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PUTTING 3D MODELS INTO CONTEXT – THE SCHACHERMEYR POTTERY COLLECTION AND THE DEFC APP

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Abstract:

In order to overcome the different knowledge schemas of research on Neolithic and Chalcolithic sites of Greece and Anatolia, an open access Django-based database called DEFC App (Digitizing Early Farming Cultures Application) has been developed. The 3D models of the Schachermeyr sherd collection are one of the many resources that will be integrated into the database. The present contribution focuses on these 3D models and their metadata and on how they are contextualized within the DEFC App database and beyond. Additionally, we discuss the 3D model provenance metadata that should accompany the 3D models in order to assure their transparency.

Key words: digital archaeology, online site database, 3D model, data integration, metadata, legacy data, linked open data

1. Introduction

The Schachermeyr pottery collection was left to the Austrian Academy of Science by Fritz Schachermeyr in order to serve everyone interested in studying the Neolithic pottery of Greece. With this intention the collection has been made available to the public and with the recent development in technology it can finally reach the broadest possible audience in the form of digital 3D models.

The 3D models will be presented within an open-access Django-based database called DEFC App (DEFC App 2016; GitHub DEFC App 2016) that has been created in the framework of the Digitizing Early Farming Cultures (DEFC) project. The purpose of this application is to integrate research data from Neolithic and Chalcolithic sites and finds of Greece and Anatolia (Aspöck and Masur 2015). Both areas were usually researched in isolation from each other, which resulted in fragmented data, organized according to different knowledge schemas. In collaboration with the Aegean Anatolian Prehistoric Phenomena (AAPP) research group (ÖAW, OREA), an app has been created, which aims to overcome this fragmentation and will finally allow collaborative research throughout the whole area. Therefore the existing digital datasets are being harmonised and analogue data from publications (Alram-Stern 1996) are being digitised. Furthermore, a selection of 90 representative sherds from the Schachermeyr pottery collection (Schachermeyr 1991) was digitised using a Breuckmann SmartScan HE 5 Megapixel Color 3D Scanner (Fig. 1).

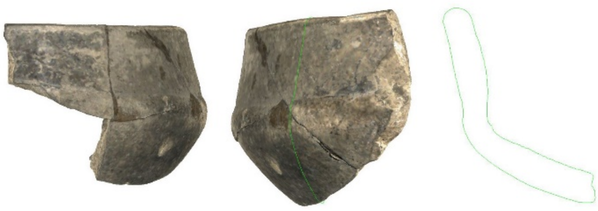

Figure 1: A textured 3D model and its cross-section of a sherd from the Schachermeyr pottery collection.

All data will be made available through the DEFC App that can be accessed through the project homepage. This app, which complies with standards of data sharing and interoperability, must allow easy access, data connectivity and data reuse.

The present contribution focuses on the 3D models of the sherds and their associated metadata. First, the 3D models will be presented in the context of the DEFC App data model. Afterwards, we will discuss the standards of the necessary metadata and paradata that accompany these 3D models in order to ensure their transparency.

2. DEFC App data model

The DEFC App data model meets the particular requirements of dealing with data of different granularity. This means that some data sets are very detailed

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containing many sub-levels (such as the documentation of modern archaeological excavations), wereas other data sets comprise broad archaeological data (e.g. old reports and other legacy data). The DEFC App data model therefore connects different levels of excavation processes, geographical location and chronological periodisation, while also keeping the complex relationships between the data objects. To meet the needs of all possible users, a clear conceptual data model that is based on the most probable relationships between archaeological objects has been defined with the following main model classes (Fig. 2):

- Site (location where archaeological research took place/observations were made);
- Research event (project and type of archaeological research that was carried out);
- Area (particular part of the site within a certain time span - period);
- Finds (artefacts, animal and plant remains found in a certain area);
- Interpretation (archaeologist's interpretation of areas/finds etc.).

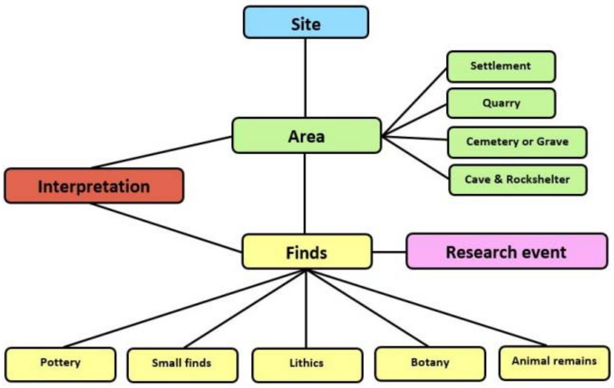

Figure 2: DEFC App conceptual data model.

Each of these classes is defined through several properties, most of them linked to a carefully curated set of controlled vocabulary that has been ordered in thesauri. To properly link the 3D models from the Schachermeyr pottery collection with the DEFC App database classes, the work on the sherds conducted by E. Alram-Stern (Schachermeyr 1991) was used to gather the assets metadata. The publication includes information that will allow us to link the 3D models to the location where they were found. The "Site" class includes the coordinates that will be displayed on the app's map (Fig. 3).

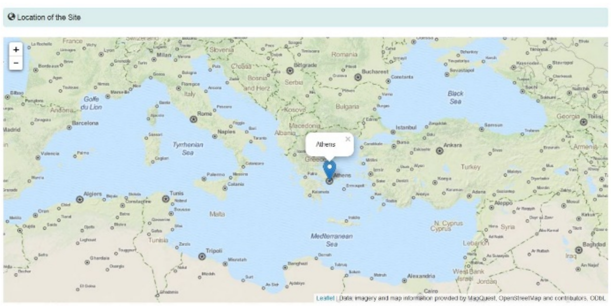

Figure 3: DEFC App map display.

Furthermore, the 3D models will be linked to the research event during which the sherds were collected ("Research event" class). The dating of the sherds will be carried out through the "Area/period" class and finally they will be included in possible interpretations ("Interpretation" class). The "Finds" class includes several detailed properties, where the form, decoration and other characteristics of the ceramic can be described. In addition, the database is linked to a Zotero-based reference library (Zotero 2016) collected by the AAPP research group. In this way it becomes possible to link the 3D models to the corresponding literature.

After this necessary first phase of literature research, the 3D ceramic models will be attributed with more detailed information concerning their form and decoration. These data were gathered by the AAPP research group. At present, these metadata are – together with other Greek pottery databases made by the AAPP research group – stored in Access databases. To integrate the latter with the DEFC App, both the DEFC App as well as the pottery Access databases are being mapped to the CIDOC Conceptual Reference Model (CRM) ontology (CIDOC-CRM 2014). After this mapping, all data will be stored in a triple store with a SPARQL endpoint. By mapping the various databases to the CIDOC CRM, it becomes possible to integrate all these different data sources since it is clear which classes and properties of the initial databases correspond. At this point, this new metadata can also be connected to the 3D sherd models.

3. 3D metadata

The content of the paragraphs above can be classified as the so-called "*heritage asset identification*"-part of 3D metadata according to the recommendations of the 3D ICONS guidelines (3D ICONS 2016). In this section we will look into the 3D model creation metadata (often called paradata) that should accompany the 3D models to asure their transparency. One of the bigger problems when using digital substitutes for scientific research is namely their critical evaluation. When we use a 3D model, we must be sure that it is reliable to a given extent (especially if it was created by someone else), i.e. we have to be sure that the 3D model corresponds within a certain accuracy to the physical object. This can be achieved by carefully documenting the capture/creation and processing procedures of the 3D data. In this way advantages and disadvantages posed by hardware and software of data processing can be considered and the 3D model's quality can be assessed.

When deciding on which data to include with the digital Schachermeyr models, we considered the standards recommended by 3D ICONS, the Archaeological Data Service (ADS) Guides to Good Practice (ADS 2016) and the IANUS project (IANUS 2016). Additionally, the CIDOC CRMdig extention (Theodoridou 2016) has been taken into account, since it is planned to link also these 3D metadata with the DEFC App directly.

First, the *"administrative metadata"* will be added:

- Project name: the name of the scanning project;
- Actor: the person who captured 3D data and the person who did the post-processing;

- Time of capture: when were the data captured and when were they processed;
- Copyright;
- Digital asset ID: the file name;
- File format;
- URI/ID.

Additionally, provenance metadata (3D model creation and processing) will be included in the "*activity*" part of the metadata schema. Activity consist of two parts. The first part represents the creation of the 3D models:

- Type of activity: which 3D acquisition method was applied (e.g. 3D structure light scanning) ;
- Digital device: the hardware for the 3D capturing. In the case of 3D scanning, the metadata that should be recorded are:
    - o Scanning device;
    - o Texturing device: scanner camera or external camera;
    - o Computer device;
    - o Accompanying software (and pre-set parameters);
- Capture conditions record of any external activities that might have influenced the 3D capture procedure (e.g. weather).

The second part of the activity log documents the 3D model post-processing workflow. In our case several software packages were used in order to prepare the 3D models for the final upload to the DEFC App. Each step will be documented as follows:

- Software: the post-processing software and its version;
- Action: the processing steps that have been carried out (e. g. hole filling, polishing, texture-colour conversion, decimation, compression)
- Import/export file format.

Since most instruments already perform a lot of automatic processing during the capturing stage, these processes will be documented in separate *.TXT files which are automatically generated by the scanners that are used. This will ensure a very complete paradata coverage.

4. Conclusion

Fritz Schachermeyr left his collection to the Austrian Academy of Science so that it could serve researchers, students and all parties interested in studying the Neolithic pottery of Greece. Therefore the collection has been opened to the public. Since the collection has been digitised, the sherds are now finally available to the broadest possible audience. Moreover, these digital sherd surrogates are not going to be presented as a plain collection of separate 3D models, but will be incorporated within an open access database DEFC App as a part of a rich dataset.

Furthermore, using the ontologies CIDOC CRM and the CRMdig extention, additional information on the sherds themselves as well as information about the 3D model creation will be available.In this way we wish to ensure the context, accessibility, sharing and transparency of these 3D data.

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