Feb 5th, 1:45 PM - 5:00 PM

Presentation Panel on Metadata Standards

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3D Models for Cultural Heritage: from Survey to shared Knowledge

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The curious (but paradigmatic) case of the Temple of Zeus Meilichios or Escolapios at Pompeii (VIII.7.25)
Currently the site is off. The project has been acquired probably by another company involved in Augmented Reality.
The graphical documentation and a philological reconstruction of the sacred building

F. Mazois, Les Ruines De Pompéi, 1838. Paris
D. Russo, Il Tempio di Zeus Meilichio a Pompei, Napoli 1991
Our 3D reconstruction on sketchfab

Metadata

<table>
<thead>
<tr>
<th>Description</th>
<th>Model information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>22kB</td>
</tr>
<tr>
<td>File format</td>
<td>.obj</td>
</tr>
<tr>
<td>Vertices</td>
<td>684</td>
</tr>
<tr>
<td>Rigged</td>
<td>No</td>
</tr>
</tbody>
</table>
Which is the model scientifically correct?

We need good metadata!
A digital resource/asset/record: 
a terminological and conceptual clarification

The physical object

Material object

Digitization

The digital object

Digital Replica/Copy/Reproduction

Digital Reconstruction
Key principles of good metadata for 3D assets


- Numerous 3D initiatives underlined the importance of ensuring both that computer-based visualisation methods are applied with scholarly rigour, and that the outcomes of research that include computer-based visualisation should accurately convey to users the status of the knowledge that they represent, such as distinctions between evidence and hypothesis, and between different levels of probability.

- the Charter aims to enhance the rigour with which computer-based visualisation methods and outcomes are used and evaluated in heritage contexts, thereby promoting understanding and recognition of such methods and outcomes. The Charter defines principles for the use of computer-based visualisation methods in relation to intellectual integrity, reliability, documentation, sustainability and access.

Principle 4: Documentation

Sufficient information should be documented and disseminated to allow computer-based visualisation methods and outcomes to be understood and evaluated in relation to the contexts and purposes for which they are deployed.

Documentation of Process (Paradata)

4.6 Documentation of the evaluative, analytical, deductive, interpretative and creative decisions made in the course of computer-based visualisation should be disseminated in such a way that the relationship between research sources, implicit knowledge, explicit reasoning, and visualisation-based outcomes can be understood.

The Sevilla Principles aims at increasing the conditions of applicability of the London Charter in order to improve its implementation specifically in the field of archaeological heritage, including industrial archaeological heritage, simplifying and organising its bases sequentially, while at the same time offering new recommendations taking into account the specific nature of archaeological heritage in relation to cultural heritage.

**Principle 7: Scientific transparency**

All computer-based visualisation must be essentially transparent, i.e. testable by other researchers or professionals, since the validity, and therefore the scope, of the conclusions produced by such visualisation will depend largely on the ability of others to confirm or refute the results obtained.

7.3 The incorporation of metadata and paradata is crucial to ensure scientific transparency of any virtual archaeology project. Paradata and metadata should be clear, concise and easily available. In addition, it should provide as much information as possible. The scientific community should contribute with international standardization of metadata and paradata.
Key principles of good metadata for 3D assets

<table>
<thead>
<tr>
<th>Provenance</th>
<th>Paradata</th>
</tr>
</thead>
<tbody>
<tr>
<td>In 3D digitisation of cultural heritage objects <strong>provenance covers the technical processes:</strong></td>
<td><strong>Paradata provides information about the human processes</strong> of understanding and interpreting:</td>
</tr>
<tr>
<td>• Equipment chosen and the instrument settings</td>
<td>• The evidence used to interpret an object and to create a reconstruction</td>
</tr>
<tr>
<td>• Light sources</td>
<td>• The methodology used in a research project</td>
</tr>
<tr>
<td>• Any obstacles to digitisation or sources of noise/reflections</td>
<td><strong>Paradata enables</strong></td>
</tr>
<tr>
<td>• Software choices and settings</td>
<td>• Alternative interpretations or hypothesis to be presented and linked to the supporting factual evidence</td>
</tr>
<tr>
<td>• Techniques chosen for meshing, textures, decimation, simplification, alignment etc.</td>
<td></td>
</tr>
</tbody>
</table>

Technical Process

Human Process
3D Models online (for sale)

https://www.turbosquid.com/3d-model/archaeology

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3D models online (for sale)

TurboSquid

Add to Cart

Roman Colosseum

Included Formats

CheckMate Pro Certified Nov 1, 2011

Exchange:

- FBX
- OBJ

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Live Chat Icon 24/7

3D Model Specifications

Product ID: 508279
Published: Jan 7, 2011
Geometry: Polygon Quad/Tri
Polygons: 558,647
Vertices: 897,471
Textures: Yes
Materials: Yes
Rigged: No
Animated: No

Metadati

Resolution
IPR
format
3D human being online

https://humanalloy.com/product/basics-free-3d-model/

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Key principles of good metadata for 3D assets

Scientific data cannot be used correctly without information about what they mean, how they were created and in which conditions.

Relevant to 3D asset are:

- The instruments, methods and techniques used in both data capture and data processing (Provenance)
- The motivations and rationales behind the 3D record (Paradata)

Metadata store information about the life cycle of a 3D object

- **Field**: keeps track of instrument settings, the condition of the physical object being scanned and the objectives of the project
- **Lab**: keeps track of post processing of the data and provides a record of how evidence has been interpreted
- **Access**: supports discovery and use of the objects for education, tourism, research
- **Preservation**: supports long term preservation and allows for re-use of the data

Metadata assure Authenticity, Historical Rigour, Scientific (Intellectual) Transparency, Training, IPR
3D-ICONS project: the Metadata Schema (CARARE 2)

3D-ICONS content includes:

• Heritage assets (monuments, buildings, landscapes and other real world objects) described in textual metadata with relations to places, events, thumbnails and other digital objects.

• Real world cultural objects (such as historic drawings and photographs, publications, archive materials) which provide sources of information about the heritage asset.

• Born-digital resources related to these objects, such as 3D models.

• Based on previous Metadata Standard (Carare) and Ontology (CIDOC-CRM, CIDOC-CRMdig)

The 3D-ICONS schema is an update of the previous CARARE. You can find it as CARARE 2

http://www.3dicons-project.eu/eng/content/download/6569/50672/file/carare-v2.0.4.xsd
Conceptually the 3D-ICONS record is focused on a heritage asset and its relations to digital resources, activities and to collection information.
Activity describes events or activities that the monument has taken part in:

Methods: the methods used in this specific activity, e.g. open area excavation, sample survey, augering, boring, stratigraphic, restoration, conservation, re-pointing, photogrammetric survey etc. Use of a controlled vocabulary is recommended. (PROVENANCE)

Event type: general classification of the type of event or activity which took place, e.g. survey, archaeological excavation, digitization, rebuilding. Use of a controlled vocabulary is recommended. (PROVENANCE)
3D-ICONS project: the Metadata Schema

To define the digitization process adopted to create the 3D final model we added some relations explaining the relations between the Heritage Asset, Digital Resource and the Activity.

The properties reuse those from CIDOC-CRM and in particular from CRMdig

L1B.was_digitized_by – associates a Heritage Asset with an Activity. It is a sub-property of Was Present At.

L20F.has_created – associates an Activity to an Digital Resource. It is a sub-property of Was Present At.

L22F.created_derivative – defines the reuse of a Digital Resource, created by a digitization process, through multiple different processing phases. It is a sub-property of Is Derivative Of.
3D-ICONS project: the Metadata Schema

THE PARTNER HAS ONE OR MULTIPLE 3D DIGITAL MODELS AS REPLICAS OF ONE PHYSICAL OBJECT

HA = the physical object

ACTIVITY = discovery, restoration, change in ownership

DR = image_is_shown_at (landingPage of the physical object)

HA

3d model HIGH Resolution

is_derivative_of

HA

3d Hypothetical Model

ACTIVITY

DR = 3d model of the physical object HIGH RESOLUTION

HA

3d Model LOW Resolution

is_derivative_of

HA

ACTIVITY

DR = 3d model of the physical object LOW RESOLUTION

ACTIVITY

DR = 3d model of the physical object Virtual Reconstruction

DIAGRAM ILLUSTRATING APPROACH TO METADATA CREATION FOR MULTIPLE DERIVATIVES FROM A SINGLE CULTURAL HERITAGE OBJECT
**Activity ... (from raw data to final rendering)**

**Consists of:** this is a repeating group of elements which allows the specific activity (or activities) that took place during the overall Event to be described.

**Had General Purpose:** this is a free text description of the general goal or purpose of an Activity. For example this could include practicing, preparing, monitoring, researching, designing, testing etc. *(PARADATA)*

**Had Specific Purpose:** a free text note describing the specific goal or purpose of this activity. For example, carrying out 3D data acquisition, restoration of a part of a building, completing a survey, constructing a building, etc. *(PARADATA)*
CARARE 2.0 Schema

3D-ICONS project: the Metadata Schema

Activity

Event Type

Consists Of

Techniques

Methods

Materials

Equipments

Dissemination

Restoration Documentation

Had General Purpose

Consists Of

Had Specific Purpose

Had Specific Purpose

Had Specific Purpose
3D-ICONS project: the Metadata Schema

CARARE 2.0 Schema

Activity
- Happened At
- Was Present At

Spatial

Actors
- URI

Temporal

URIs
- Linked Open Data
- Geonames
- Pleiades
- FOAF
- VIAF
3D-ICONS project: 3D models published on Europeana

CARARE 2.0 has been mapped on EDM
3D-ICONS project: 3D models published on CISA repository

Heritage Asset
Source: CISA, Centro Interdipartimentale di Servizi per Archeologia, Italy
Metadata Rights: The Creative Commons CC0 1.0 Universal Public Domain Dedication (CC0)
Asset Description: Modello 3D della statua di Claudio Seduto (MANN, inv. 6056) trovata ad Ein Canal. Doveva essere parte dell'Augusteum (od. Basilica), inserita a destra nell'edificio rettangolare del lato di fondo. La statua di Claudio Seduto faceva pendant con l'altra colossale statua di Augusto (MANN 6040, cat. 23) della quale ripropone lo stesso schema iconografico di Giove in trono, seguito con levi differenze. L'iconografia dell'imperatore assimilato a Zeus, ben si confaccev all'immagine del potere imperiale, supremo e universale, così come sintetizzato dal simbolismo della Gemma Augustea, in cui Augusto in persona e raffigurato nei panni di Giove e con il titus degli auguri in mano, segno del potere militare.
Provenance: 3D Icons Project
Type: STATUE
JULIO-ClaudIAN
http://vocab.getty.edu/aat/300020545
http://vocab.getty.edu/aat/300047600
Data Range: 2014 - 2014
Period: http://pleiades.stoa.org/vocabularies/time-periods/roman
Date: Julio-Claudius Age
Materials: Marble
Dimension: width and height 80 x 222 centimetres
Location: National Archaeological Museum
http://www.geonames.org/7303972/naples-national-archaeological-museum.html
Publication Statement:

Digital Resources
Type: 3D ~ Format: .pdf
Link: http://vast-lab.org/3dicons/data/96
Copyright: Copyright CISA and SopArChNapoli
Access Rights: Restricted Access
Digital Provenance

Acquisition
Description:
An amount of photos have been shot from different points of view by Nikon D90 Camera with 18-55mm lens, using an auto focus. average distance camera from the object is 1.50-2 mt with 2 reference distances of 3.5 cm.
Consists Of:
carrying out 3D data acquisition
Methods:
metric survey
Techniques:
structure from motion
Equipment:
Manfrotto tripod

Post-processing
Description:
Consists Of:
3D pdf production
mesh decimation
photo rendering
Methods:
the textured 3D model is exported to 3D pdf format
snapshot
Declimate command
Techniques:
Export command
Reduction mode is triangle count
image capture and export in jpg format
Equipment:
Agisoft Photoscan Professional Edition 1.0.4
Geomagic Studio 2013
Geomagic Studio 2013
Meshlab 1.3.2

Processing
Description:
the photos alignment has been performed by Agisoft Photoscan Professional Edition in order to produce a dense points cloud and to build a textured dense surface model.
Consists Of:
texturing
mesh noise removal
dense surface reconstruction
photos alignment
Methods:
points triangulation
Scale-invariant feature transform approach
texture mapping
Techniques:
Feature matching across the photos and solving camera orientation parameters
Poisson Surface Reconstruction
generic mapping mode and mosaic blending mode
Mesh is cleaned up using the Relax and Remove Spikes command. The remaining errors are fixed through the Mesh Doctor function. The mesh has been exported as an obj file.
Materials:
Equipment:
Meshlab 1.3.2
Agisoft PhotoscanProfessional Edition 1.0.4
Agisoft PhotoscanProfessional Edition 1.0.4
Geomagic Studio 2013
Agisoft PhotoscanProfessional Edition 1.0.4
# 3D-ICONS: the project repository

## 3D model of Augusteum at Herculaneum with Quadrifrontal Arch

<table>
<thead>
<tr>
<th>Metadata</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annotation</td>
<td>3D model of Augusteum at Herculaneum with Quadrifrontal Arch</td>
</tr>
<tr>
<td>Address</td>
<td>Ercolano, Ercolano, Italy</td>
</tr>
<tr>
<td>Coordinates (Lat, Lon)</td>
<td>(40.82552, 14.34750)</td>
</tr>
<tr>
<td>See it on Europeana</td>
<td><img src="link" alt="Europeana" /></td>
</tr>
<tr>
<td>Link</td>
<td><img src="link" alt="Link" /></td>
</tr>
<tr>
<td>Landing Page</td>
<td><img src="link" alt="Landing Page" /></td>
</tr>
</tbody>
</table>

### Heritage Asset

#### Activity 1

<table>
<thead>
<tr>
<th>Metadata</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Acquisition_4</td>
</tr>
<tr>
<td>Description</td>
<td>CAD format data of archaeological plans, profiles and sections of the excavation areas and survey provided by publications and reports</td>
</tr>
<tr>
<td>Purpose</td>
<td>documentation</td>
</tr>
<tr>
<td>Equipment</td>
<td>Rhinoceros 5</td>
</tr>
<tr>
<td>Actor</td>
<td>Angela Bosco, person, researcher</td>
</tr>
<tr>
<td>Actor</td>
<td>Marco Barbanco, person, researcher</td>
</tr>
</tbody>
</table>
3D-ICONS: the project repository
3D-ICONS: the project repository
Thanks!

Andrea D’Andrea
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