Harnessing Digital Strategies for Resilient Heritage: Small Museums' Response to the Climate Change Threat

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In order for cultural institutions to fulfil their goals that include the analysis, documentation, maintenance, restoration and promotion of their material, along with a creative interaction with their audiences, they need to rely on modern technologies as well as sustainable practices and modern business management models (Anderson, 2009; Jankowska & Marcum, 2010; Stylianou-Lambert et al., 2014; Loach et al., 2017). Although the integration of culture into the Sustainable Development Program is a focus of the United Nations (UNESCO, 1996; 2005), the issue of museum viability has not been systematically addressed. The Museum Association has organized a training program for the assessment of collections by encouraging museums to prioritize the viability of collections (Museums Association, 2010) and has issued guides (Museums Association, 2023), practical rules and good practices of Sustainability and Museums Check-List (Museums Association, 2009), basic principles for sustainable museums, and has developed the simplified Draft Sustainability Principles (Museums Association, 2008). However, both these initiatives and (very few) scientific publications on museum viability models mainly focus on "green" development. Stylianou-Lambert et al. (2014) determine the parameters of a theoretical model of sustainable development focused on sustainability support policies and not on museums themselves by identifying 4 pillars, culture- environment-economy-economy and 5 steps to design sustainability policies. Cultural institutions have long recognized the importance of leveraging digital technologies, sustainable practices, and modern business models to achieve their goals. However, many small public and private non-profit cultural organisations face significant management challenges in attracting funds, maintaining assets, and staying visible in the market to ensure long-term viability, while still being able to mitigate climate change challenges. Securing funds and promoting museums require well-crafted public relations communication policies, involving feasible macro-, medium-, and short-term programs that consider the current situation, target audience, and specific strategies. Moreover, with the increasing integration of digital services, such as electronic guides, virtual tours, and exhibitions, managing museum assets has become more complex alongside traditional educational programs and periodic exhibitions and events.

Recent times have witnessed a surge in digitization and the application of digital tools for cultural heritage, encompassing multi-dimensional digitization, standardized data schemas and metadata for documentation, advanced cultural management, virtual exhibitions, and various innovative technologies like virtual, augmented, and mixed reality, geoinformatics, gamification, and educational innovations (Tsirliganis et al., 2002; Tsirliganis et al., 2004; Pavlidis et al., 2007; Koutsoudis et al., 2012; Pavlidis & Sevetlidis, 2015; Kiourt et al., 2016; Kiourt et al., 2016; Kiourt et al., 2017a; Kiourt et al., 2017b; Pavlidis, 2019; Pavlidis & Koutsoudis, 2022). These approaches have been combined in diverse ways, presenting new possibilities for museums and heritage preservation. However, small cultural institutions encounter significant barriers in embracing this digital revolution due to their non-profit nature, limited staffing, and technical specialization requirements, making it challenging for

them to adapt. Consequently, their sustainability and viability are at risk, particularly in this era, in which climate change creates new challenges.

Small museums face a growing urgency to adapt and mitigate the effects of climate change on cultural heritage. Still, small museums can leverage digital strategies to enhance their resilience and contribute to climate change mitigation efforts. By adopting innovative approaches and embracing sustainability practices, small museums can play a crucial role in safeguarding heritage under the climate change threat. The digital transition of small museums offers opportunities to integrate climate change considerations into their operations, thus minimizing their carbon footprint and promoting sustainable practices. By embracing greener technologies and energy-efficient solutions, museums can reduce their environmental impact and contribute to climate change mitigation efforts. This includes leveraging virtual experiences and online platforms to reduce physical travel and associated carbon emissions, while still providing immersive and educational experiences to visitors. Furthermore, the adoption of sustainable asset management practices within small cultural organisations can support climate change resilience. Importantly, collaboration and knowledge- sharing among small museums are vital in addressing the climate change threat. By joining forces, museums can collectively develop resilience strategies, share best practices, and advocate for sustainable policies. This collaborative approach empowers museums to have a broader societal impact, actively contributing to climate change mitigation at a local, regional, and global level.

Project "Thalia-Digital toolset for the analysis, promotion, and protection of the Greek cultural reserve in small cultural institutions" aims to address these challenges through a compact comprehensive framework. Thalia introduces modern and adapted asset management and marketing planning strategies, coupled with a state-of-the-art toolset. Bridging the domains of culture, technology, and economy, Thalia builds upon the CIDOC-CRM data model and a shared web structure for seamless integration of all tools and services. Thalia empowers small cultural institutions with secure and private asset management, asset valuation, communication planning, virtual exhibition spaces, adapted guided tour apps, and access to information sources, including crowdfunding portals. Additionally, Thalia introduces a collaborative augmented reality tool, powered by Microsoft HoloLens technology, facilitating shared virtual spaces for event planning and asset sharing among multiple stakeholders (see example screenshots in Figure 1).

Figure 1. VR and AR technologies supporting both the backend and frontend of the Thalia framework for small cultural organisations.

Thalia goes beyond frontend innovations and primarily focuses on providing comprehensive backend tools to empower museums in their independent development. By offering state-of-the-art

frontend experiences for visitors, Thalia enhances visitor engagement, sustainability efforts, and indirectly contributes to climate change mitigation. Thalia's backend tools play a crucial role in supporting museums to work autonomously and evolve in their operations. The enhanced museum asset management system enables museums to efficiently organize, assess, and preserve their cultural assets. Through standardized data schemas, metadata, and valuation methods, museums can make informed decisions regarding resource allocation, conservation efforts, and strategic planning for long-term sustainability. Additionally, Thalia's adaptive marketing planning approaches equip museums with customized and adaptable marketing plans. These tools enable museums to effectively reach their target audience, enhance visibility, and attract visitors. By utilizing data-driven insights, museums can optimize their marketing strategies, ultimately supporting not only their financial sustainability and resource allocation but also their capacity for climate change mitigation measures. In parallel, Thalia offers cutting-edge frontend innovations that enrich the visitor experience. Virtual reality museums, augmented reality exhibits, and interactive guides provide immersive and engaging experiences for visitors, fostering a deeper appreciation for cultural heritage.

The overall focus on efficiency is expected to have a significant impact on the environmental footprint of the museums and the planning of shared activities and events can also contribute to minimise the carbon footprint of the involved organisations. Establishing strategies for the sustainable development and collaboration or even clustering of small museums is among the best approaches towards the next generation cultural institutions with stronger social, educational and environmental impact.

Acknowledgements

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