

# INTRODUCTION

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One of the cornerstones of the digital society debate on the national, European and global levels is the digitisation of cultural heritage assets. Archaeology and material cultural heritage have often enjoyed a particular status as a form of heritage that has sparked the imagination of politicians and the general public. The physicality of objects and structures, the monumentality of the major archaeological sites and the popular interest in the past are only a few of the reasons why archaeology has in many cases become a linchpin in the discussions on new digital technologies and digitalisation of the society.

However, even though nations have made considerable investments in creating technologies, infrastructures and standards for digitalisation, preservation and dissemination of archaeological heritage, there is very little in-depth research on the consequences, opportunities and implications of digitalisation for archaeological work, the emergence of archaeological knowledge and how it is used by diverse stakeholder groups from ordinary citizens to researchers, museum professionals, landowners and property developers. The Swedish Fornsök ([www.fornsok.se](http://www.fornsok.se)) database has information on over 1.7 million entities, the Dutch archaeology data service has over 25 000 datasets and reports and the Italian ministry of culture has been es-

estimated to have about 2 million records in their digital archaeological archive. We know a lot about technical and practical challenges in the different phases of producing and using archaeological information, but significantly less about how the practices and technical, theoretical and administrative decisions affect and influence consecutive use and reuse of information. Paul J. Cripps remarked at the Computer Applications and Quantitative Methods in Archaeology 2012 conference that “information that goes into databases is far too perfect and too often a perfect view of the world”, an apt remark on the current state of affairs which has obvious but poorly known consequences. This seems to indicate the possibility that models of reality may become convincing enough to be mistaken as “real”. It is therefore crucial to highlight the choices and considerations involved in data collecting and in digital presentation: what is selected? what is excluded? what implications will this have for knowledge production and mediation?

The aim of this small book is to briefly discuss some of the premises for studying the implications and opportunities of the digitalisation of information and information work in the domain of archaeology and material cultural heritage. This book has been written under the auspices of the research project Archaeological Information in the Digital Society (ARKDIS) funded by the Swedish Research Council as a part of the work of the project to set the stage for researching the production and use of archaeological knowledge. The texts present a combination of musings and recapitulations on the earlier work of the authors as well reflections and entries to their on-going work. Instead of attempting to put together a single argument, the authors have been given an opportunity to write about aspects of archaeological information they consider to be important at the moment from the perspective they see as important and in a style that best fits the specific purpose of their text.

Rather than a conclusion, the texts in the volume are a new start in working towards understanding the complexities of working with archaeological documentation and information. The intricacies of managing archaeological information and documentation have been acknowledged for a long time (Reilly and Rahtz, 1992), but the rapid changes in premises, tools and the idea of how archaeology should be conducted in the digital age have shifted many of the parameters of the process. The introduction of computers into archaeological work has facilitated the processing of information and the integration of isolated datasets into massive data infrastructures. At the same time, new documentation instruments have enabled archaeologists to capture more precise data than before. The new technologies have not, however, provided any obvious automatic solutions to meet the fundamental challenges of an effective use of the data. On the contrary, the introduction of technologies has increased the amount of available data and underlined further the necessity of its effective management (Lock, 2003; Brown 2011) and the need to develop new approaches and techniques to take advantage of the processing power, data infrastructures and documentation equipment. The Big Data issues identified in the 2007 report of English Heritage and UK Archaeology Data Service are becoming increasingly topical for the management of archaeological information (Austin & Mitcham, 2007). At the same time, the societal expectations of increased cooperation together with the apparent opportunities and benefits of larger integrated data spaces and e-Science infrastructures have spurred archaeologists to address the challenges relating to the effective management and innovative and appropriate use of archaeological information by different stakeholder groups. The necessity of better understanding the fundamentals of archaeological information process has been discussed in several studies that have provided several examples of how it is necessary to combine technical innovations (such as three-dimensional representation of data or Semantic

Web technologies, e.g., Huvila 2006; 2012) with institutional and paradigmatic change.

The necessity of developing new strategies for addressing the use and management of archaeological and other cultural heritage data in the rapidly digitalising contexts of information use of the stakeholders the information has been underlined in the recent literature. The research agenda set by the European network of excellence in open cultural heritage EPOCH (Arnold & Geser, 2008) revolves around these two issues with a specific focus on integrative societal approaches to cultural (including archaeological) heritage, increased engagement and empowerment of traditional and non-traditional stakeholder groups and strategies and technologies of knowledge transfer and management. V-MUST NoE has similarly emphasised the lack of integrative approaches and understanding in the field of virtual museums (V-MUST, 2011) and the ARIADNE infrastructure in the field of the management of archaeological data (Papatheodorou, 2013). The Swedish National Heritage Board published in 2011 a white paper on ‘net presence’ (Swe. nätnärvaro) in the digital society (Summanen, 2011) that sees the presence in the digital sphere as an unavoidable necessity in the future. Further, the white paper identifies three challenges facing the management of heritage information in the digital society: 1) the amount of information and the need for new methods to manage it, 2) the broadening use of information by a growing number of stakeholder groups, and 3) the changing roles of producers and users of information. Both other national archaeological institutions and researchers have made similar remarks.

Even if the earlier literature discusses some of the challenges of the management and use of archaeological information by different stakeholder groups, the main body of literature relates to the issues and opportunities, and practical development of technologies and tools for data management and exploitation. As Ross (2007) has

noted of the state of the art of preservation research, the bulk of the necessary technologies and principal approaches exist, but there is a lack of comprehensive understanding and demonstration of their practical usability. As the report by Arnold and Geser shows (2008), there are technological challenges, but the major focus of future research should be on the interface of information and the processes of its use. The US-based tDAR data archive (<https://www.tdar.org>), the Dutch DANS data archive (<http://dans.knaw.nl>) and the pioneer in the field, the Archaeology Data Service (UK) have engaged in developing practical digital methods and techniques for the preservation and publication of archaeological data. A number of projects and initiatives both in Europe and the US, including STAR (<http://hypermedia.research.southwales.ac.uk/kos/star/>), STELLAR (<http://hypermedia.research.southwales.ac.uk/kos/stellar/>), CARARE (<http://www.carare.eu/>), ARENA (<http://ads.ahds.ac.uk/arena/>), DARIAH (<http://www.dariah.eu/>), Digital Antiquity (<http://www.digitalantiquity.org/>), 3DCOFORM (<http://www.3dcoform.eu/>) and ARIADNE research infrastructure project, have conducted practical work on developing different aspects of data management and provision of access to the data e.g., in the case of CARARE, by integrating archaeological data to the Europeana gateway. There is also a growing body of mostly technology-oriented Semantic Web-based research on developing the management, accessibility and usability of digital archaeological assets (Isaksen, 2011).

In addition to the large-scale research on the management of archaeological data, there are a large number of examples of developing the use of archaeological data in various sites around the world for public presentation, preservation, management (Tsipopoulou, 2009; Caravale, 2009) and to promote the accessibility of archaeological data and information, often with museum- and cultural heritage-oriented underpinnings. The Public Archaeology (Skeates et al., 2012) movement has further promoted the principle of openness and par-

ticipation in archaeological contexts. In spite of the considerable political interest in the public archaeology initiatives, archaeological and cultural heritage data and the number of local case studies, there is still relatively little research on the qualitative impact of these efforts beyond individual stakeholder groups and contexts, and their broader implications to the use and reuse of archaeological information in the digital society.

The literature on theoretical archaeology has addressed some of the central issues of archaeological interpretation and reasoning, and how archaeologists use and should use archaeological data to make inferences of the human-activity part, but it seems that the theoretical discussion has had only a limited impact on the stakeholder practices (Thomas, 2006). The same limitation also applies to the relatively small corpus of ethnographical literature on the practices of archaeological work and knowledge production. (Edgeworth, 2006; Davidovic, 2009; Pyburn, 2009, and other articles in *Public Archaeology* 8/2-3). Some of the findings have been taken back to field in some individual cases (Edgeworth, 2006), but there is a clear lack of a comprehensive feedback loop and generalisation of the relatively isolated findings of the individual projects. The remark by Lönn (2012) on the need for developing a theoretically inductive way of working in archaeology is valid well beyond its original scope of archaeological fieldwork.

On the basis of the synthesis of the earlier literature in the field, it is possible to list some apparent challenges in the way of matching the emerging technologies with the practices of archaeologists and other stakeholders of archaeological information. An obvious challenge is the complexity of the different types of archaeological data and its uneven quality and accuracy. The body of relevant information consists e.g., of measurements, scientific analysis results, objects, samples, drawings and photographs. The different types of materials are seldom comparable per se, and because of the vary-

ing technical formats of representation, their management and use in a single system without the use of multiple parallel data structures and conceptual separation of the data models require new techniques and research approaches (Signore, 2009). The codification and representation of different types of archaeological data is an intricate problem (Orlandi, 1993). By allowing artificially high levels of precision, computers have been observed to feed this propensity and to support a false sense of accuracy even with technically inaccurate data (Kantner, 2000).

Some authors, especially in the field of theoretical archaeology, have raised the question of the consequences and implications of various analysis and information-management practices, but the scope of these remarks tends to be relatively limited. Some authors, including Gaffney and van Leusen (1995), Rajala (2004) and Haciguezeller (2012), have discussed the implications of GIS technologies for archaeological reasoning, but as Haciguezeller (2012) points out, these types of considerations have tended fall into the margins of the generally rather unproblematising mainstream use of the technologies. A central challenge of the use and integration of data is the incompleteness of available archaeological information and the ambiguous relationship between primary data and the consequentially emerging archaeological knowledge (Thomas, 2006). In spite of the increased precision of measurements and the growing amount of available data, the documented and documentable data always represent an unknown sample of the original data. Another challenge is that even the theoretical 'complete corpus of original data' consists of miscellaneous remnants of past human and natural processes and is capable of providing only indirect evidence of the past human activity.

Present archaeological information practices have also been suggested to lead to major discontinuities in the information process (Greene, 1998) and abrupt breaks in the information continuum (Oliver,

2010). In many cases only the field director and deputy directors have the direct responsibility and possibility of developing a general idea of the excavation, but in practice, there is often very little time and opportunities for an extended synthesis of the data during the field season (Huvila, 2009). The discontinuities do not end with the end of the archaeological investigation. From the perspective of cultural heritage managers and, for instance, museum professionals, the available data in reports and publications is not necessarily highly useful for their purposes (Huvila, 2006). As a result, there is often a major gap between the capture of data, the analysis and reporting and the use of the findings by the different stakeholder groups of archaeological information. A related problem of the effective use of archaeological data is that if the results are published (most of the data, especially from rescue excavations is never analysed or published properly, Greene, 1998, 83-84), even then the different groups of materials and aspects of excavation are very often reported separately. Thomas (2006, 30) has made the obvious argument that these discontinuities are a major problem and essentially lead to a sub-optimal documentation of archaeological sites and investigation processes. The fundamental problem with the broken continuum is that the gaps will be extremely difficult to bridge in the future (Huvila, 2009; 2012). Because archaeological fieldwork and the use of archaeological data are interpretive in all stages (Thomas, 2006, 30), discontinuities tend to become cumulative and are difficult to remedy afterwards.

From the point of view of this volume, the interesting issue is to trace back some of the discontinuities in different areas of archaeological work and stages of archaeological information process. This volume contains altogether five texts from five authors working in the ARKDIS project. Daniel Löwenborg's chapter on the re-use of GIS data starts the volume with a focus on the exploitation of the data gathered in earlier excavations. In the second chapter, Isto Huvila



discusses in retrospect the findings of a study of archaeological information practices on the verge of digitalisation in 2004, and how these findings can help us to understand the changing landscape of information practices and infrastructures a decade later. The third chapter by Nicolò dell'Unto discusses the role of three-dimensional models in archaeological reasoning with a specific focus on his work in the Uppåkra project conducted near Lund in southern Sweden and in Pompeii. The following chapter, written by Bodil Petersson, discusses the influence of digital agendas and digital tools on heritage communication. The final chapter by Per Stenborg looks back to the presentation of archaeology in the Digital Time Travels project funded by the National Heritage Board (Sweden) and conducted in cooperation with the University of Gothenburg, Chalmers University of Technology and the Swedish University of Agricultural Sciences.

As a reader of this book, you are free to peruse this volume from the beginning to the end, or to read it in any other order of your choosing. If you think you have more questions after you are finished reading this small volume, we contributors to this volume will have achieved our goal with this small collection of texts. Seeing the complexity and open questions is only the beginning of making sense of archaeology and archaeological information in the digital society. What the answers might be is beyond the scope of this small collection of texts. They are the focus of the work we are currently engaged in and topics of future studies that not only we, but also many other researchers need to explore and study.