



3D TECHNOLOGIES IN CYPRIOT PREHISTORIC ARCHAEOLOGY AND HERITAGE: THE ERIMI USER EXPERIENCE

Francesca Dolcetti^{a,*}, Luca Bombardieri^b

^a Department of Archaeology, University of York, King's Manor, York, YO1 7EP, UK. francesca.dolcetti@gmail.com

^b Dipartimento DFCLAM, Università di Siena, Palazzo S. Niccolò, Via Roma 56, 53100 Siena, Italy. luca.bombardieri@unisi.it

Abstract:

The use of digital technologies is deeply affecting our engagement with the archaeological record and reshaping cultural heritage encounters. However, the creation of digital resources for specialists and non-specialists alike is rarely informed by design theory and practices, even though design is deeply embedded in archaeological practices and in the way archaeologists and heritage professionals produce and share knowledge. By not engaging with core design epistemologies and audiences we are missing meaningful opportunities in terms of alignment of project goals with user outcomes and the creation of more impactful archaeology. This paper discusses the application of 3D technologies within the Erimi Archaeological Project and the creation of 3D models and interactive digital media for research and public engagement, through an iterative process of User Experience Design (UXD), evaluation and implementation or redesign based on users' feedback and insights gained through each iteration.

Keywords: digital archaeology, digital cultural heritage, 3D modelling, museum experience design, Erimi, Cyprus

1. Introduction

In the past few decades, the use of 3D technologies has become ubiquitous within the archaeological and heritage sectors, changing how the archaeological evidence is collected, interpreted, shared and communicated.

Three-dimensional models of stratigraphy and structural remains are a valuable tool for the interpretation of stratigraphic sequences and the analysis of spatial relationships. As such, more and more excavations have implemented 3D documentation workflows using laser scanning and photogrammetric techniques to generate 3D models at the trowel's edge (Dell'Unto, Landeschi, Apel, & Poggi, 2017; Opitz, 2018).

Moreover, museums have been increasingly adopting digital technologies as part of their efforts to democratise their practices and transform what is usually a passive learning process into a more active performance. Virtual and augmented reality installations, 3D prints, mobile apps and other interactive digital media have become a meaningful medium for museums and exhibitions, since they offer a wide range of possibilities for a more dynamic, interactive and emotionally engaging experience. (Simon, 2010; Di Franco, Camporesi, Galeazzi, & Kallmann, 2015; Economou, 2015).

Using the case study of the Middle Bronze Age site of Erimi-Laonin tou Porakou (Limassol, Cyprus), this paper discusses the application of 3D technologies as a research tool and a medium for public communication, by

presenting the iterative design journey from a standalone interactive 3D model to a multimedia museum visiting experience (work undertaken as part of Dolcetti PhD research).

2. Prehistoric Erimi in context

The development of the Middle Bronze Age community at Erimi (2000/1950-1650 BC) in the southern coastal region of the island, takes place on the verge of the origin of the urban society in Cyprus.

Thanks to a wide-ranging and multi-scalar analysis of the archaeological evidence, the Italian research team has identified three major occupational areas different in use and functions, where the Prehistoric community had decided to organize its space for living, working, gathering or burying and commemorating the dead. On the top of the hill we locate the central complex with the main function of a workshop (Area A). On the large natural terrace extending southward the workshop complex, the lower city extends with its dense framework of housing units belonging to the residential area (Areas B and T): it is surrounded and protected by an imposing circuit wall that separates the settlement from the funerary areas (Area E). Here large chamber tombs and smaller pit tombs were excavated into the limestone bedrock terraces.

The processing structures and storage spaces, together with the residual artefacts and raw materials from the central workshop complex, are evidence of a complete

* Corresponding Author: Francesca Dolcetti, francesca.dolcetti@gmail.com

textile *chaîne opératoire*, consisting of the diversified activities of spinning, weaving and dyeing. The great ideological significance that this community ascribed to textile craftsmanship is reflected in the increasing efforts to secure and monumentalize the workshop complex; and, on a broader perspective, the success in trade exchanges accelerates the emergence of elements of social differentiation based on the prestige of some family groups or clans (Bombardieri, 2017).

Erimi offers an emblematic case study as the nature of its interpretation addresses many of the issues present in the field of 3D visualisation of archaeological sites. Its poor state of preservation (due to erosion, bioturbation and grazing) is problematic for achieving a comprehensive interpretation of the site's architecture and more broadly in terms of communication to academic and public audiences. Erimi in fact, like many other archaeological sites, in its present state does not have features that are easily recognisable and understandable by people outside a restricted circle of experts, thus making their 3D visualisation extremely valuable for public engagement.

3. From field to museum

The first design iteration was carried out between 2015 and 2016 and resulted in an interactive 3D model of the workshop complex, presenting the area in its actual state and the hypothetical reconstruction of the built environment, modelled according to several interpretive hypotheses made over the years by the Erimi research team (Dolcetti, Bonora, Fiorini, Conti, & Tucci, 2017).

The model was then imported in Unity (Unity Technologies, 2021), to create a graphic user interface (GUI) that allows to explore the 3D model, while retrieving information through interactive hotspots, and also provides a first-person navigation via avatars (luminous silhouettes) (Fig. 1).

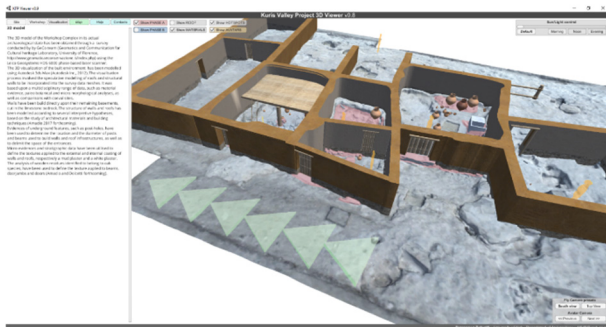


Figure 1: Erimi interactive 3D model (credit: Francesca Dolcetti).

The GUI was subjected to peer review and assessed through a series of interviews and focus groups conducted with members of the Erimi research team. Feedback from participants highlighted how the interaction with the 3D model heightened their comprehension of the built space, seen as more tangible, while also fostering new interpretive issues regarding accessibility and the different use of spaces.

Moreover, the interface was evaluated by different user groups (experts, non-experts and students) outside the Erimi research team. Feedback gathered through a multi-stage survey was used to assess different audiences' responses to the interactive 3D model and subsequently

integrated within the redesign and improvement of the GUI during the second design iteration (Dolcetti, 2021 in prep).

In 2018, the Erimi research team started a collaboration with the Musei Reali in Turin to develop the exhibition "Cipro. Crocevia delle Civiltà", aimed at presenting the history and art of Cyprus across millennia in its paradigmatic role within cultural exchanges in the Mediterranean. As part of the exhibition, the thematic session "Turin in Cyprus. From fieldwork to virtual reconstruction: 3D models and immersive experiences", was designed with the purpose of providing a multimedia immersive experience of Erimi and enhancing visitors' engagement with ancient material culture through different interactive media. In order to do so, the pathway was designed as a journey into the archaeological site through the stories and lives of three artefacts selected from the Erimi assemblage (a goat-shaped askos, a comb-shaped pendant and a decorated spindle whorl), while presenting archaeologists' interpretation of the symbolic meaning embedded in these artefacts and their significance for the Prehistoric community at Erimi.

Here, the original 3D model, designed as a computer-based standalone feature, was refined and enhanced using users' feedback gathered during the previous iteration. Some components of the GUI, for example, were criticised in terms of usability and comprehensibility of text descriptions. Users reported the feeling of disorientation while interacting with the model and suggested the adoption of a story as a recommended path of exploration. Users also advocated the use of less academic jargon to ensure readability. Moreover, users' feedback registered a negative reaction to the choice of using avatars as neutral silhouettes.

To overcome these issues, the following improvements were undertaken. Firstly, the exploration mode was redesigned, providing a predefined exploration path to avoid the sense of disorientation. As for information, content was revised and layered so it can be accessed if desired, without being overwhelming or disruptive of the visitor experience (Fig. 2).



Figure 2: Exhibition touchscreen app (credit: Francesca Dolcetti).

Secondly, a narration was developed to make the visitor experience more engaging (Perry, 2019). The story of the artefacts from Erimi, interpreted as common-use objects and ornaments embedded with symbolic value in relation to textile activities, introduces a narrative on how textile productions were pivotal to the local economy and performed by a large number of the community members. It also presents one of the interpretations about the

abandonment of the settlement and how these artefacts, along with other objects found in the workshop complex, were left behind on purpose as a part of a ritual practice involving the burning of significant structures, to physically and symbolically 'seal off' a place that was an integral part of the community identity (Amadio & Bombardieri, 2018).

Finally, to convey the sense of an inhabited place and provide a multi-sensorial experience, the 3D model was populated with animated characters, performing working activities supposedly conducted at Erimi, and complemented by a natural and human soundscape (Dolcetti, 2021 in prep).

The visitors' pathway also presents 3D printed replicas of the three artefacts associated with interactive tablets to offer visitors a tactile and embodied experience with the objects, while retrieving more contextualised information on their function (Fig. 3).

The overall aim is to encourage visitors to reflect on the cultural significance of these artefacts and what they can tell us about the identity of the community who made them.

4. Discussion and conclusions

In this paper, we presented how 3D technologies have been integrated within the Erimi Archeological project as aids for archaeological interpretation and as a means of public engagement. By adopting an iterative design process the initial interactive 3D model has been refined and implemented as part of a multisensory museum experience to enable a more reflective and critical engagement with the archaeological record. Further evaluation during the exhibition, currently on hold due to the COVID-19 pandemic, will provide a deeper understanding of the impact of digitally enhanced museum visiting experiences on a wide and variegated audience.



Figure 3: Exhibition tablet app (credit: Francesca Dolcetti).

Acknowledgements

This work was supported by the Università di Torino, the Italian Ministry of Foreign Affairs and the Ente CRT (Grant 2019.0470. *ArcheoTech to ArcheoTeach*) Thanks are also due to the University of York, the Department of Antiquities of Cyprus and the Erimi team.

References

- Amadio, M., & Bombardieri, L. (2018). Abandonment processes at Middle Bronze Age Erimi: A multi-scalar approach. *Antiquity*, 93(368), 1-7. <https://doi.org/10.15184/aqy.2019.29>
- Bombardieri, L. (2017). *Erimi-Laonin tou Porakou. A Middle Bronze Age Community in Cyprus. Excavations 2008-2014*. Studies in Mediterranean Archaeology Vol. 145. Uppsala, Sweden: Paul Åströms Förlag.
- Dell'Unto, N., Landeschi, G., Apel, J., & Poggi, G. (2017). 4D recording at the trowel's edge: Using three-dimensional simulation platforms to support field interpretation. *Journal of Archaeological Science: Reports*, 12, 632-645. <https://doi.org/10.1016/j.jasrep.2017.03.011>
- Di Franco, P. D. G., Camporesi, C., Galeazzi, F., & Kallmann, M. (2015). 3D Printing and Immersive Visualization for Improved Perception of Ancient Artifacts. *Presence: Teleoperators and Virtual Environments*, 24(3), 243-264. https://doi.org/10.1162/PRES_a_00229
- Dolcetti, F. (2021). Designing digital experiences in archaeology: integrating participatory processes into archaeological practice. PhD Thesis. York, UK: University of York. Manuscript in preparation.
- Dolcetti, F., Bonora, V., Fiorini, L., Conti, A., & Tucci, G. (2017). 3D modelling and architectural visualisation. In: L. Bombardieri, *Erimi Laonin tou Porakou. A Middle Bronze Age Community in Cyprus. Excavations 2008-2014* (pp. 327-334). Studies in Mediterranean Archaeology Vol. 145. Uppsala, Sweden: Paul Åströms Förlag.
- Economou, M. (2015). *Heritage in the Digital Age*. In: W. Logan, M.N. Craith & U. Kockel (Eds.), *A Companion to Heritage*

- Studies, 15 (pp. 215-228). Hoboken, USA: John Wiley & Sons, Inc. <https://doi.org/10.1002/9781118486634.ch15>
- Opitz, R. (2018). Publishing Archaeological Excavations at the Digital Turn. *Journal of Field Archaeology*, 43(1), 68-82. <https://doi.org/10.1080/00934690.2018.1505409>
- Perry, S. (2019). The Enchantment of the Archaeological Record. *European Journal of Archaeology*, 22(3), 354–371. <https://doi.org/10.1017/eea.2019.24>
- Simon, N. (2010). The participatory museum. Santa Cruz, USA: Museum 2.0.
- Unity Technologies (2021). Unity Real-Time Development Platform | 3D, 2D VR & AR Engine. Retrieved February 2, 2021, from <https://unity.com/>