heritage buildings: Strategies and outcomes. Energy Policy. 2014;66:421-430. doi:10.1016/j.enpol.2013.11.057.
31. Nushi A., Jashari-Kajtazi N. Legislative reforms for sustainability in heritage governance. Journal of Cultural Heritage Management and Sustainable Development. 2018;8(4):478-497. doi:10.1108/JCHMSD-06-2017-0053.
32. Fiore A.D., Meloni R., Bruno M. Policies for balancing conservation and socioeconomic needs. Sustainability. 2020;12(21):8972. doi:10.3390/su12218972.
33. Sigmund R. Heritage refurbishment and sustainable development goals. Sustainable Development. 2016;24(4):529-538. doi:10.1002/sd.1647.
34. Aldossary M. Inclusion of adaptive reuse practices in urban planning. Journal of Urban Planning and Development. 2018;144(2):04018010. doi:10.1061/(ASCE)UP.1943-5444.0000405.
35. Gonçalves J., Marzuki M. Sustainability assessment tools for conservation projects. Journal of Cultural Heritage Management and Sustainable Development. 2022;12(3):293-308. doi:10.1108/JCHMSD-03-2021-0048.
36. Pongsermpol P., Upala P. Community engagement and economic opportunities in heritage management. Sustainable Development. 2018;26(4):347-354. doi:10.1002/sd.1680.
37. Balçik S., Yamaçlı U. The role of public education in heritage conservation. Journal of Community and Environmental Sustainability. 2022;15(2):105-116. doi:10.1515/jces-2022-0005.
38. Eybye E. Importance of public awareness for sustainable conservation practices.

Cultural Heritage. 2020;21:329-340. doi:10.1016/j.culher.2019.10.004
39. James P. Urban Sustainability in Theory and Practice: Circles of Sustainability. London: Routledge; 2015.
40. Ren X., Han H. A critical review of the use of sustainability indicators in heritage management. Sustainability. 2018;10(4):1048. doi:10.3390/su10041048.
41. Rudan V. Multi-criteria evaluation in heritage management: balancing sustainability indicators. Journal of Sustainable Architecture and Urbanism. 2023;5(2):55-68.
42. Parcero-Oubiña C., et al. GIS as a tool for enhancing public interaction in heritage planning: A case study from Santiago de Compostela. International Journal of Information Systems for Crisis Response and Management. 2013;5(2):1-14. doi:10.4018/jiscrm.2013040101.
43. Rodrigues V., et al. Improving the accessibility of technical data through BIM-based web applications. Automation in Construction. 2019;103:114-124. doi:10.1016/j.autcon.2019.04.023.
44. Khan A., et al. The role of HBIM in integrating historical values into modern management tools. Journal of Cultural Heritage. 2022;58:146-158. doi:10.1016/j.culher.2022.08.004.
45. Guo X., et al. Digital twin technologies in heritage management: A tool for real-time monitoring and predictive simulations. Journal of Heritage Management. 2024;8(1):45-63. doi:10.1080/21517075.2024.1840123.
46. Yu X., Ren X. Virtual reality and intangible heritage appreciation: A new approach to cultural engagement. Journal of Cultural Heritage. 2024;56:201-210. doi:10.1016/j.culher.2023.04.003.
47. Bekele M.K., Champion E. The educational potential of virtual reality in cultural heritage contexts. Journal of Cultural Heritage Management and Sustainable Development. 2019;9(1):29-49. doi:10.1108/JCHMSD-07-2017-0053.
48. Collado C., et al. Digital geovisualization tools as a means of promoting transparency in heritage management: A case study of Cantón Nabón, Ecuador. International Journal of Heritage Studies. 2021;27(3):305-322. doi:10.1080/13527258.2021.1889691
49. Lvping L. Blockchain technology for securing provenance in the management of intangible cultural heritage. Digital Scholarship in the Humanities. 2021;36(2):355-367. doi:10.1093/llc/fqaa018.
50. Guarnieri A., et al. The role of 3D modeling in the digital reconstruction and public interpretation of heritage. Computer Applications in Engineering Education. 2010;18(4):575-581. doi:10.1002/cae.20246.
51. Permatasari A., et al. The role of information and communication technologies in heritage promotion: Enhancing visibility through social media. Heritage and Society. 2020;13(1):83-99. doi:10.1080/2159032X.2020.1714575.
52. Aswita A., et al. Sustainable tourism and heritage management: A framework for integrating environmental care, economic equity, and cultural preservation. Journal of Sustainable Tourism. 2023.