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DIGITAL STRATEGIES FOR ENHANCING CULTURAL HERITAGE: THE VILLA DEL CASALE OF PIAZZA ARMERINA PROJECT, FROM LEGACY DATA TO DIGITAL ECOSYSTEM

1. Introduction

Legacy data plays a pivotal role in reconstructing archaeological sites and historical landscapes, often consisting of diverse analogue resources that require a multifaceted approach to unlock their heuristic potential. In response, digitization emerges as a transformative solution which offers opportunities to safeguard and democratize access to this heritage, transcending geographical borders and enabling remote access to materials previously confined to specific locations. Depending on data quality and scientific objectives, focused strategies for digital acquisition and deployment are needed, bridging disciplinary boundaries, and overcoming evidence fragmentation (Allison 2008; Aspöck 2020; Katsianis, Kalayci, Sarris 2022).

This is particularly pertinent in a geographic and cultural context like Sicily, situated at the crossroads of civilizations, boasting a diverse cultural heritage spanning millennia. In the digital age, Sicily faces the challenge of preserving its tangible and intangible assets due to severe constraints like technological obsolescence, fragmented efforts, and the digital divide. Against this background, innovative approaches and digitization strategies are crucial for preserving artifacts, mitigating physical deterioration, and sharing cultural resources globally (Bonacini 2012; Cardaci, Versaci 2019; Gabellone *et al.* 2020). Since the last decade, a few international projects have tackled this issued by deploying innovative approaches in digital technologies to document, preserve and enhance Sicily cultural heritage. Online platforms provide access to digitized artworks and historical records, traditionally stored in remote physical archives, democratizing knowledge, and promoting cultural exchange. Some recent initiatives employ 3D scanning, AR, and VR to document archaeological sites and artifacts, and enable immersive experiences that transcend physical boundaries (Barone, Nuccio 2017; Bonacini *et al.* 2019; Bonacini 2020; Vennarucci *et al.* 2021; Kingsland 2023).

2. The project

The project entitled 'Digital strategies for enhancing cultural heritage: the Villa del Casale of Piazza Armerina, from the late antique building site to the Museum Collection' aligns perfectly with this context. Launched in 2023 as a three-year endeavor, it represents a research case study of a wider, EU-funded initiative entitled 'Virtual Technologies for Museums and Art

Fig. 1 – Drone photo of the Villa del Casale archaeological site (photo C. Lamanna).

Collections, which acts as a thematic spoke of the project CHANGES 'Cultural Heritage Active Innovation for Next-Gen Sustainable Society' (https://sites.google.com/uniroma1.it/changes/, PNRR Mission 4). It focuses on the use of virtual technologies for the promotion, preservation, and enhancement of cultural heritage in Italian museums and art collections, exploring heritagization processes and conceptualizing digital cultural heritage as a network of interlinked relations among digital objects and their cultural environment (Balzani *et al.* 2024).

The present project focuses on Palazzo Trigona Museum of Piazza Armerina in its relationship with the archaeological context of Villa del Casale, a UNESCO World Heritage site since 1997 (Fig. 1). Generally appreciated for the imposing decoration of the 4th c. residence, for centuries it played the role of key landscape marker with an almost uninterrupted occupation from the so-called Villa Rustica (end of the 1st c. AD) to the Medieval village (12th c. AD) (Gentili 1999; Sfameni 2006; Bonanno 2020). This settlement palimpsest has been brought to light during many excavation seasons lasting from the second half of the 19th century to 2014 (Pensabene, Barresi 2019). After a short break, since 2022 scientific activities have been resumed under the coordination of the University of Bologna and the auspices of CISEM (Baldini *et al.* 2023; https://centri.unibo.it/cisem/it).

The Palazzo Trigona Museum collection aims to showcase the historical development of the Villa through select excavation findings, yet only a fraction of its extensive heritage is on display. In addition, the significant

distance between the Museum and the Villa (about 6.5 km) frequently hinders the development of a cohesive itinerary linking the two sites. To bridge this gap, the creation of a web-based digital ecosystem intends to expand users' perception of Piazza Armerina cultural heritage and provides them with a novel, updated and comprehensive understanding of its historical developments. By enhancing Museum exhibits and virtually accessing artifacts stored in the Villa's storerooms, the project seeks to enrich visitors' experiences and promote cultural exchange.

3. Methodology

Adopting a multidisciplinary approach, the project aims to gather scattered legacy data, advances scientific understanding, and develops precise datasets through historical research and digitization. The overarching goal is to comprehensively document 2D and 3D assets, getting them to interact and offering unrestricted access in a digital environment. The project pipeline outlines a sequence of steps including the collection of historical, archaeological, and archival data, the digital acquisition and processing of documents and artifacts, and the sharing of content and metadata online on an open-source Web3D framework (ATON). Semantic metadata enrichment

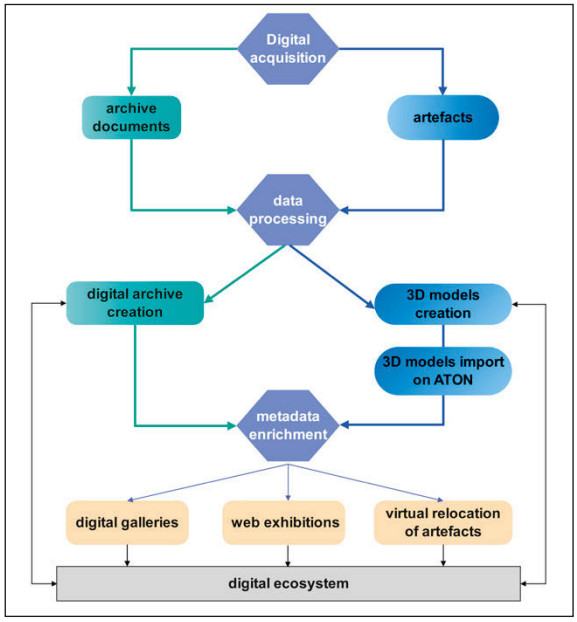

Fig. 2 – Pipeline for the implementation of legacy data into project digital ecosystem.

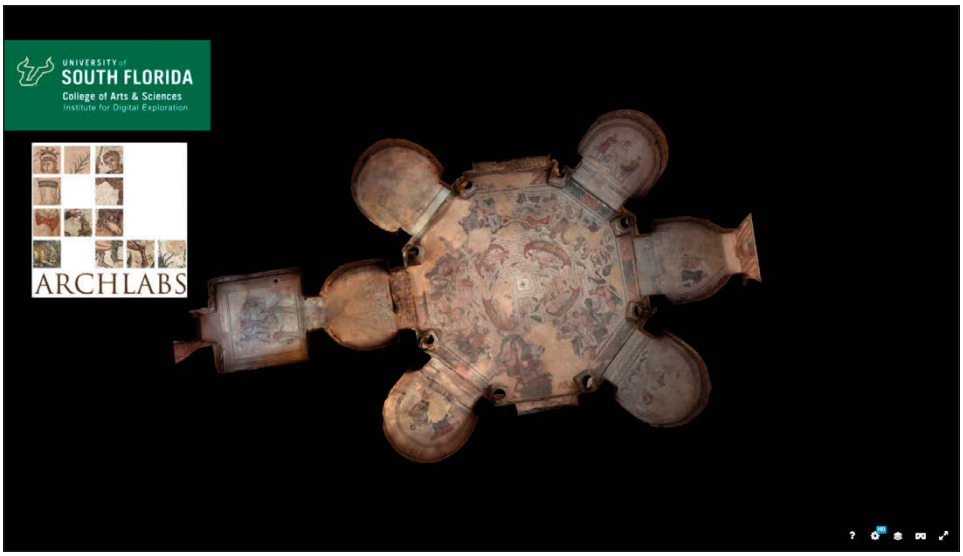

Fig. 3 – 3D model of the *frigidarium* of Villa del Casale on iDEX Sketchfab collection (© D. Tanasi, https://skfb.ly/oA6ou).

will be ensured by the adoption of ontologies and existing standards, such as CIDOC CRM, integrating application profiles for specific targets, such as CHAD-AP for the description of acquisition and digitization workflow (Barzaghi *et al.* 2024), to foster interoperability and data integration (Fig. 2). This endeavor seeks to facilitate a profound exploration of the monument's history and the context of its discovery, boosting the use (and reuse) of digital content in research, entertainment, and education.

The resulting digital ecosystem will feature different sections related to archive resources and archaeological heritage, offering immersive experiences and educational opportunities, such as: 1) a digital collection of archive photographs and excavation diaries related to the first excavations seasons; 2) the virtual reconstruction of the Villa and galleries of 3D models of artefacts with a curated set of descriptive metadata; 3) virtual exhibitions focused on thematic sections; 4) a virtual relocation of selected 3D modelled findings. The generation of 3D assets strongly benefits of the collaboration of IDEx – Institute for Digital Exploration of the University of South Florida, which in the last years has been carrying out a far-reaching 3D digitization campaign of the Villa for documentation, conservation, and entertainment (Gabellone *et al.* 2020; Vennarucci *et al.* 2021; Kingsland 2023; https://youtu.be/3DYPrdgYcy4?si=g0MIFi889EpWe6q5) (Fig. 3).

4. Legacy data in Piazza Armerina: open issues and future challenges

The present state of the monument reflects not just various construction stages, but also many excavation seasons conducted with different methodologies. Setting up an intra-site GIS specifically for past excavations, gathering data from V. Gentili and E. De Miro archives, has helped organize diverse

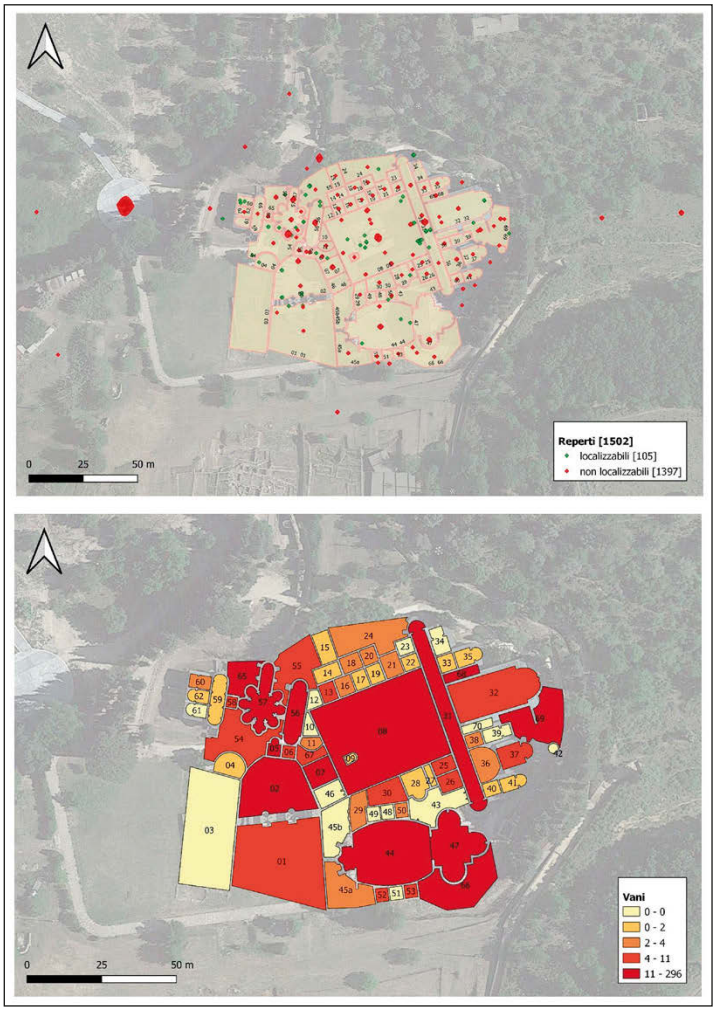

Fig. 4 – Villa del Casale legacy data in GIS environment: a) distribution of georeferenced and non-georeferenced items from Gentili's excavations; b) graded colored map according to the number of unearthed artefacts (after Pizzi 2023).

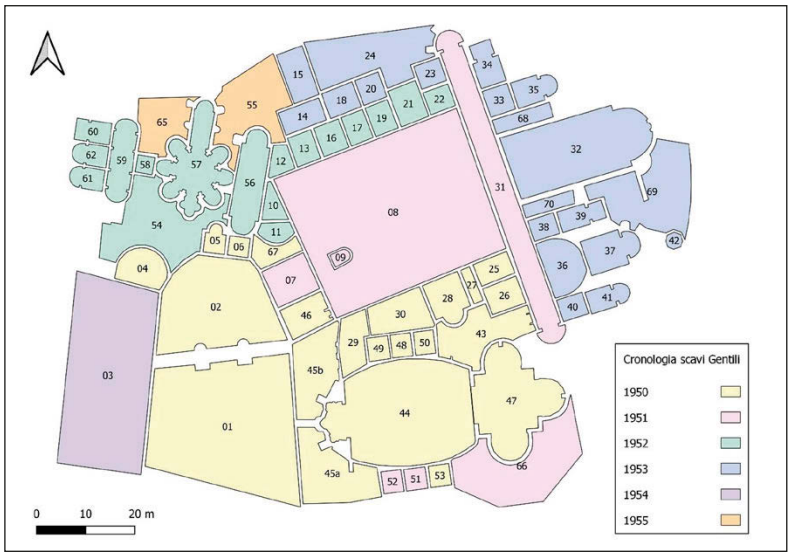

Fig. 5 – Thematic map illustrating the chronology of Gentili's excavations (after Pizzi 2023).

data, revealing overlooked issues due to scattered information (Pizzi 2023) (Fig. 4). Significant concerns arose from Gentili's excavations, which uncovered nearly the entire surface of the Villa but were published only 40 years later (Gentili 1999) (Fig. 5). The publication of a limited selection of findings with brief descriptions and a lack of stratigraphical information greatly impedes proper georeferencing of data in the GIS environment and metadata population. These constraints, along with the considerable research potential in analyzing distribution patterns of specific artifact categories, underscore the need to reassess archive documentation in search of primary data.

Recent inspections of the archives of Siracusa and Enna Superintendences have resulted in the recovery of over a hundred, partly unpublished, photographs from the early excavation seasons, along with formal documents detailing the logistics of Gentili's investigations and his epistolary correspondence regarding significant findings (Fig. 6). These data are invaluable to archaeological research, providing visual insight into ancient structures prior to the extensive restoration efforts carried out in the second half of the 20th century. Additionally, they serve to enrich narratives depicting the day-to-day operations of research and are intended for inclusion in virtual exhibitions.

Building on the newly acquired documentary basis, a 3D modeling campaign of artifacts from Gentili's excavation has been initiated through collaboration with IDEx. The 3D collection, currently showcased in a Sketchfab

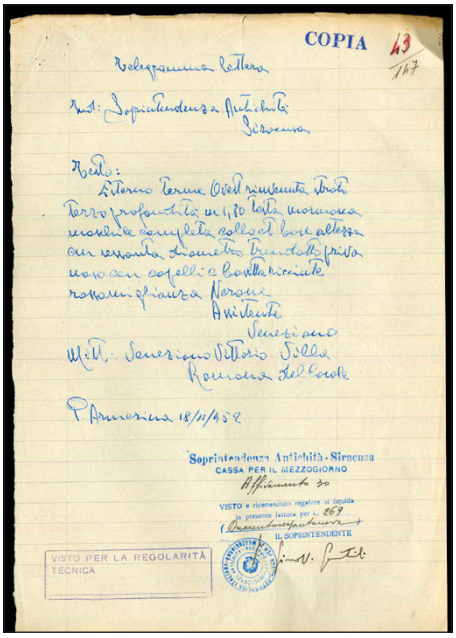
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Fig. 6 – Local attendant's telegram to G.V. Gentili announcing the discovery of a marble statue, dating 1952 (Courtesy of Soprintendenza per i Beni Culturali e Ambientali di Siracusa).

gallery (https://skfb.ly/oA6ou), may be further integrated in ATON Web-based framework, developed by CNR-ISPC, which with its modular architecture offers a scalable and adaptable solution for creating and deploying cross-device Web3D/WebXR applications tailored for the Cultural Heritage domain (Fanini *et al.* 2021).

An important discovery within the archives is an undated excavation diary, the chronology of which can be tentatively hypothesized based on internal references to the work calendar's festive dates of Easter (April, 21st) and *Corpus Christi* (June, 20th) (Fig. 7). Among the possible dates, G. Cultrera's 1935 excavation appears the most probable, as suggested by the correspondence between the situation described in the work diary and Cultrera's reports (Cultrera 1936). Extensive earthworks and trenching activities are documented throughout a wide area previously partially investigated, likely pertaining to the *triclinium*. These efforts resulted in the exposure of known structures and the discovery of new mosaic floors, promptly covered over «to document the depth of excavation». References to Decauville wagons, first introduced by Cultrera and Inglieri in 1935 for transporting earth and artifacts across the

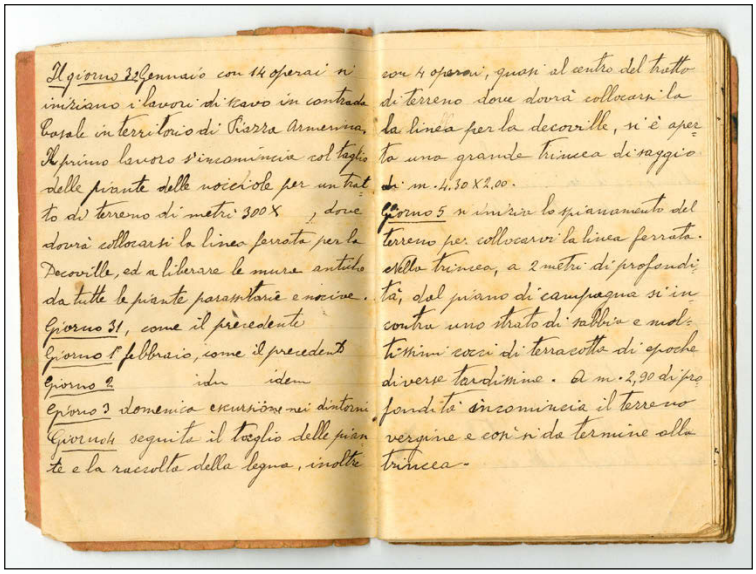

Fig. 7 – First pages of the excavation diary likely attributable to G. Cultrera's works, dating 1935 (Courtesy of Soprintendenza per i Beni Culturali e Ambientali di Siracusa).

site (Nigrelli, Vitale 2010), provide further support for this identification. Similarly, mentions of structures «unearthed five years before», likely during Orsi's earlier investigations, contribute to the contextual understanding. In addition to shedding light on the excavation methods employed during this period, the diary descriptions significantly aid in the mapping of medieval structures, which were heavily disturbed during the initial excavations, as well as the spatial distribution of finds predominantly associated with the Medieval settlement. Alternative dates suggested by liturgical holidays, such as 1946, are deemed improbable due to the cessation of B. Pace's excavations in 1943. Another possibility is 1957, coinciding with the final phase of Gentili's activity; however, the alignment of the diary's descriptions with an earlier stage of investigation renders this scenario unlikely.

5. Conclusions

In conclusion, the Piazza Armerina project aims to move a significant step towards integrating legacy and new data to advance scientific knowledge and cultural exploitation of one of the best preserved monuments of the Late Antique Mediterranean. By enriching metadata with shared ontologies and standards, the project aims to enhance accessibility and interoperability of

digital contents. The integration of 3D artifact galleries with virtual models of the Villa and legacy data in GIS environments opens up new possibilities for exploration and interpretation, such as the virtual relocation of specific set of artefacts in the original setting according to information obtained by legacy data reassessment. Ultimately, the project seeks to unlock the full potential of Villa del Casale cultural heritage, fostering appreciation and understanding for future generations.

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ABSTRACT

The paper highlights the crucial role of legacy data in reconstructing archaeological sites and historical landscapes, emphasizing the need for digitization to safeguard and democratize access to heritage. Focused strategies for digital acquisition are essential, particularly in regions like Sicily with diverse cultural heritage facing challenges of preservation in the digital age. The project 'Digital strategies for enhancing cultural heritage: the Villa del Casale of Piazza Armerina, from the late antique building site to the Museum Collection' exemplifies this approach. Its foundation, aiming to bridge the gap between the Palazzo Trigona Museum and Villa del Casale through a web-based digital ecosystem, is firstly presented here. By adopting a multidisciplinary methodology, the project aims to gather scattered legacy data, advance scientific understanding, and develops precise datasets through historical research and digitization. The resulting digital ecosystem will feature immersive experiences and educational opportunities, enhancing accessibility and interoperability of digital contents. By integrating 3D artifact galleries with virtual models and legacy data, the project seeks to reveal the full potential of Villa del Casale cultural heritage, promotingappreciation and understanding for future generations.