Digital Cultural Heritage meets Digital Humanities

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ABSTRACT:

Digital Cultural Heritage and Digital Humanities are, historically seen, in focus of different communities as well as approaching different research topics and - from an organizational point of view - departments. However, are they that different? The idea of this joint article involving digital humanists and heritage researchers is to examine communities, concepts and research applications as well as shared challenges. Beyond a collection of problem-centred essays this is intended to initiate a fruitful discussion about commonalities and differences between both scholarly fields as well as to assess to which extent they are two sides of the same medal.

1. INTRODUCTION

From a historical point of view, Digital Heritage and Digital Humanities are approaching different aspects of heritage. While digital heritage concentrates on tangible and intangible cultural heritage objects and their preservation, education and research (e.g. UNESCO, 2003), digital humanities focus on the application of digital technologies to support research in the humanities (c.f. e.g. Gibbs, 2011; Schreibman et al., 2004; Waters, 2013). Formerly known as humanities computing, digital humanities originated in the text-driven disciplines as linguistics or codiology but spread to art and architectural history, museology, or archaeology (Davidson, 2008; Hauke, 2016; Hockey, 2004; Svensson, 2009, 2010). Due to this historical divide, digital heritage and digital humanities are still in the focus of different communities. Under the umbrella of the Alliance of Digital Humanities Organizations (ADHO) numerous continental and national chapters are covered. Vice versa, numerous associations as for instance the ICOMOS/ISPRS CIPA were funded, and a lively scholarly community has arisen on digital cultural heritage during the last decades. Against this background, it is our overarching interest to initiate a fruitful discussion about communalities and differences between digital humanities and digital cultural heritage as well as to assess to which extent they are two sides of the same medal. Following a panel about digital cultural heritage as a part of digital humanities held at the ADHO annual conference in June 2018 (Münster et al., 2018), this paper is intended to sketch an outline of current research topics, challenges and practices on the frontier between digital humanities and digital cultural heritage. Hence, this article is about the complimenting question - how digital humanities are contributing to the research cultural heritage. Specifically we ask the following questions:

- What are the objects, topics, concepts and methodologies of digital humanities and cultural heritage research?
- What are the research applications in heritage related digital humanities?
- What are the shared problems and challenges?

2. COMMUNITIES AND OBJECTS

Despite various attempts (Alvarado, 2011; Carter, 2013; Gold, 2012; Kirschenbaum, 2010; Terras et al., 2013), the definition of digital humanities is still blurred and heterogeneous (Alvarado, 2011; Gibbs, 2011), and there is still controversy about the use of digital methods. That comprises the questions whether digital humanities are "worthy of an academic department" by means of a sufficient level of academic rigor (Terras, 2006a, p. 230), whether an object of research is limited to digitally supported research methods or dealing with all aspects of digitally supported scholarship (Beaudoin, 2009; Beaudoin and Brady, 2011; Hersey et al., 2015; Kemman et al., 2014; Long and Schonfeld, 2014; Stam, 1997; Unsworth, 2000; Zorich, 2012) and finally, what are unique research benefits. Concerning that latter aspect and from the perspective of humanities research, especially novel qualities and opportunities for pattern recognition, easy scalability and editing of information are mentioned (Bodenhamer et al., 2010b; Ch'ng et al., 2013; Moretti, 2007; Münster, 2016). The data foci of digital humanities are texts, images and objects. While the use of digital methods in the text-oriented disciplines is currently widely established and standardized (Bundesministerium für Bildung und Forschung, 2014, p. 10), a scope of digital methods related to images and other visual objects and based on vision rather than close reading remains – despite various attempts (Arnold and Geser, 2008; Bentkowska-Kafel et al., 2006; Bodenhamer et al., 2010a; Ch'ng et al., 2013; Frischer, 2008) – essentially undiscovered. Possible reasons may be seen in the "diverse nature of the methods used" in disciplines focussing on these types of artifacts like art and architectural history, cultural heritage studies or museology (Long and Schonfeld, 2014, p. 48), but also in the heterogeneous level of establishment of digital research methods in those disciplines (Hicks, 2006). What are the fields of research in the digital humanities? Beside the investigation done by Terras (Terras, 2006b) on publications prior to 2006, Scott performed a similar analysis for the DH 2017 conference submissions (Weingart, 2016), as did Given and Willson, in

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particular for textually oriented digital humanities (Given and Willson, 2018). A community identified by Terras's analysis from 2006 exclusively dealt with textual and – few – image sources. Also, nowadays digital heritage-related aspects such as visualization, geospatial analysis or Virtual Reality/Augmented Reality (VR/AR) are only occasionally named. Where does a discourse on digital heritage take place instead? Despite the broad variety of approaches and topics, digital cultural heritage evolved to a specific academic field with conferences, journals and various frequently contributing researchers and institutions (Münster, 2017b). A general finding is that an academic discourse takes place primarily on technology-related topics (Münster, 2017a). Most prominent research areas are data acquisition and management, visualization or analysis. Recent topics are for instance unmanned airborne vehicle (UAV)-based 3D surveying technologies, AR and VR visualization, metadata and paradata standards for documentation or virtual museums (Münster, 2017b). The community is driven by researchers from European countries and especially Italy with a background in humanities. Moreover, conference series are most relevant for a scientific discourse, and especially EU projects set pace as most important research endeavours. Beside the differences in topics, there are some shared characteristics of digital humanities and digital cultural heritage. A scholarly discourse is closely related to practical applications within projects and often takes place within cross-disciplinary cooperation. As another shared characteristics, their objects are cultural heritage – according to Panofsky "'the records left [by] man' — works of literature, art, architecture, and other products and traces of human intellectual labour" (Alvarado, 2011). Beside these obvious communalities, digital humanities and heritage share several concepts such as spatiotemporality.

3. SPACE AND TIME AS SHARED CONCEPT

Digital humanities methodologies have introduced radical changes in the cultural heritage fruition. At the same time the digital approach is profoundly changing the historical research that is the foundation of cultural heritage's knowledge and understandings. The most evident effect is a sort of 'public use' of the history (Calabi, 2013; Tamborrino, 2016). The outputs of digital history are more accessible for the uses of preservation and, at the same time, for the audience of cultural heritage at large. For this purpose, cultural information becomes more understandable by linking data into space-temporal frameworks. Space and time create an immediate orientation of users that successfully affect the fruition of heritage sites. Digital approach also adds something more to a fully exploitation, by activating users' participation. Nevertheless the connection between historical information and fruition is not so simple, as well as the space-time link in the historical approach. They require some premises. If a "spatial turn" has been characterizing the recent historical research (Bodenhamer, 2013), the spatialisation of historical data predate the digital approach with some theoretical implications. Urban history as an implicated field is very useful for outlining this scenario. Since the 1970s significant changes in the nature of this field were introduced related to the notion of space (Rodger and Sweet, 2008), until digital history emerged in the late 1990s (Brügger, 2016). The essential relationships between history and space were established by focussing on built environment and its significances at different scales of housing, urban space, territory (Lefebvre, 1974). Furthermore, this reading contributed to recognizing different kinds of conceptual spaces: a physical space (the built environment), an intellectual and constructed space, and a third space 'practiced' and lived. In the context of a growing new field as urban history was at that time, it fostered new approaches. Brief historians couldn't neglect the space anymore (Rodger and Sweet, 2008). It should be noted that in parallel architectural writings produced other contributions about the relevance of the space, too. We refer the successful title of a milestone on architectural studies (Giedion, 1941) to say as *Space and Time* have been outlined as basic components of critical architectural surveys. Moreover, architectural urban history also emphasized the *visual* factor. Among others, Bruno Zevi especially underlined and taught the space experience (Gullberg, 2016). While architects needed "*learning to see*" in order to understand the built environment, architectural historians practiced a specific history with a method that included drawing and visualizing (Zevi, 1948, 1965). Although based on traditional methodologies, then, the intent of spatializing and visualizing their research can be found in some tables of studies of historians with a background as architects who shaped a specific approach for a history of the built environment (Tafuri, 1985). It should be noted that since the Sixties in Italy the debate about historical centers was encouraging a vision of cultural heritage as a part of a more complex system of relationships in the space (ANCSA, 1960). Nevertheless, the practice of historical spatialisation and visualization was as exceptional as addressed to experts, history and memory mostly appearing as disconnected distinct fields. Digital heritage as 'computer-based materials of enduring value that should be kept for future generations' (UNESCO, 2018) has introduced a new fruition and understanding of cultural heritage. Digital tools in fact allow the general public to be captivated by easily grasping visualized historical contents. Timelines synthetize written pages, and 3D models represent different forms of tangible heritage at different periods. These uses of digital technologies created a widespread communication of cultural information and applied research. If new progress has been introduced, a change of perspective does not come only from an updated communication. Information and communication technologies (ICT) enabled humanities to change the approach (Svensson and Goldberg, 2015). Digital humanities are now creating the broken perspective by changing the production of cultural information and the innovation of all the process since the co-creation of the knowledge (Terras, 2014). Historical approaches with methodologies that entail digital humanities steer the process from the historical survey and data extraction to data representation till the elaboration of historical information for its dissemination/communication (Weller, 2013). They have allowed historians to match space and time in a more effective way by improving the historical survey and implementing keys of interpretations for telling stories (Tamborrino, 2014). This new approach deeply involves cultural heritage by bridging the gap between history and memory. Even if some historians still are reluctant by avoiding a finalization of research for tourist consumption (Stabel, 2014), the new trend has strongly connected the 'producer' of 'contents' with their uses. At the same time this approach strongly needs and fosters interdisciplinary research. Peculiar expertise is asked to go beyond data representation and communication. Moreover, beyond a visualization of cultural information in space and in time, digital humanities foster different systems of data representation and data management by introducing new customs among scholars for collecting and sharing them. In our research we experienced some large scale urban and landscape dynamics of change (Tamborrino and Rinaudo, 2015b; Tamborrino and Rinaudo, 2016; Tamborrino and Wendrich, 2017). In this case, time and space concern both the survey areas and the preservation sites of tangible and intangible

heritage. The quantity and the heterogeneous nature of data of one hundred years can be combined with the places from where they come: archives, libraries, and museums (Tamborrino and Rinaudo, 2015a). An enormous articulated heritage of images, narratives and cartography make the multifaceted developments in centuries of tangible cultural heritage more understandable, and also this material presence link immaterial heritage that is scarcely accessible. Digital approach when related to intangible heritage especially provides evidence of new cultural research and politics perspectives. By referring to cultural heritage as a cultural notion (Sonkoly, 2017), clever facts have still to come to light. We could only imagine how digital humanities entail controversial heritage or contentious memories in a postcolonial perspective as the BURRA Charter has prospected (ICOMOS, 2013). The 'making visible' inequalities, such as slavery for instance (Araujo, 2012), or the use and the abuse of urban space by different actors imply the search for some peculiar data together with spatializing and visualizing them for conceiving and expressing new keys of readings. Digital history then makes it possible to produce a fresh vision of shared cultural landscapes as well as tangible and intangible heritage. In the meantime the digitalization of archives, libraries, and the new trend of research museums have produced new sceneries for a collaborative research. Methodologies that entail digital humanities can link this large and articulated community for a new exploitation and understandings of space and time of cultural heritage in the digital society.

4. METHODS: IMAGERY

Main objects of study of both digital heritage and humanities are images and objects. What are the related research applications? Images occur in three different forms in the digital cultural heritage and the digital humanities:
a)   Primary historical sources (i.e. painting of Christ)
b)   Representation of cultural heritage (i.e. photo of a historic building)
c)   Visualization of content (i.e. 3D reconstruction of a city or plot of images due to their style)

This categorization is not strict. Primary images (a) could also be representations of cultural heritage, and also a representation of cultural heritage (b) gets a genuine historical source due to its own context. Lately we have also seen the historical dimension of thirty-year-old 3D reconstructions (c) and so on. Although we mainly think of digital images in b and c, the digitalization is complementary to all categories: there are digital primary sources and there are of course analogue representations of cultural heritage and visualizations. Meanwhile new printing technologies seem to take the digital representation to an intermediate stage and AR and VR approaches enrich and confound our notion of images. However, these are sidelines in the extreme growth of digital imagery of cultural heritage: pictures are digitized with technically high standards so that they preserve information, hard to achieve in front of the original (Google Arts & Culture project, 2016). Although not every object receives the modes of representation due to its appearance yet, a huge amount of representations from different origins (photography of originals, scans from reproductions, visualizations) are accessible. Different interests and a global academic and crowd-driven collection process allows a cultural diversity and breaking of canons. However, the accessibility is the main obstacle in the exploitation of the visual corpus of cultural heritage. Still, memory institutions forget their duty to communicate their cultural heritage digitally or cannot afford it (German Museums

Foundation, 2017). Copyright issues interfere with the sharing of digital cultural heritage and are the sword of Damocles for digital humanities projects. Accessibility is also complicated due to the different players who host images of cultural heritage (memory institutions, art market, social media etc.). An open access strategy of cultural heritage institutions has to meet with meta-repositories or at best linked open data to contextualize and link the images. International classification systems, taxonomies like CIDOC-CRM seem to build an infrastructure in which cultural heritage can be documented online. In the vivid and productive discussion about metadata standards, authority files, and interoperability of metadata in general, it is sometimes overseen that metadata is not the sole information we have of an image. The image itself bears a lot of visual information often complementary to the metadata, which tackles mostly the context of the object (author, place, and provenience). Beside the aim to rethink metadata by tagging also obvious visual occurrences, the visual content is a challenging opportunity for pattern recognition, machine learning, image processing, and computer vision (Bell and Ommer, 2015; Bell and Ommer, 2016). Image and text processing can work hand in hand to retrieve comparable images, deep learning algorithms can develop an own concept of style and sort different periods, regions and artists, scene recognition understands basic semantics. Convolutional neural networks, which accelerated the development of computer vision in the last years, need a great amount of data to learn, thereby the scattered appearance of the digital corpus of cultural heritage and the bias of local repositories are big problems. For that reason and due to the fact that until now most of the research is mostly made by computer vision groups, it concentrates on basic research, prototypes and proofs of concept (Bell et al., 2014; Crowley and Zisserman, 2014). The success of convolutional neural networks and easy-to-use environments has by now led to applied approaches and research in the digital humanities (Seguin, 2016). Furthermore, the evaluation, training and use of these algorithms need the attendance of image sciences, visual studies, art history and related fields. The potential of image processing (with and without text) requires not only the re-entry in discussions of the Iconic turn, it stimulates a revision of numerous methods of art history and visual studies from their beginning (frequently mentioned Morelli, Wölfflin, Warburg, Gestalt theory) (Elgammal et al., 2018; Morelli, 1997). This reconsidering of methods, theories, tools and techniques also shows digital cultural heritage and digital humanities in their treatment of imagery not in a disruptive but enriching process. A treatment of images not in a new way but in a new scale. This new scale needs also new visualizations to present the manifold.

5. METHODS: 3D AS RESEARCH TECHNOLOGY

With the development of computer graphics from the 1960s, and explicitly since the 1990s, virtual reconstruction was discovered and used for object and space-related research (Messemer, 2016). Three decades after it was popularized, we find that 3D modeling and visualization are primarily used in the form of tried and tested film animations and/or image publication. The manifold possibilities of computing are not fully exploited due to a lack of digital methodology and infrastructure, especially in scientific documentation and presenting results. 3D retro-digitization of existing artefacts produced by 3D laser scanning and photogrammetry and source-based digital 3D reconstruction of non-existent objects provides adequate access to research objects in archaeology, art, architecture and urban history in the age of Web 3.0/4.0. The

main repositories for the scientific models are libraries, so metadata-based contextualization of 3D models is being considered (Blümel, 2013). There are two reasons why 3D models have such great potential; the first is precise reproduction of the geometric and material properties of an object. Secondly, profound interpretation of the sources and hypothetical reproduction of the object provide historical researchers with an extensive understanding of the object. One can start adding value to the digital 3D model by linking it to research questions, sources, interpretation and results to the 3D data sets in human and machine-readable form (Kuroczyński). In contrast to the building industry, which has developed Building Information Modeling (BIM) and an Industry Foundation Classes (IFC) data exchange format in response to digital change, digital humanities have yet to agree on a digital methodology for dealing with 3D models. If the data model and exchange format are not standardized, the sustainability and traceability of digital 3D objects is not guaranteed. In this context, Linked Data has become established as future-oriented technology, with knowledge formalization in structured data models and open source with WebGL for web-based visualization of 3D data sets. Formalizing and structuring knowledge in a way that is compatible with computers makes it possible to operationalize data and promotes computer-supported knowledge acquisition and web-based knowledge networking. Two projects worth mentioning in the field of monument preservation are MonArch (Freitag and Stenzer, 2017) and SACHER (Apollonio et al., 2017), which enable comprehensive and collaborative management of (digital) cultural heritage, using innovative viewers such as 3DHOP (http://vcg.isti.cnr.it/3dhop/). They make it possible to document damage mapping and conservation work comprehensively, and contextualize the object with additional Linked Data resources. Regarding source-based historical reconstruction, projects which make web-based visualization comprehensible deserve a special mention. For instance, Digital 3D Reconstructions in Virtual Research Environments (Kuroczyński et al., 2016) and DokuVis (Bruschke and Wacker, 2016) show the potential of sustainably recording processes and connecting 3D data to events, sources and actors as Linked Data. For the digital humanities, these projects create a new access point to the data sets behind the 3D models. The digital research data can be operationalized with SPARQL query language – which can generate new insights and conclusions. From the 3D model, it is possible to process and analyse new ways of evaluating complex factual relationships and implicit knowledge, including other networked Linked Data resources. Furthermore, documenting creative, source-based reconstruction ensures that the results are scientific, because the process is verifiable. Developments in VR/AR/ Mixed Reality (MR) technologies are enabling new immersive interactive experiences, which, in turn, bring with them new experiences of looking at and communicating research results. We are now in the early days of a technological process; in terms of both content and methods, digital reconstruction is gradually becoming established as a proven research methodology. Only when our 3D models are semantically structured and available long term with open access online can applications such as "Wikipedia 3D" (Russell et al., 2013) and the resulting discourse be applied to the models in the spirit of open science.

6. CHALLENGES: DATA PERSPECTIVES ON DIGITAL HERITAGE

What are the shared problems and challenges of digital humanities and heritage? One of those originates from cultural heritage as research data and / or object. Today, cultural heritage researchers use digital data coming from different sources (e.g. written documents, paintings, photographs, drawings, video etc.) to extract all the possible information to build up a complete documentation of the investigated object (e.g. archaeological site, building, urban center, landscapes etc.). The documentation links all the possible information together, which allows underlining and understanding of the cultural values that characterize the investigated asset (Letellier and Eppich, 2015). The main contents of a documentation are based on historical (e.g. origin of the asset, evolution of the asset through time) and on geometric knowledge (e.g. shape, dimensions, relationship with surrounding assets etc.). Historic studies have found advantages in the spatial localization and modelling of human and physical phenomena that are, in many cases, certified and assessed by written documents, paintings, photographs, and drawings. To allow this interaction a second generation of digitization is necessary. In the past, after a simple scan of the document to preserve the originals and to diffuse the contents by networks, the digital transcription of the documents took place by using specific character recognition software to ease automatic text analysis and comparisons. In the last years, many of the semantic data coming out by mixing the different sources of information have been transformed into geometric and alphanumeric databases. The use of the database theory allows inquiring data coming from different origins, which is technologically connected by experts, to ease the interpretation of phenomena. This heavy work must be developed by a multidisciplinary team able to merge the different scientific approaches into a unique instrument: geomatics, IT and historic experts have to work together to find the best possible solution. Old documents and census can be transferred to a database and, thanks to Geographic Information System (GIS)/BIM platforms, the semantic data can be located into a given space (e.g. a land or a building) (Osello and Rinaudo, 2016). This added information, the geo-localization, help the specialists to connect historical information (e.g. time and actions) to the space and so to interpret and understand the data in a more complete way (Tamborrino and Rinaudo, 2015b). Thanks to open source format (e.g. *.shp* and PostGres database structures) all the collected and stored information can be shared with the scientific communities allowing the verification of the proposed interpretation and the upgrade of new information related to the same asset, without forcing the specialists to repeat the heavy and time consuming steps of "data-entry". Metric survey drawings, historical photographs, and videos could help the 3D geometric modelling of existed assets (Stanco et al., 2011). They could also allow the reconstruction of no longer existing landscapes and buildings or to reconstruct the evolution of the investigated asset, over a range of years. Among these kinds of applications, digital photogrammetry is today the best tool which allows the recovering of shapes and dimensions from old photographs, central perspective-based drawings and video. The integration of 3D models using photogrammetric approaches by means of historic drawings used to represent old survey actions, and semantic data extracted form written documents, could allow to describe destructions, refurbishments, and different uses of the investigated assets. Those 3D models could be used to show the interpretations coming out from history of architecture or as the metric base for BIM platforms. .

7. CHALLENGES: FORMALIZING SEMANTIC KNOWLEDGE AND NEW FORMS OF REPRESENTATION

The advent and subsequent establishment of digital humanities offered greater and wider access to digital archives of historical documentary sources, it provided new digital tools for scholars in the study and research, and finally it led to the construction of infrastructures (i.e.: Virtual Research Environment/VRE) that have increased exponentially the possibility of sharing data. Above all it redefined the whole way of working in the field of social sciences and humanities, as well as broken down many barriers to accessibility to sources and contents, and redefined the ways in which the cultural heritage can be used, even by non-professionals. The 'Numerical approaches to historical sources' (Baillot, 2018) (literary, philosophical, historical etc.) for instance brings us face to face with the problem, on the one hand, of how to develop theoretical tools able to address the question of construction and interpretation of historical sources and, on the other hand, to pay proper attention to data architecture in the theoretical perspective opened by the conceptualization of trace and archive concepts. Therefore, it is not just a question of quantitative data that can be archived, but of quality of information related to raw data (i.e. the reconstruction of a lost context of any inevitably speculative reconstruction, since the original is no more available) (Baillot, 2018). It is, inevitably, an epistemological work. In a similar way the adoption of visualization tools by the digital humanists in their work has been concretized by the mere borrowing of methods developed in other disciplinary fields for the graphical display of information in the natural and social sciences. As Drucker underlines (Drucker, 2011), the adoption of these tools carry with them assumptions of knowledge as observer independent and certain, rather than observer co-dependent and interpretative. Therefore she wishes a humanities approach to the graphical expression of interpretation, beginning from a re-definition of the concept of *data* as a given, that has to be characterized instead as *capta*, taken and constructed. This involves, as a consequence, a re-definition of the same forms for graphical expression of *capta* that as Drucker wishes need to be more nuanced to show ambiguity and complexity, and expressed according to graphics built from interpretative models. Digital reconstructions have turned into a complex medium of historical reconstruction not to be disregarded by researchers in art and architectural history (Hoppe and Breitling, 2016). Virtual models open the doors to new and unexplored dimensions. They could be a useful tool for non-destructive archaeological research as well as for defining the historical impact and cultural wealth of architectural remains and sites (Hoppe and Breitling, 2016), and then used as an interactive tool for scientific research. Digital formats could be used in order to enable the emergence and inclusion, alongside the resources themselves, of the heuristic as well as hermeneutic foundations that govern the constitution of these resources (Baillot, 2018). Digital technologies introduce the possibility of interchangeable media able to offer multiple nodes of access to a given term or object, and enable a multidimensional approach to knowledge on several levels (Stefani, 2013). On the one hand, therefore, we have the theme/problem connected to visual communication through digital tools/technologies and on the other, the theme/problem connected to the formalization of the knowledge elaborated/produced through the digital tools/technologies used in order to reprocess data (analogue or digital) to produce new digital artefacts. The first theme has to do with the languages, methods and techniques of data representation, information

produced and results achieved; the second has to do with epistemology, that is, of the conditions under which one can have certain or scientific knowledge, of the methods to achieve this knowledge and how it can be transmitted and communicated. The inescapable problem remains the need to make retrievable the documentation process (Münster et al., 2016) behind the production of any digitized, born-digital, and reborn-digital material, as well as that concerning the cultural asset and the preservation of the data during the whole lifecycle of any artefact. Therefore, besides spatial modeling and its representation the digital humanities, as well as digital heritage, open to the temporal dimension (diachronic and synchronic) - which allows to know artefact not only in its evolution and transformation during its life cycle, but also through its analysis - and to the extrapolation of various possible models from fragmentary pieces of information (remains), which imply of portraying uncertainty in a digital imagery, and defining an inventory of new forms of representation for indicating distinctions between known and projected or imagined evidence. Thanks to the development of the ICT technologies and infrastructures, virtual reconstructions can indeed be understood and implemented as spaces of specialized knowledge. As sets of data virtual reconstructions may contain single pieces of information such as construction data, source extracts, surveys and documentation embedded in a multidimensional context. The semantic virtual environment platforms, able to visually present space enriched by a range of meta-information, act as medium/metaphors for the spatially organized 'interface', which refers to an essential scientific framework (Hoppe and Breitling, 2016), and becomes the engine for dissemination of different and customized level of knowledge (Apollonio, 2018). According to theoretical humanities approaches to knowledge as knowing, observer dependent, emergent, and process-driven rather than entity-defined, even though web-based ICT systems can offer increasingly updated tools for the cultural heritage management, we need to adopt a transparent reconstruction workflow, and to define standardized methodology of source or reality-based 3D reconstruction of tangible cultural heritage, able to ensure:

- 3D modeling qualified by readable quality/properties;
- a proper semantic structure of the 3D digital model;
- a retrievable knowledge reconstruction and formalization process (Apollonio, 2018);
- the interoperability of data sets by referring to recognized standard reference ontologies.

The challenge, as desired by Drucker (Drucker, 2011; Drucker, 2012) due to a shifting humanistic study to a humanistically informed theory of the making of technology, consists in developing a new web philological toolbox (Brügger, 2016) that can help the scholar gain as much information as possible about the object of study. This approach, in fact, should be able to develop applicable working techniques, to define valid strategies, and to apply classifications useful to supporting scientific work besides the conveyance of knowledge to its extraction, elicitation and representation.

8. PERSPECTIVES: LARGE SCALE DATABASES FOR CULTURAL HERITAGE

These issues take yet another dimension, when large scale databases for cultural heritage are considered. Indeed, digitization campaigns and interlinks between previously segmented datasets offer, for the first time, the possibility to conduct large scale studies on cultural heritage items. Millions

of digitized artwork or primary sources offer new opportunities of research and scholarship. Previously disconnected datasets form larger wholes that can be studied using algorithm methods. The articulation between Digital Humanities and Cultural Heritage can be explored in the way skills must be combined to process and interpret these large cultural databases (Kaplan, 2015; Kaplan and Lenardo, 2017). More precisely, Digital Humanities and Cultural Heritage expertise must be combined at crucial interpretative moments: a) During the redocumentation processes, when data from the past systematically undergo a form a regularization to match the paradigm of contemporary information systems and documented and reversible choices are made for massive reinterpretation. b) During the reconciliation process, when the establishment of exchange standards and new interpretation methodology opens the door to multiscale, collectively negotiated common histories. c) During the fruition process, when previously frozen datasets are put in motion again linking back the continent of data from the past with the one of the Big Data of the present. Large scale initiatives like the Time Machine Project (www.timemachine.eu) organises the encounter between these different expertise and the training of a new generation of scholars mastering both Cultural Heritage and Digital Humanities skills.

9. CONCLUSION: SHARED DIFFERENCES?

What is the linkage between digital humanities and digital cultural heritage? Due to the predominance of textual content, spatial objects and imagery – as shared object of both domains - are still minor topics of digital humanities. Vice versa, humanities driven research is – compared to heritage recording, conservation and exhibition – a small field in digital cultural heritage. Beside the aspect of general relevance, there are many similarities especially in this pivot area. Both domains share concepts such as the idea of spatialisation, rich information about an object as research base and a strong link to the creation and perception of visualization and imagery. Also technology and data are important drivers, although there is a still open question about whether research is primarily data driven or data led (Scharloth et al., 2013) and – in a wider scope – belongs to arts or sciences. Consequently, there is the question for a common clamber.

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