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## Building a Wiki resource on digital 3D reconstruction related knowledge assets

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### Structured Abstract

**Purpose**—While single theoretical approaches related to visual humanities research and in particular digital 3D reconstruction – as the virtual, interpretative 3D modeling and visualization of historical objects – are widely described in compendia like Wikipedia, and various publications discuss approaches from certain disciplinary perspectives, a comprehensive and multidisciplinary systematization is still missing. Against this background, the research activity described within this article is intended to gain a wide and multidisciplinary overview for research approaches, theories, and methods which are relevant to investigate or explain knowledge-related phenomena in the context of visual humanities research and education.

**Design/methodology/approach**—To meet these interests we intend to set up a Wiki resource as a structured repository. The content will be based on (a) interactive workshops held at conferences to collect and structure knowledge assets on visual knowledge involving experts from different domains. Moreover, (b) a student seminar starting in early 2017 is designated to describe some typical research designs as well as amend related methods and theories in the Wiki resource based on Wikipedia articles. A content structuring principle for the Wiki resource follows the guidelines of Wikimedia as well as plans for the results to be populated again in Wikipedia.

**Originality/value**—While Wiki approaches are frequently used in the context of visual humanities, these resources are primarily created by experts. Furthermore, Wiki-based approaches related to visualization are often focused on a certain disciplinary context as, for example, art history. A unique aspect of the described setting is to build a Wiki on digital 3D reconstruction including expertise from different knowledge domains – i.e. on perception and cognition, didactics, information sciences, as well as computing and visual humanities. Moreover, the combination of student work and assessments by experts also provides novel insights for educational research.

**Practical implications**—The intended product is a comprehensive and multidisciplinary structured repository on digital 3D reconstruction research approaches, methods, theories, publication bodies, and good practice examples. The editing of

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the project results into the Wikipedia will lead to a wide dissemination and visibility of group activities and outcomes as well as enhance competencies of all contributors on collaborative work.

**Keywords**—wiki, visual humanities, digital 3D reconstruction, education, visual knowledge

**Paper type**—Academic Research Paper

## 1 Research question

Theoretical approaches related to visual humanities research and, in particular, digital 3D reconstruction, i.e. the virtual, interpretative 3D modeling and visualization of historical objects, are widely described in compendia like Wikipedia and discussed in numerous publications from different disciplinary perspectives. However, a comprehensive and multidisciplinary systematization of research, procedures, and formal methods, as well as basic principles, is still missing. Against this background, the research activity described within this article is intended to gain a wide and multidisciplinary overview for research approaches, theories, and methods, which are relevant to investigate or explain knowledge-related phenomena in the context of visual humanities research and education. A particular interest is to map their epistemological and methodological interconnections and to refer to related good practice examples.

### 1.1 Definition

Computer-based, i.e. digital, 3D reconstructions have become increasingly important for sustaining conservation, research, and broad accessibility of cultural heritage as knowledge carriers, research tools, learning materials, and means of representation over the last three decades (c.f. Favro, 2006; Greengrass and Hughes, 2008; Sanders, 2012).<sup>1</sup> Concerning digital 3D reconstruction, the focus of most projects is put on the creation of a spatial, temporal, and semantic virtual models. Main differences refer to the kind of object of assessment in terms of material and immaterial objects (e.g. usages or digital data). Furthermore, in regard to the question of how to proceed, the difference between (a) the reconstruction of objects which are no longer existent or which have never been realized (e.g. the current status of plans which have never been realized) and the (b) digitalization of objects which are still existent is essential (De Francesco and D'Andrea, 2008). While a digitalization describes the technological transfer of an object to a digital asset (e.g. by means of a semi-automatic modeling with the help of laser scans or photogrammetric technology), a digital 3D reconstruction process includes the necessity for human interpretation of data. This further means that digital reconstruction does not describe a type of project or object, but a particular work style (Münster, 2013).

A digital 3D reconstruction process creates 3D models from various sources - for instance, photographs and historic drawings. With regards to a function, the generated 3D models support preservation, reconstruction, documentation, research, and promotion of cultural heritage. Finally, the created virtual 3D models will be presented to an audience as visual output, which could be static images, animations, or even interactive visualizations such as computer games. An adjacent phenomenon is that digital reconstruction projects require skills to cope with both highly specialized and complex software as well as humanities interpretation. For this reason, most projects are addressed in the scope of cross-disciplinary projects (Münster, 2016).

## **1.2 Discussion**

There are various attempts to evaluate, to quantify, as well as to qualify a state of usage of digital 3D reconstruction and visualization for particular fields of visual humanities by using social empirical methods. Most of these approaches focus on a qualitative analysis, e.g. by expert boards or surveys. The European Network of Excellence in Open Cultural Heritage (2004-2008) employed focus group discussions to evaluate a current state as well as perspectives on digital 3D techniques in Cultural Heritage studies (Arnold and Geser, 2008). The German Workgroup on Digital Reconstruction (Arbeitsgruppe Digitale Rekonstruktion des DHd e.V.) used similar instruments to investigate ongoing research challenges specifically for digital 3D reconstruction in Germany (Münster et al., 2015). While qualitative approaches are appropriate to identify and explain (Dilthey, 1970) phenomena in terms of evolutions, current states, and perspectives, they show only limited usefulness for quantifying uncovered phenomena or investigating scientific structures. The Visualisation in Archaeology (VIA) project organized a series of workshops and questionnaire-based surveys to investigate a situation specifically on visualization in archaeology in the UK (Gibbons, 2012). Since 2012 the Enumerate project has performed a bi-annual monitoring of digitization activities of Cultural Heritage institutions within the EU area – primarily focusing on museums and archives (Stroeker and Vogels, 2012, 2014).

According to research on methodologies, investigations on methods in digital 3D reconstruction and more generally digital humanities, as the use of digital methods to answer humanities research questions (c.f. Schreibman, Siemens, and Unsworth, 2004), are widely driven by researchers originating in humanities and methodically mostly focus on exemplification and problematization within a certain disciplinary context. With regards to the use of digital methods in art history, Drucker (2013) sketches a historical evolution as well as a current state of application of digital methods in humanities. Complementary, Kohle (2013) defined fields of supplementation by digital tools and practices in art history and Heusinger (1989)

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for a general visual humanities research process. Similarly, many texts describe a comprehensive state of the art as well as methodologies for digital archaeology (e.g. Evans and Daly, 2006; Frischer and Dakouri-Hild, 2008; Kansa, Kansa, and Watrall, 2011). Furthermore, there are many standards and guidelines as well as rules defined and discussed for dealing with historical content (Beacham, Denard, and Niccolucci, 2006; Bendicho, 2011; Kiouss, Karoglou, Labropoulos, Moropoulou, and Zarnic, 2011; Pfarr, 2009; Sürül, Özen, and Tutkun, 2003). An adjacent question is for a general workflow modeling of archaeological reasoning. Against this background, Barceló (2010) discusses various approaches for computable reasoning and artificial intelligence to support archaeological reasoning. Moreover, there exist some meta-reviews on similar aspects in museology (e.g. Huvila, 2014; Romanelli, 2015). Some further elaborated methodological overviews are available for adjacent disciplines, such as game research (Lankoski and Björk, 2015), editorial studies (Sahle, 2013a, 2013b, 2013c), as well as graphic design (Noble and Bestley, 2014). In contrast to philosophical approaches, there is little empirical research on practices and users of digital 3D reconstruction (c.f. Huvila, 2014). Huvila (2006, 2010) investigated user roles and practices in archaeology as well as certain practices within the ongoing Archaeological Information in the Digital Society (ARKDIS) project. Another empirical perspective is the research on usability and requirements for software design for humanities researchers which was investigated within the Virtual Environments for Research in Archaeology (VERA) project (Fisher, Terras, and Warwick, 2009; Warwick, 2012).

Against the background of these activities and according to our interest in creating a knowledge body on digital 3D reconstruction, Wiki repositories are well-known and established approaches to build collaborative electronic knowledge repositories. Wikis are “World Wide Web (WWW) site[s] that can be modified or contributed to by users” (Dennis, 2014) via a web browser. The use of Wikis as knowledge compendium in education and research has been widely practiced and discussed in literature (e.g. IT-User Services, 2008; Konieczny, 2007; Lundin, 2008; Parker and Chao, 2007). With regards to digital humanities and, in particular, archaeology, they have been used especially to collect and manage knowledge around certain Cultural Heritage objects (Chudyk, Müller, Uhler, and Würriehausen, 2013; Henze, Lehmann, and Fischer-Genz, 2005; Khazraee, Malek, and Forghani, 2008; Kondo et al., 2011; Mantegari, Cattani, Marinis, and Vizzari, 2006; Parcero-Oubiña, 2012; Vernicos et al., 2004). Moreover, they have been discussed as a general approach for knowledge organization (Artese and Gagliardi, 2012; Fazal, 2008; Huvila, 2011; Johnson, 2008). A good-practice example from the field of art history is the Wiki resource on digital art history, which was created by the German task group on digital art history (Arbeitskreis Digitale Kunstgeschichte). A major obstacle for collaborative Wikis is

to develop, communicate, and keep a consistent structure of contained information as well as articles (Huvila, 2011). In large-scale Wiki repositories like Wikipedia, articles follow specific structuring rules and use specific vocabularies according to subjects, areas, and topics (Gerlach and Altmann, 2014). Against this background, the Wiki Education Foundation offers various principles for structuring and quality control in Wiki resources (Wiki Education Foundation, n.a.-a) as well as suggestions for designing and performing academic projects (Wiki Education Foundation, n.a.-b).

## 2 Research design

With regards to design of the proposed research activity, (1) initially a structuring blueprint was developed and tested in April 2016 involving members of our departments. As an ongoing task, (2) interactive workshops will be held at conferences, as for example the IFKAD 2016, to collect and structure knowledge assets on visual knowledge involving experts from different domains. While these activities lead to a structured overview about typical research designs in digital visual humanities, a future step will be (3) to describe methodologies to make these adoptable for scholars. For thus, a student seminar starting in early 2017 is designated to describe some typical research designs as well as amend related methods and theories in the Wiki resource based on Wikipedia articles.



Figure 1: Clustering of terms (yellow: research interests, green: procedures, red: formal methods, white: basic principles, blue and orange: categorization of terminology)

## 2.1 Expert workshops

Starting from the previously mentioned recommendations for knowledge organization via Wikis, a preparing task is to develop a workshop layout for enquiring about expert opinions via semi-structured questionnaires and group discussions (Lamnek, 2005). A general function of these workshops will be:

- Identification of a scope of research interests and questions in the field of digital 3D reconstruction
- Provide a scheme of related research methodologies
- Provision of related state-of-the-art literature and good practice examples
- Against this background we developed an initial workshop design (c.f. Table 1).

**Table 1: Initial expert workshop design**

Part	Method	Questions / procedures
1. Naming of research interests or research questions in digital 3D reconstruction	Capture on a pre-structured worksheet (used for parts 1-3, max 3 minutes)	Question: What is your most important research interest or research question in digital 3D reconstruction?
2. Structured description of associated research methodologies	Bilateral interviews (Role change after 5 minutes)	Questions: <ul style="list-style-type: none"> <li>- What are outcomes / additional values of that research (e.g. overview of significant actors, functional prototype, distribution function; max. 1 item like word, phrase, sentence)?</li> <li>- How did you proceed (max. 3 items)?</li> <li>- Which methods did you employ (max 2 items)?</li> <li>- Your data, sources (max. 3 answers)?</li> <li>- Your theoretical background (max. 3 answers)?</li> </ul>
3. Referencing	Capture on a pre-structured worksheet (max. 3 minutes)	<ul style="list-style-type: none"> <li>- Which literature describes your research activity (max. 3 answers)?</li> <li>- Which literature describes related theoretical background (max. 3 answers)?</li> <li>- Which literature describes employed methods (max. 3 answers)?</li> </ul>
4. Structuring of research designs	Group discussion, comprehensive mind map	<ul style="list-style-type: none"> <li>- Clustering of research designs (Group discussion, arrangement on a flipchart, max. 5 minutes)</li> <li>- Selection of one prototypical question per cluster (max. 2 minutes)</li> </ul>

A pilot study to assess feasibility and improve quality as well as efficiency was conducted at Julius-Maximilians-Universität Würzburg with six researchers from the chair for Human-Computer Interaction. After introducing the procedure of the study as shown in Table 1, structured questionnaires were handed out. The participants then continued to note research interests, structured descriptions of methodologies, and

references without interference from the instructor. In a group discussion, research interests, methods, procedures, and theory were then categorized and clustered to create the schema shown in Figure 1.

As a general implication from that pilot study, several participants reported that availability of the questionnaire prior to the study would have enhanced the quality of their answers, in particular with respect to formal research methods, basic principles and references.

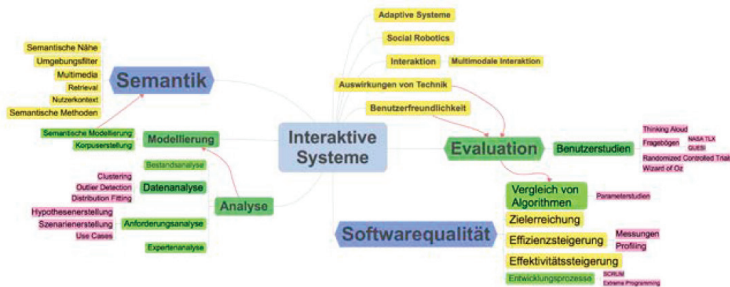


Figure 2: Final mind map created in the pilot study

It was noted that five minutes was too short to perform bilateral interviews in Part 2 of the study. Furthermore, when trying to structure research designs during Part 4, it became clear that degree of detail as well as formalization of answers to questions in Part 1–3 were not homogenous between the participants. An additional, time-consuming unification of terminology was then performed in a group discussion prior to clustering and categorization of the resulting abstract concepts. During wrap-up of the workshop, a mind map showing relations between the identified and clustered concepts was created by the organizer of the study (c.f. Figure 2). Conclusions from the pilot study were used to create an amended study design for the workshop (c.f. Table 2).

To stay within the proposed time frame, it was decided to hand out the questionnaires in advance to enable the participants to perform a structured description of their research themselves in the first part of the study. The second part then is adapted to formalize the research interests, methods, and principles by working out key words in bilateral interviews with another researcher. A collaborative clustering of research designs is then to be performed interactively on a flip chart.

In a next step the presented scheme will be employed to perform short workshops at IFKAD 2016 as well as the ARKDIS conference in June 2016.

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## 2.2 Student Seminar

While these workshops are proposed to generate a structured overview about typical research designs in digital visual humanities, a future task will be to describe related methodologies to make these adoptable for scholars in digital humanities and, in particular, digital 3D reconstruction. Against this background, a student seminar starting in early 2017 is designated to describe some typical research designs on digital 3D reconstruction aspects within a Wiki resource. Even if using a separate, self-managed Wiki system to meet legal and practical requirements, we intend to follow both the structuring and quality principles of the English Wikipedia (Wiki Education Foundation, n.a.-a) as well as the Wiki Education Foundation suggestions for designing and performing academic projects (Wiki Education Foundation, n.a.-b). Moreover, comprised descriptions of related methods and theories are proposed to be based on Wikipedia articles, but being amended to the specific needs for research description. The intended product from this research activity is a comprehensive and multi-disciplinary structured repository on digital 3D reconstruction research approaches, methods, theories, publication bodies, and good practice examples. As a structuring approach, a decision tree is intended, leading from prototypical research questions to methodological options and highlighting good practice examples. This structure is intended to allow scholars in the field of digital 3D reconstruction to adopt already tested research designs in case of similar research interests. A major challenge is not only to create appropriate articles on certain topics, but to classify, structure, and interconnect these knowledge assets properly and make information findable and browsable in an appropriate manner for an intended usage and for designated users. Against this background we intend to populate outcomes of our activities as, for example, amended versions of articles on specific methods or theories within Wikipedia again.

The editing of parts of the project results into Wikipedia will lead to a wide dissemination and visibility of group activities and outcomes as well as enhance competencies of all contributors on collaborative work (Purdy, 2009).

## 3 Summary

Within our article we described the general motivation as well as a tested design for a workshop which is proposed to gather a scope of research interests as well as related methodologies by querying experts. This workshop is proposed to take place at IFKAD 2016 as well as the ARKDIS conference in June 2016. Furthermore, this workshop proposes to set the cornerstone for further activities. As a future task, a student seminar which is intended to take place in summer 2017 is proposed to create a Wiki resource which provides a structured overview on research designs in digital 3D reconstruction to make them adoptable for scholars in this field of research.



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