Re-examining a 20th century archaeological excavation in 3D GIS

The Ayia Irini (Cyprus) sanctuary and its finds

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Introduction

In the last years, technologies have been employed to revise and re-examine old archaeological excavations and their material. In many cases, such an approach brought to new discoveries and highlighted the importance of the digital technologies' use in the entire archaeological process: digitization of legacy data, documentation, data analysis, visualization, and results' publication.

Notably, the digitization of legacy and archival data (including excavation diaries, drawings, sketches, and photographs) as well as the re-examination of the material coming from past excavations, revealed the presence of information that was not recorded (or was not possible to record) in the final results of several kinds of research. This fact is not a rare possibility when analysing old excavations: such 'mistakes' could be due both to misunderstandings of the archaeologists and to limitations of the analogic technologies employed in the past. The situation can be much more complicated if we are in front of archaeological sites or structures that are now destroyed, severely degraded or not reachable and accessible for many different reasons.

Precisely, this paper presents a case like the one just mentioned. The development of a 3D digital methodological approach, based on the integration of semantics and 3D analyses, is applied to the re-examination of a (not more accessible) 20th century archaeological excavation and its material: the Cypriot Ayia Irini sanctuary.[1] Specifically, here it will be presented the part related to the digital re-assessment of the site's stratigraphy in a 3D GIS environment, by analysing published material and unpublished data extracted from grey literature[2]: the digital reconstruction of the sanctuary and its stratigraphy supports the revision of the archaeologists' interpretation. The research tries to clarify the position and setting of the artefacts, the existence of natural or human-made features and the presence and impact of possible flooding events on the material settings in the area.

The Ayia Irini sanctuary and its finds

In October 1929, the site of Ayia Irini was excavated and interpreted as a sanctuary by the Swedish Cyprus Expedition (SCE): the archaeologists identified seven periods of use, from the end of Late Cypriot III (ca. 1200 BC) to the Cypro-Archaic II periods (ca. 500 BC), with a small reoccupation in the 1st century BC, suggesting that the area was flooded several times (Gjerstad et al., 1935).

The remains showed the presence of a *temenos* constituted of small structures around an open area. Inside this area, around a limestone altar in a semi-circular position, the archaeologists found more than two thousand ex-votos, different in size and shape, represented by human statues and statuettes, animals (bulls and horses), chariots and minotaurs.[3]

Just after the excavation, the material was divided into almost two halves between Sweden, the country of the archaeologists, and Cyprus. Upon their arrival to the northern country, the collection was further divided into different parts. Today, part of the assemblage is still conserved at the Cyprus Museum (Cyprus) and four different museums in Sweden: at the Medelhavsmuseet, together with the archive of the SCE, at the Lund University Historical Museum, at the Malmö Konstmuseum, and the Gustavianum-Uppsala University. Such an arrangement, of course, prevents unified access and study of the material. Moreover, since 1974 the site is under the Turkish military occupation and therefore the site is not accessible for operating any further excavations and official investigations. After that date, all the studies on the sanctuary and its material have

[1] This is the subject of the author's doctoral research project.

[2] With grey literature is intended all the material that is either unpublished or has been published in non-standardized form (e.g. the unpublished excavation diary where the archaeologist takes notes versus the final interpreted publication of the excavation data)

[3] Beyond the cited material, other kind of objects, such as pottery, lamps, pendants, coins, and scarabs, were found at the site.

therefore focussed on reviewing published and unpublished material to clarify the questions about the stratigraphy and its chronology (Houby-Nielsen, 2016; Bourogiannis and Mühlenbock 2016; Mühlenbock and Brorsson 2016).

Revision of the archaeological excavation data and issues' identification

Beyond the problems of the material dispersion in different museums and the inaccessibility of the site, other issues have been identified after the re-examination of the published and unpublished material and the above mentioned more recent studies on the subject. First of all, the SCE publication of the results was done several years after the excavation and by the leader of the team, Gjerstad, instead of the archaeologist who excavated the site, Sjöqvist. Most probably, such a situation brought to different opinions on the interpretation of the presence and number of flooding events that occurred in the sanctuary area. Moreover, further inconsistencies have been identified between the archival data and the published material: drawings with missing elements, wrong direction of some sections, lack of maps and some layers not identified in all the site. A lack of accuracy has been noted in the maps published for the positioning of the site, as well as in the more detailed ones regarding the artefacts positions. Last but not least, the relative reference measurement system used by the SCE is not related to any geographical coordinate system, causing difficulties in the reconstruction of the site respect to the modern landscape. All these discrepancies might have affected the interpretation of the site.

The 3D GIS project as a support to the stratigraphy re-assessment

Therefore, a 3D GIS project has been developed to integrate and analyse the unpublished material (original sections, drawings, and maps from the archive) with the published one together. This data integration allows to 3D reconstruct the Ayia Irini sanctuary and its finds diachronically, and to contribute with the support of the 3D visualization to the archaeological discussion. For the creation of the GIS project, ESRI ArcGIS Pro 1.3 software package, has been employed. This software is, in fact, able to manage 3D geometrically complex models, useful to the reconstruction of the site under study (Fig. 1).

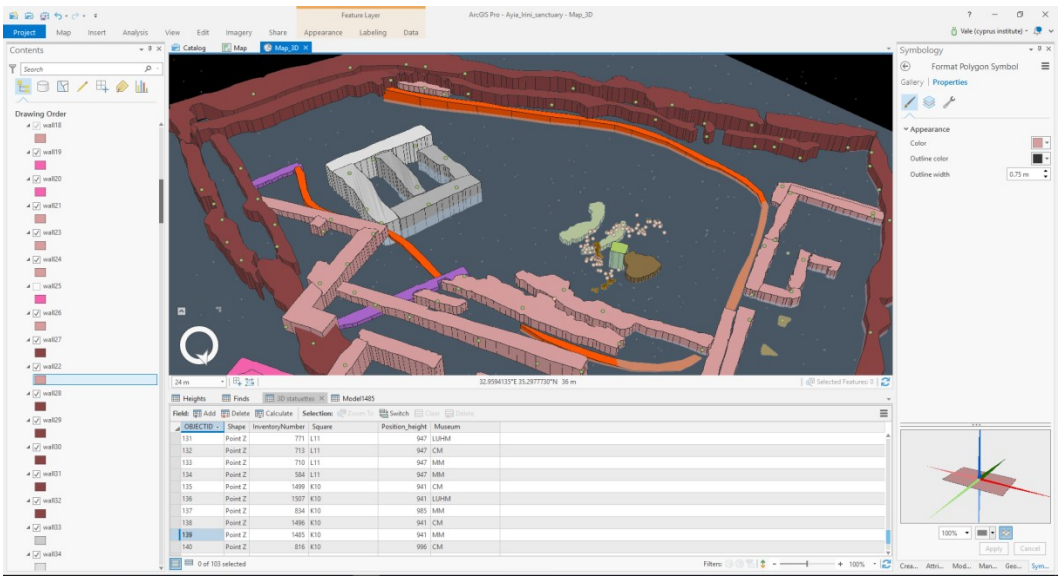

Fig. 1. Reconstruction of the excavation: visualization of the 3D layers and re-positioning of the 3D finds (© author).

The digital reconstruction of the site has been performed following the subsequent steps:

- Digitization of the excavation documentation
- Geo-referencing of the digitized maps, plans, and sections
- Reconstruction of the 3D space (3D reconstruction of the structures; 3D volumes of the excavation layers)

- Integration of the 3D models of the finds (obtained employing laser scanning) within the 3D space (Fig. 2).[4]

Some preliminary results

The paper will present the methodology of the reconstruction and the description of all the passages, the various issues encountered, and the solutions adopted to solve them. Moreover, all the preliminary results and the interpretative hypotheses will be further discussed. Briefly, the identification of measure errors and other inconsistencies have been used to correct the documentation material; the non-visible underneath sanctuary has been positioned, and geo-referenced respect to the modern landscape; a reference measurement system has been built to integrate and relate all the excavation's sections. Finally, a preliminary reconstruction on the base of the artefacts' sample distribution has been performed. Such a reconstruction showed so far two main stratifications of the material, interspersed and divided by a layer that might be identified as a flood, also according to the description of its texture, and finally covered by the debris of another natural event that covered the entire area.

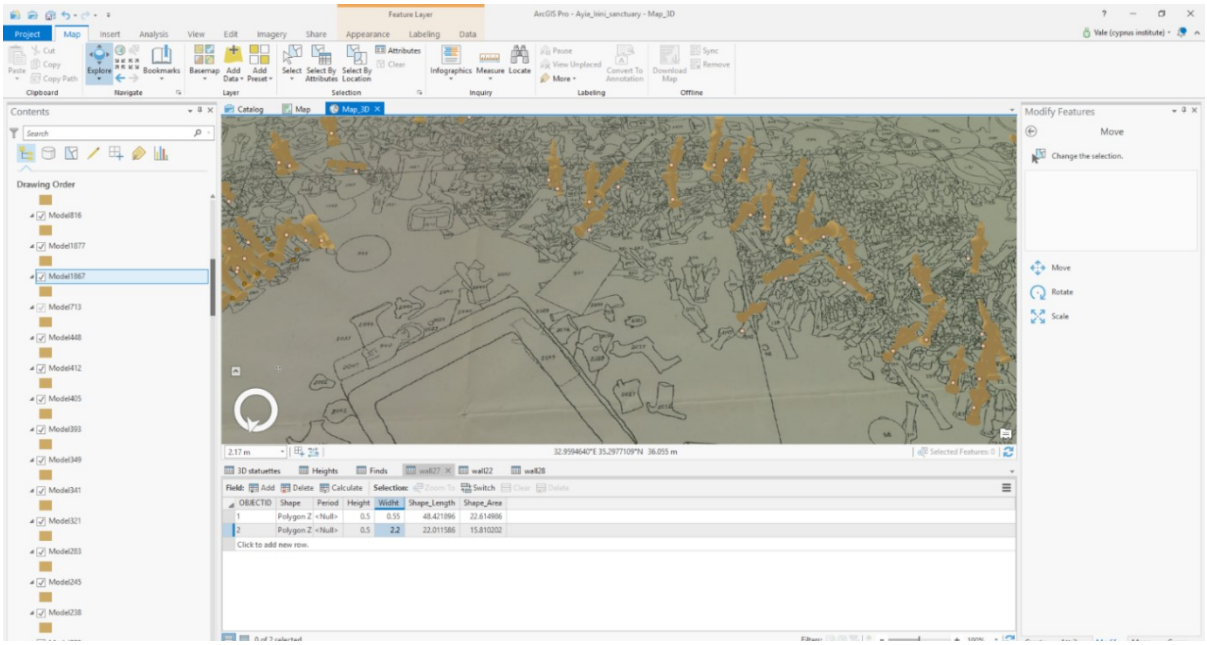

Fig. 2. 3D models of the finds integrated in the 3D GIS (© author).

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[4] This step is important also to have a digital unified access to the collection and a holistic vision of the archaeological discovery.