

Metadata scheme for 3D models

How to capture the source-based 3D reconstruction of Cultural Heritage?

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Introduction

Every generation left their own inheritance, which would be respected and protected by their successors. Unfortunately, human-kind history brought a huge amount of destruction and disrespect for the achievement of ancestors. Current technologies give a chance of “second life” to the lost heritage in the form of 3D digital reconstruction models and visualisation of lost Cultural Heritage (CH). The field of a sourced-based hypothetical 3D-reconstruction of CH allows investigating the history of the building and present research results in the easy-to-understand visual way.

However, the publication of the CH reconstruction as images and animations could give an inappropriate impression that this kind of visual presentation is sufficient. The true value of this work lies in the whole (hi-)story behind the model. Lack of documentation and publication standards for source-based 3D-reconstructions is a reason for the loss of knowledge and information about the process.

First attempts of Link Data documentation

Last source-based 3D reconstruction projects realized by the Institute of Architecture of Mainz University of Applied Sciences (AI MAINZ) were focused on developing a documentation system as a virtual research environment (VRE) based on WissKI¹. Designed solution was prepared in the web application Drupal with use of an application ontology specially designed for describing source-based 3D reconstruction - “ontscidoc3D”, which is based on the ISO-certified CIDOC CRM ontology, which is established as the reference ontology in the field of CH.²

The project of “New Synagogue in Wrocław. Virtual Research Environment for digital 3D reconstructions was a testing environment for proposed solutions. The main emphasis was placed on entries

¹ WissKI Homepage, <http://wiss-ki.eu/>, (Accessed 28 May 2021)

² Kuroczyński, P., Bajena, I., Große, P., Jara, K., Wnęk, K. (2021): Digital Reconstruction of the New Synagogue in Breslau: New Approaches to Object-Oriented Research. In: Niebling, F., Münster, S. (eds.), *Proceedings of the Conference on Research and Education in Urban History in the Age of Digital Libraries & Digital Encounters with Cultural Heritage*, Deutsches Hygiene-Museum, Dresden, Germany, 10th–11th October 2019, Springer Communications in Computer and Information Science (in Edition).

concerning research activities, which could take the form of creating own sources, events such as workshops, or creating 3D models of reconstructed objects.³ Advantages of the system is the complexity and possibility of extension according to own needs. However, use of the VRE was complicated and barely possible without a decent introduction. It leads to the conclusion that such complexity of the system is a threshold, which could discourage potential users from using it.

Minimum standard

The experience gained made it possible to see the need to change the approach and develop a minimum standard of documentation. The new approach under development is not based on all research activities undertaken during the project, but it focuses on the 3D model itself. This change worked out an appropriate compromise between the complexity and descriptiveness of the 3D models. In result a new repository for 3D reconstruction models will be developed in the project of the “DFG – Viewer 3D – Infrastructure for 3D–Reconstruction”⁴, where new approach will be introduced and made available for testing by potential audiences in the community.

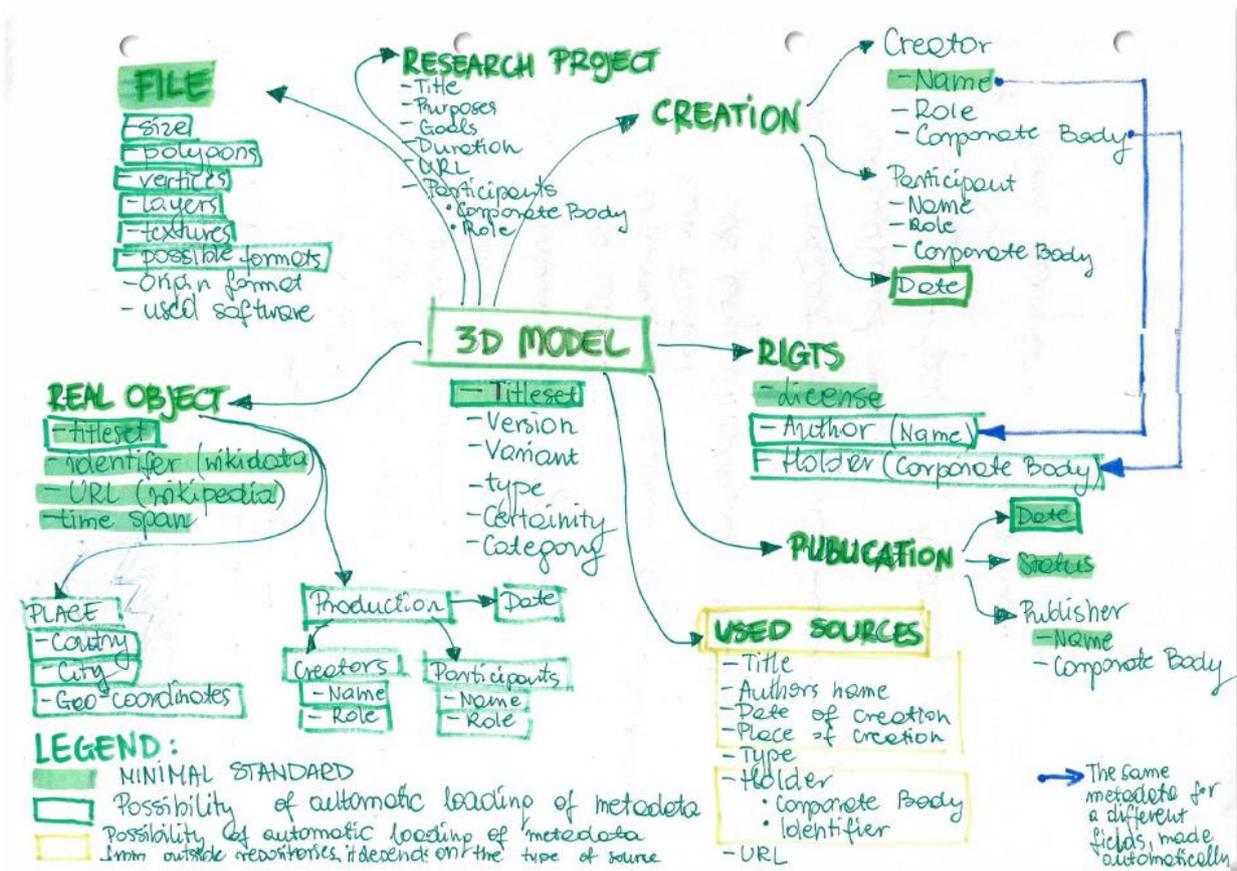


Fig. 1. Draft of the metadata scheme for the 3D repository (© 2021, AI MAINZ).

In order to promote the use of the new infrastructure among a wider audience, it is planned to create a minimum documentation standard. The considerations include information which should appear in

³ Digital reconstruction of the New Synagogue in Wroclaw Homepage, <https://www.new-synagogue-breslau-3d.hs-mainz.de> (Accessed 28 July 2021)

⁴ DFG-Viewer 3D - Infrastruktur für digitale 3D-Rekonstruktionen, <https://gepris.dfg.de/gepris/projekt/439948010?context=projekt&task=showDetail&id=439948010&> (Accessed 28 July 2021)

the repository in order to provide basic information about the provenance, assumptions and properties of the model. Initial research led to the conclusion that the necessary metadata standard will be closed in categories of classification, properties, creation, publication, copyrights and the object represented in the model. Current work is focused on developing paths and groups with Pathbuilder tool in WissKI environment. The core elements of standards will create main bundles for further relations with other metadata.

Table 1. Extract from the Pathbuilder (schematic) of the current bundles

3D OBJECT	Group [https://www.ontscidoc3d.hs-mainz.de/73a_3D_Reconstruction]
Rights	Group [https://www.ontscidoc3d.hs-mainz.de/ontology/osd_73a_3D_Reconstruction -> ecrm:P104_is_subject_to -> https://www.ontscidoc3d.hs-mainz.de/ontology/osd_30a_Copy_Right]
Real Object	Group [https://www.ontscidoc3d.hs-mainz.de/73a_3D_Reconstruction → ecrm:P130_shows_features_of → https://www.ontscidoc3d.hs-mainz.de/osd_22a_Object]
Creation	Group [https://www.ontscidoc3d.hs-mainz.de/ontology/osd_73a_3D_Reconstruction -> ecrm:P94i_was_created_by-> https://www.ontscidoc3d.hs-mainz.de/ontology/osd_65a_Production]
Research project	Group [https://www.ontscidoc3d.hs-mainz.de/ontology/osd_73a_3D_Reconstruction -> ecrm:P94i_was_created_by-> https://www.ontscidoc3d.hs-mainz.de/osd_7a_Research_Activity]
Publication	Group [https://www.ontscidoc3d.hs-mainz.de/ontology/osd_73a_3D_Reconstruction -> ecrm:P140i_was_attributed_by -> https://www.ontscidoc3d.hs-mainz.de/ontology/osd_13f_Documentation_Assignment -> ecrm:P141_assigned -> https://www.ontscidoc3d.hs-mainz.de/ontology/osd_7c_Documentation]
Used source	Group [https://www.ontscidoc3d.hs-mainz.de/73a_3D_Reconstruction → ecrm:P94i_was_created_by-> https://www.ontscidoc3d.hs-mainz.de/ontology/osd_65a_Production -> ecrm:P16_used_specific_object → https://www.ontscidoc3d.hs-mainz.de/ontology/osd_31b_Source]

The next step in simplifying the documentation process is to automate the filling process of metadata to the system. By limiting the number of fields that will necessarily have to be handled, using the repository should become easier. Current ideas for automation include loading information about the properties of a 3D model from an uploaded file, loading data about the selected object from external databases, such as wikidata or wikipedia, reading source materials from external repositories, or automatic generation of titles of entries based on the provided data.

Research model validation

Even if the entire system aims to simplify and introduce minimum standard, it does not mean abandoning the possibility of extending information about the 3D reconstruction model. The complete set of metadata should contain all necessary information for a complete understanding of the scientific process, in accordance with the guidelines of good scientific practice.⁵ Some of the metadata will need to be presented in a more complex way. Such an example is the hypothesis level of the model specifying its certainty. Previous research on this topic conducted by scientists from the University

⁵ Deutsche Forschungsgemeinschaft German Research Foundation (2019): Guidelines for Safeguarding Good Research Practice. Code of Conduct, Bonn, Germany. Available at https://www.dfg.de/download/pdf/foerderung/rechtliche_rahmenbedingungen/gute_wissenschaftliche_praxis/kodex_gwp_en.pdf. (Accessed 30 July 2021).

of Bologna has led to the presentation of this in the form of a matrix that should be implemented in the tools for documentation.⁶

According to the above-mentioned approach, it is planned to introduced a scientific validation system. Uploading the model to the system will begin rating process. It will be based on the provided documentation. It is planned to prepare a matrix assessing how individual elements of the documentation (source materials, references, additional information about the project) will affect the scientific validation in accordance with the guidelines of good scientific practice. This system will develop necessary standards, but it will also enable an evaluation of the reliability and usefulness of the published models.

3D reconstruction of New Synagogue in Wroclaw [Poland] from ca.1872 | AI MAINZ



CLASSIFICATION

Title: 3D reconstruction of New Synagogue in Wroclaw [Poland] from ca. 1872
Version: 1.0
Type: 3d reconstruction
Category: Building

CREATION

INSTITUTE OF ARCHITECTURE IN MAINZ

Karolina Jacek Providing Sources
Substantive correctness
Substantive correctness
Maja Kwiecinska Semantical division
Kings Wnek 3d Model Coordination
3d Modeling
Textures Creation
Texture Mapping
Sources Analise
Igor Bajena Semantical division
3d Model Coordination
3d Modeling
Texture Mapping
Sources Analise
Sima Agajew Semantical division
3d Modeling
Sources Analise
Semantical division
Patrycja Stelmach 3d Modeling
Sources Analise
Semantical division
Marta Zielinska 3d modeling
Sources Analise
Semantical division
Yannick Geulach 3d modeling
Mateusz Jozepkiewicz 3d modeling
Anna Pexis Textures Creation
Date of creation December 2019

3D Model
Download
Size: 1,266B Polygons: 18M Vertices: 9M Layers: Yes Textures: Yes

Origin format: .pjn
Used software: Archicad 21 [SER], Archicad 22 [INT]
Available formats: .pjn, .pla, .ifo, .skp, .fbx

Date of publication: 15.12.2019
Publisher: Igor Bajena
Status: Published

Real Object

CLASSIFICATION
Type: Religious buildings
Title: New Synagogue in Wroclaw/Wroclaw
Identifier (wikidata): Q327947
URL (wikipedia): [https://en.wikipedia.org/wiki/New_Synagogue_\(Wroclaw/Wroclaw\)](https://en.wikipedia.org/wiki/New_Synagogue_(Wroclaw/Wroclaw))
Destruction date: 9-10.11.1938

LOCATION
Country: Poland
City: Wroclaw
Address: ul. Podwale 34
Geo-coordinates: 51° 6' 15" N , 17° 1' 44" E



PRODUCTION
Production date: 29.09.1872
Architect: Edwin Oppller

USED SOURCES

[1] Bajena I., Glass model as a base for digital reconstruction of Synagogue in Wroclaw, Mainz, 23.08.2018. Holder: Institute of Architecture in Mainz.

[2] Jacek K., Floor tiles in Sokolowska 2, Sokolowsko, 27.05.2018. Holder: Institute of Architecture in Mainz.

[3] Lillienfeld S., Neuester Plan von Breslau, Wroclaw, 1873. Holder: Biblioteka Cyfrowa Uniwersytetu Wroclawskiego, 798-1.B.

[4] Oppller E., Site plan of New Synagogue, Wroclaw, 1872. Holder: Muzeum Architektury we Wroclawiu, Archiwum Budowlane Miasta Wroclawia, MA-AB-70590.

[5] Unknown author, PAN Northern and western Facades J. Wroclaw, 1900s. Holder: Zydowski Instytut Historyczny, ZIH-III-6314.

Certainty*

X	1	2	3	4	5	6
1						
2						
3				X		
4						

*in cooperation with Irena Czarzaco

RIGHTS
License: CC-BY-NC-SA 4.0
Holder: Institute of Architecture in Mainz

PROJECT

Title: New Synagogue in Wroclaw/Wroclaw. Virtual Research Environment for digital 3D reconstructions.

Purposes: Research (scientific project)
Preserving memory (for 80th anniversary of pogrom of German Jewry)

Goals: Animation
3D BIM model

PARTICIPANTS
AI MAINZ Initiator
Executor
Federal Government Commissioner for Culture and the Media* [BKM] Fundator
Foundation for Polish-German Cooperation Fundator
Institute of Arch History, University of Wroclaw Partner
Initiator
Berta Kahan Foundation Partner
Museum of Architecture in Wroclaw Partner
City Museum of Wroclaw Partner
Duration: March 2018-November 2019

OTHER MODELS CREATED BY Institute of Architecture in Mainz



Fig. 1. Sample of the documentation frontend being developed based on the model of the Wroclaw synagogue with full documentation (© 2021, AI MAINZ).

⁶ Apollonio, F. (2016): Classification for Visualization of Uncertainty in Digital Hypothetical Reconstruction. In: Münster, S., Pfarr-Harfst, M., Kuroczyński, P., Marinou, I. (eds.): 3D Research Challenges in Cultural Heritage II, pp. 173–197. Springer International Publishing, Cham.

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- Apollonio, F. (2016). 'Classification for Visualization of Uncertainty in Digital Hypothetical Reconstruction.' In: Münster, S., Pfarr-Harfst, M., Kuroczyński, P., Marinos, I. (eds.): 3D Research Challenges in Cultural Heritage II, pp. 173–197. Springer International Publishing, Cham.
- Deutsche Forschungsgemeinschaft German Research Foundation (2019) 'Guidelines for Safeguarding Good Research Practice. Code of Conduct, Bonn, Germany.' Available at https://www.dfg.de/download/pdf/foerderung/rechtliche_rahmenbedingungen/gute_wissenschaftliche_praxis/kodex_gwp_en.pdf, (Accessed 30 July 2021).
- DFG-Viewer 3D - Infrastruktur für digitale 3D-Rekonstruktionen, <https://gepris.dfg.de/gepris/projekt/439948010?context=projekt&task=showDetail&id=439948010&> (Accessed 28 July 2021)
- Digital reconstruction of the New Synagogue in Wroclaw Homepage, <https://www.new-synagogue-breslau-3d.hs-mainz.de> (Accessed 28 July 2021)
- Kuroczyński, P., Bajena, I., Große, P., Jara, K., Wnęk, K. (2021) 'Digital Reconstruction of the New Synagogue in Breslau: New Approaches to Object-Oriented Research.' In: Niebling, F., Münster, S. (eds.), Proceedings of the Conference on Research and Education in Urban History in the Age of Digital Libraries & Digital Encounters with Cultural Heritage, Deutsches Hygiene-Museum, Dresden, Germany, 10th–11th October 2019, Springer Communications in Computer and Information Science (in Edition).
- WissKi Homepage, <http://wiss-ki.eu/>, (Accessed 28 May 2021)