



## BRIDGING TRADITION AND TECHNOLOGY: A SYSTEMATIC REVIEW OF DIGITAL INNOVATIONS IN CULTURAL HERITAGE PRESERVATION

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### ABSTRACT

This study evaluates the integration of advanced technological tools for the purpose of preserving a cultural heritage, emphasising innovative strategies relevant to the digital era. Despite considerable technological advancements, significant gaps remain regarding the full implications of these tools for data preservation and long-term accessibility. Consequently, this research investigates how advanced technologies can effectively enhance preservation practices and overcome existing challenges. Specifically, it analyses core themes such as the efficacy of digital technologies, levels of public engagement, sustainability considerations, integration barriers, and strategic investment opportunities. The findings highlight that tools such as artificial intelligence (AI), photogrammetry, and virtual reality (VR), substantially enhance heritage documentation accuracy and accessibility. Nevertheless, persistent issues related to data preservation and consistent accessibility warrant continued investigation. This systematic review critically analyses 50 selected articles from an initial dataset of 2,476 articles using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) framework. The study also emphasises the value of existing initiatives such as 4CH and Twin-IT, underscoring the need for harmonising traditional preservation techniques with innovative digital solutions, thereby offering essential guidance for future cultural heritage preservation efforts.

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### Introduction

Digital tools have revolutionised the field of cultural heritage conservation, offering innovative solutions for preservation, documentation, and restoration. By harnessing the power of digital technology, cultural heritage professionals can now engage in unprecedented levels of collaboration, research, and public outreach, ensuring the preservation of our diverse heritage for future generations (Biryukova & Nikonova, 2017).

The European Commission has been a pivotal force in promoting digitisation within cultural heritage preservation through

strategic initiatives that address key challenges and opportunities. A landmark effort is the Commission Recommendation of 27 October 2011, which underscores the importance of digitisation, online accessibility, and digital preservation of cultural material (European Commission, 2011). This recommendation has laid the groundwork for advancing digital methodologies in this dynamic field. Big data analytics play an important role in monitoring and protecting cultural heritage sites by providing insights into preservation efforts and identifying areas of concern for targeted

intervention. Digital tools not only facilitate heritage preservation but also democratise access and participation in conservation efforts (Kopalle *et al.*, 2020).

Digital technologies such as 3D, cloud computing, virtual reality (VR), and augmented reality (AR), have been identified as offering unprecedented opportunities for engagement, online access, and digital preservation, necessitating an integrated approach that caters to the needs of site managers, local curators, and communities (Bekele *et al.*, 2018). The heritage site manager or the cultural institution can create storytelling (from the supply side) through digital tools to create additional narratives. The overall vision of the conceptual model in Figure 1 is grounded on an efficient use of digital technologies, to be provided to heritage site managers, municipalities, local administrations, or cultural institutes needing to increase sustainable tourist flows, achieved through the integration of bottom-up and top-down approaches, complemented by tools that foster social participation (Maietti, 2023).

This systematic review, guided by the PRISMA framework, navigates through the

existing research landscape from 2019 to 2023 to evaluate the effectiveness of digital tools, identify technology usage, analyse the influence of technology on public engagement, assess long-term impact, identify integration challenges, and explore future technologies. An initial pool of 2,476 articles from Scopus and Web of Science, selected for their comprehensive, high-quality, peer-reviewed research, was carefully reviewed to select 50 studies offering significant insights into digital technologies' current state and prospects in this field.

**Research Aim**

This systematic review aims to analyse current research trends and identify prominent themes, frameworks, and relevant examples in the field. It evaluates the effectiveness of various digital tools utilised in cultural heritage conservation such as 3D technologies, cloud computing, VR, and AR. The study seeks to determine ways digital technology can be leveraged more effectively for heritage conservation and to establish best practices. Additionally, this review examines how technological advancements

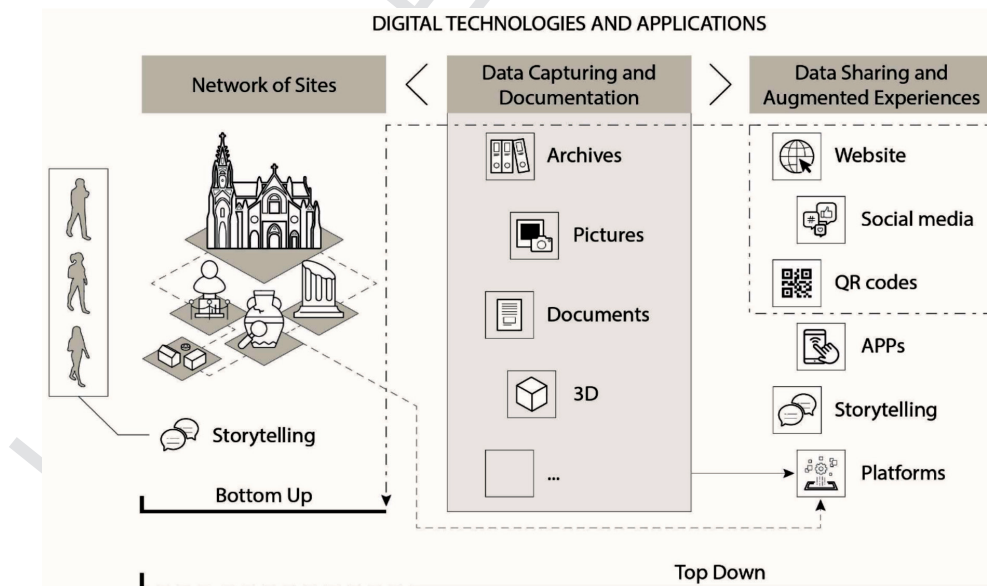


Figure 1: Integrative digital strategy model for storytelling in heritage management  
Source: Maietti (2023)