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Archaeological information work and the digital turn

Isto Huvila, Lisa Börjesson, Nicolò Dell'Unto, Daniel Löwenborg, Bodil Petersson and Per Stenborg

Abstract

This final chapter of the book outlines the impact of digital technologies and ‘the digital’ on the archaeological information process and seeks to identify how and when the digitisation influences the practices of using, producing and managing information. Digitisation has affected the infrastructures and topology of archaeological information work, how archaeology is achieved, and to a certain degree, also what is information from an archaeological perspective. Even if many aspects of the coming of the digital has been revolutionary, this chapter proposes that the principal change has been in the *lieux de savoir* of archaeological practices, in the space and place where archaeological knowing happens.

Introduction

The discussion in this volume so far has brought forward examples of how digitisation of archaeological information practices changes archaeology. As Dell'Unto demonstrates, it has an impact on what and how archaeology can document objects, features and processes it is interested in. Further as Börjesson and Huvila suggest, it can also change the premises of what and how information can be organised, managed and preserved, and eventually sought and used, as Löwenborg discusses in his work. Further, as Stenborg, and Petersson and Larsson illustrate, digitalisation has a capability to transform the outcomes and impact of archaeological work. After traversing through these themes, this final chapter of the book brings together themes discussed in earlier chapters and outlines the impact of digital technologies and ‘the digital’ on the archaeological information process and seeks to identify how and when the digitisation influences the practices of using, producing and managing information.

Digital turn

An obvious question that stems from acknowledging temporality and change of situations as a constitutive part of the archaeological enterprise is how change and continuity are premised in the process. Even if it might be tempting to claim on the basis of the examples that the ‘digital’ has turned archaeological information work into a new digital archaeological information work, it would be a too simple explanation. As Galloway (2014) notes, similarly to seeing digital as an object, the digitisation

of a field of inquiry such as conveying a new discipline of digital archaeology, misses an important point – even if it the point would be other than his non-philosophical perspective on the digital based on the work of Laruel. An outcome of such an externalisation of a digital turn would the institutionalisation of the binary of digital and non-digital, or as it is often problematically portrayed (Boellstorff, 2016), between digital and real.

Even if the impact of the digital technologies on archaeology has been often described using strong adjectives. Zubrow (2006) and Díaz-Andreu (2017) write about “digital revolution”, and, for instance, Dell’Unto and colleagues about “radical change” (2011). Others (e.g. Kristiansen, 2014a; Boast & Biehl, 2011) see the digital shift as an aspect of a broader paradigmatic or methodological change. At the same time, however, many researchers have remarked that there is much subtlety in this purported paradigm shift. The claim that “we are all digital archaeologists” (Morgan & Eve, 2012, 523) is equally valid than that it is of dubious value to essentialise digital archaeology or being a digital archaeologist. Post-digital-turn-archaeology is evidently a mixture of ‘old’ analogue and ‘new’ digital archaeologies (Olsen, 2012). Dallas (2009) notes also importantly that the digitisation of archaeological heritage is only a part of the “dramatic shift” that has taken place since the 1970s. A myriad of changes including the increasing involvement of new stakeholders from computer and information scientists to anthropologists has played a significant role in the process. There is indeed a reason to be critical to suggestions of an on-going paradigm shift (Gordon et al., 2016), where and what is changing and causing a change, and whether there is convincing evidence available. Even if the digital technologies have many evident opportunities to influence archaeological work and information work, the it might not be altogether clear where the ‘real’ change takes place. Stenborg notes aptly in this volume that the digitalisation of archaeological work has coincided with an accelerating destruction of archaeological sites around the world.

As Shott (2014) remarks, archaeologists have been using digital data already for a couple of decades. Therefore, it might be an exaggeration to talk from an overarching perspective about a revolution here and now. Similarly, even if the digital tools have had a major impact on data capturing both in field and in laboratories, archaeologists have captured data before. Of course, it would be unfair to trivialise the direct practical impact of digital technologies. Firstly, as the ecological perspective anticipates and the different examples discussed in this volume suggest, archaeology is literally done, and as a system it is ‘becoming’, through a mangle of different large and small practices. A museum exhibition, archaeological archive or a three-dimensional field documentation do not emerge out of nothing but are an outcome of a complex socio-material processes. Secondly, even if the daily interactions with digital technologies might appear as only partially meaningful routine work, they take up a large part of the working time of present day archaeologists. But still, there is a good reason to bring more introspection into digital archaeology as Huggett (2015a) urges, starting from questioning its role as an auxiliary discipline or a fundamental aspect of archaeological thinking (e.g. Cortese, 2016) and its compatibility with the epistemological underpinnings of archaeological work (cf. Kay, 1995), but not ending there, and not separated from the elucidation of the mundane practices but to complement them to see clearer the outcomes of these often somewhat technical shifts of everyday work. Eventually, they have an impact on the analysis of observations and materials and the making of archaeological knowledge. It may seem subtle (Shott, 2014) and it can be undoubtedly difficult to pin down (Huggett, 2015a).

The accounts of how digital technologies have penetrated archaeological practices convey a story of a change but it is also rather apparent that the change does not apply as much to the intellectual and theoretical aims and underpinnings of archaeological work and information work than their practical

premises. The multitude of examples throughout the chapters of this volume reasserts Olsen's (2012) thesis that archaeology is still a discipline of things. Archaeology deals with material remains of past peoples, societies and cultures (Drewett, 1999), and simultaneously is "a strange mixture of scientist and science and storyteller and narrative reconstruction" (Zubrow, 2006, 8), and a form of political action (McGuire, 2008) rather than a digital thing. In spite of the perseverance of many of the fundamental underpinnings of archaeology and archaeological information work and the occasional elusiveness of the digital turn, many aspects of archaeological information work have indeed changed, and as, for instance, Cortese (2016) and dell'Unto (in this volume) reminds, it is important to keep epistemological reflections and technologies close to each other.

Without attempting to provide an exhaustive account of everything, it is obvious that there are some themes that have recurred in this volume from one chapter to another. Without exaggerating it is fair to claim that the infrastructures of archaeological information work have changed. Digitisation has also had an impact on the rudimentary practices of how archaeology is done, or in more general terms how archaeology is achieved. Further, the topology of how archaeology is organised in space and time has shifted, and finally, even if the evidence would not be conclusive, it is necessary to take seriously the question of whether also the archaeological information itself has changed.

Infrastructures

To start with, it would be difficult not to put emphasis on how all the previous chapters evince of the change of the infrastructures of archaeological information work. Some of these sub-structures are emerging like digital repositories for archiving and accessing archaeological data for large scale analysis. Some of them are national and generic to all archaeological (field)work like the UK Archaeology Data Service (Beagrie & Houghton, 2013) or DANS (Palaiologk et al., 2012) in the Netherlands but many of the infrastructures are more specific and local like to specific conditions and needs like the ones developed by the authors of this volume for the specific purposes of particular field projects and research questions. Also, very generic technologies and movements like the nearly ubiquitous availability of portable (digital) computers and handheld devices, or such movements as open access publishing and open data have infrastructural qualities and provide a substructure to contemporary archaeological work. The currently emerging small and large repositories and laboratories are already functioning as an infrastructure for some archaeological activities and as Löwenborg and many others point (e.g. Richards, 2006; Aspöck & Geser, 2013), there is potential for more. Even if these changes may seem as diffuse and non-specific as they have been portrayed in the different chapters of this book, the principal locus of change may well lie precisely in these subtle changes rather than in the major national and international initiatives. The shape of infrastructure changes every time when the distribution of power is changing and new ideas are imported into them, as Strathern (1995) reminds, not only when it is faced by a dramatic metamorphosis. In the heterogeneous and intertwingular enterprise like archaeology, the number of these shifts make them difficult to trace but at the same time, potentially much more potent than large more obvious changes. Some of the infrastructures and infrastructural practices, like archaeological report writing are resisting change (Huvila, 2016b). Some, like the soil, which is an infrastructure par excellence for archaeology, are not going to change even if, as Dell'Unto demonstrates, they can be reframed, repositioned and transformed in archaeological work by the use of digital technologies. Soil can be many things. It is a particular type of material information infrastructure for non-digital archaeological work, but in a broader sense, a bio-infrastructure accessed by myriad ways of

conducting research, gardening, cultivating, composting, and building (Puig de la Bellacasa, 2016). Digital technologies allow new kinds of archaeological approaches to access it and the information that may come about when someone is working with it. At the same time, it is obvious that the digital is not a universal key and to a certain extent, it is only healthy if the digital turn will be followed by a relative 'post-digital' reemphasis of analogue techniques (Selwyn, 2003; Thorén & Kitzmann, 2015) that would contextualise different techniques in the context of each other.

In contrast to infrastructures and premises that are emerging, some of the digital sub-structures of doing archaeology are definitely there and their effects are profound but they can be difficult to pin down. Petersson shows in her chapter how diffuse the impact of digitalisation can be to the storytelling in museums. The impact of 'the digital' becoming a new default in society (Huvila, 2012b), an outline and a yardstick of how things are supposed to work, it becomes difficult, if not impossible, to say what is the direct impact of digital technologies, digital ideologies and what are their repercussions that are filtered to specific areas of life and work through their broader social and cultural contexts. As a societal phenomenon, digitalisation can be described as an exogenous shock (Morville, 2014) for archaeological work that comes from outside and forces archaeology to adapt. At the same time, as an infrastructure it can function as a yardstick to compare and critique and point to the inadequacy of long-held views on archaeological practices (cf. parallels in archival studies, Hand, 2008), revealing the contemporary condition of archaeological information work. In this respect one of the most apparent infrastructural peculiarity is the assumption underlying, in practice, all contemporary efforts of managing archaeological information that such information as archaeological documentation would keep same characteristics over time. As the different excursions, albeit brief and few in number, in this volume have shown there is little linearity in how archaeology works with information. There is always a gap between the one who makes information and the one who takes it. Even if they would be the same person, the situation would be different. Similarly to the false expectation of changelessness, also its opposite can be equally dangerous. With the constant increase in the specificity of documentation methods and research questions, there is a real risk to end up in a situation where information becomes unintelligible. The question posed by Löwenborg on how to make infrastructures useful is a crucial one. Both he and Stenborg underline the importance of standards as enablers of interoperability of collections and clean data. However, as Börjesson and Huvila underline, there might be problems in the current assumptions of how and what to standardise for ensuring the longevity of infrastructures and information.

However, in contrast to the rather obvious infrastructural impact of the explicit technical digital sub-structures of archaeological work or the repercussions of the largely implicit digitalisation of societal assumptions and defaults, the most pertinent question of the impact of the changing infrastructures for archaeological information work may lie elsewhere. The question is whether the digital changes deeper infrastructures of the infrastructural landscape that are underlying the conceivable sub-structures and assumptions of how archaeology is done. None of us who have contributed to this volume have made a claim for this kind of a shift. The digital might not, at least not alone, be enough to stop archaeologists to excavate or collect, turn archaeology from a discipline of things to a discipline of data, to turn its primary focus from the past to the future (acknowledging that archaeological methods are being used to investigate contemporary phenomena and to inform future plans of action e.g. Holtorf, 2012), or to solve the age old debate of the appropriate degree of how much archaeology should be concerned of collecting and how much of interpretation (cf. Andrews et al., 2000). The value of considering of such largely hypothetical infrastructural possibilities might not be in the likelihood that they would realise but rather in how it leads to consider the relation of infrastructures, digitalisation and other facets of archaeological information work

Achieving archaeology

In addition to its infrastructural premises, digital technology and the digital are affecting also the conduct of archaeology. As a part of everyday practices of archaeological work, this is apparent in the emergence of new routines of work and the use of new tools. These are obvious throughout this volume. Löwenborg describes the opportunities to use mass data for asking new questions and pursuing for new answers. Dell'Unto and Stenborg point to similar possibilities with different types of three-dimensional representations, and Petersson to how a broad variety of digital technologies can change how the impact of archaeology is realised in a societal context in museum exhibitions. On a more profound level, the digitalisation of information is, as Olsen (2012) proposed, affecting how data and the past are achieved. Digging even deeper, the influence of digitalisation does not stop at the level of the achieving the lieu of archaeology but archaeological work itself including the invisible work with archaeological information. As Olsen notes by referring to the notion of Latour (1993), the “infraphysics” of digital media is different. The digital does not only provide opportunities but makes us to do things differently as the examples discussed in the book from field documentation to museum work show. The new data collection methods in field from 3D acquisition to a more mundane use of databases for recording finds and observations change how information is collected, preserved, mediated and used today, and what are its prospects of longevity in the future. The emerging research on the reuse of archaeological data has pointed both to opportunities and difficulties of achieving the valiant objectives of the open data movement (Faniel et al., 2013; Faniel & Yakel, 2017). As Löwenborg's work shows, there is still a lot of work to be done before the archiving of archaeological information genuinely is capable of facilitating the reuse of data for research and other purposes. There is a need for more empirical research on reuse, documented case studies of both successful and unsuccessful reutilisation of archaeological information, and an in-depth theoretical understanding of what reuse does to information, and how and what implications it has on archaeology – the interpretations of the past. Like in the sciences in general (Bowker, 2005), digitalisation has brought a profound change to the memory practices in archaeology, and even more so, to conceivable practices of how archaeology can remember through a nexus of extreme heterogeneity and standardisation. However as, for instance, Löwenborg's text and, for instance, the progress in semantic processing of archaeological grey literature (e.g. Vlachidis et al., 2010; Vlachidis & Tudhope, 2015) show, the contemporary memory practices, their affordances and constraints as a whole, rather than a specific technology, dictate the premises and realities of archaeological (information) work. It is not information (or data), its methods and infrastructures, or the practices of working with information alone that dictate the outcome but the (soft) system as a whole. Here, a parallel reading of the texts of Löwenborg and Dell'Unto can give a hint of the complexities of combining the best of the both worlds, even if doing that, as Cooper and Green (2015) justly suggest, would be an ideal course of action. Digitality allows individual archaeologists, amateurs and, for instance, actors in the development-led archaeology to act as collectors, a peculiar role that previously had shifted from being a private enterprise of upper class individuals and academics to a public monopoly. However, even if different types of digital information can be put together, copied and distributed unlike any analogue information, its digitality is not a guarantee of its fertility, transparency and the preservation of the traces of its origins, engagement and participation as the multiple constraints pinpointed by Börjesson and Huvila, Stenborg, and Löwenborg suggest. The potential is there as earlier literature has been keen to highlight (e.g. Olsen, 2012; Richardson, 2014) but it is not there to be taken for granted. There are multiple opportunities as, for instance, Olsen (2012) has suggested earlier and

those highlighted by the authors of this volume, but they are not only dependent on how digital technologies are applied in the context of archaeology but as much on how archaeology resists or pushes back (cf. Pickering, 1995) against the digital. Why this might be exceedingly difficult, as Stenborg notes earlier in this volume, are the expectations of efficiency, increased productivity and lower costs so closely attached to the introduction of digital technologies. It is not easy for archaeology to resist the affective assumptions of easiness and efficiency that has become to underpin general assumptions of everyday information work, especially the searching of information online (Huvila, 2016a, 2012b). The focus on gathering data, in (often relational) databases (Fuller & Goffey, 2012; Gugerli, 2012; Huvila, 2012a) and analysing it algorithmically as a part of a new archaeological paradigm (e.g. Kristiansen, 2014a, see also Löwenborg in this volume) turns the past human beings to 'quantified them', past versions of the contemporary quantified self (Neff & Nafus, 2016) that are more meticulously documented, and to a certain extent more present in the data-sphere than through the physical evidence of their existence. Simultaneously as the privileged frame of working with information about the past turns to a digital one, also archaeological work of how archaeology is achieved becomes digital. Even if it might sound contradictory, archaeological work can become digital even if the discipline itself would remain, citing Olsen (2012), that of things.

Topology of archaeological information work

In addition to affecting the premises, infrastructures and practices of achieving archaeology, the digital is affecting the topology of archaeological information work: how its different human and non-human constituents are connected and related to each other. Börjesson and Huvila describe meticulously how the organisations and reorganisations of development-led archaeology has changed the roles and responsibilities of different archaeological actors, and how, to a certain extent, the archaeological landscape is still very much in the making. A large part of the problems of accessing archaeological primary data currently held by myriad actors in Sweden, as the situation is described in the chapter of Löwenborg, can be traced back to the friction between how the existing legacy structures are organised and what type of topology would be useful from the perspective of digital tools and data. Topological aspects are highlighted also in the texts of Petersson and Larsson and of Stenborg. Digital technology is changing the expectations of how a museum space is organised and how archaeologists, visitors and museum professionals are connected to each other. Stenborg describes a similar change on local and global scale. How digitality changes the social and geographical access to artefacts and make them not only accessible but usable in different terms than they have been that before. He is optimistic on the democratic potential of the Internet but emphasises the need to actively act for its continuing openness. In Stenborg's examples, the changing topology is, however, as much social as it is geographical. It marks a general shift from consulting to collaboration (Zimmerman & Branam, 2014), and the premisory (Huvila, 2016a) and practical impact of digital technologies in not only intensifying but also changing the landscape of working together with the stakeholders of archaeological work.

In addition to changing the topology of engaging with archaeology, the digital changes also the prospect of archaeological information. Löwenborg criticises the tendencies to overemphasise the uniqueness of archaeological sites and the reluctance to strive for inclusive and flexible documentation. The changing topology of archaeological information work means also that it will be increasingly difficult to make such claims of distinctiveness. At the same time, in cases when such claims are feasible, they can and have to be made from different premises. A possible alternative to

trying to balance between two essentially irreconcilable needs could be to cater for the contemporary and anticipated future needs as two parallel pursuits. A part of the effort could be directed to serving immediate needs and interest where a part would be focussed on the longevity (as in Börjesson and Huvila) of data and its usability in aggregated analyses (as for Löwenborg). Studies show that digital access to scholarly information has changed scholarly information practices in across the disciplines (e.g. Borgman, 2007; Rowlands & Fieldhouse, 2007a,b) similarly to how it has already changed, and with useful infrastructures to support scholarly work, could change how scholars manage information (Trace & Karadkar, 2017). Easier access to older and geographically remote materials make them easier to cite and use, a tendency, which is apparent also in the chapters of Stenborg and Löwenborg. The changing topology of archaeological information work means also changes in the topology of archaeological information. Information that previously has been remote and difficult to access becomes closer but also vice versa, if closely located information is difficult to access and use for different reasons. Incompatible file formats as Löwenborg has experienced, or copyright issues are merely a couple of examples how the shifting topologies might affect its usability and longevity.

Brave new information

Probably the most contentious question is whether the digital turn would also come with new information. The sheer amount of new archaeological information, or data, highlighted in this volume by Löwenborg warrants the claim that there is indeed new information even if it might not be altogether clear how much of this new information is new and how much of it is actually more of the same. Before, apart from a selection of artefacts that were preserved as such, much of the archaeological information were interpretations whereas at the present, there is an increasing strive towards ensuring the longevity of less processed data. Also, observing in practice in the contexts ranging from archiving and landscape research to museums and fieldwork how knowledge making is indeed political in how it is not only about making propositions and suggestions but ontologies (Nickel, 2015), means that the very activity itself is generative of new knowledge and information. Another way of formulating the question is whether there are new types of information that would be useful for the archaeological discipline. In general, there is no doubt that this would happen or that it would be a specific feature of digital technologies. Since the advent of archaeology, new methods from typological classification to scientific dating and elementary analysis have opened new sources of information for archaeological inquiry and theories have introduced novel perspectives to seeing old things informative in new ways. Different stakeholders of archaeological interesting sites and objects have also had diverging ideas of whether various things can be classified as archaeological information or if they are a part of completely different typological regimes. Indigenous artefacts and human remains tend to have been among the most debated types of things (e.g. Grose, 1996). Even if the status of digital things is not necessarily as contested as that of physical remains or landscapes, asking whether and to what degree, a (digital) photograph or (digital) spatial coordinate are new information when compared to non-digital ones – whether they the digital things belonging to the realm of the digital, or to those of photographs and spatial coordinates.

Huvila (2014) has suggested earlier that much of the paradigmatic development in archaeology could be explained by the availability of new (types of) information. Kristiansen (2014b) dismissed this idea by reminding that paradigms have always been associated with new theory as well. His emphasis of the significance of theory in the formation of new paradigms or intellectual movements within scholarly disciplines is undoubtedly correct but it might be too hasty to discard the role of new

information altogether, especially without thoroughly considering the links between theories, technologies and 'new' information. Even if theory guides inquiry, use of technologies and insights into what is informative and how, technologies do also give access to (new types of) information and (new types of) information informs theory formulation. Theories do not emerge *ex nihilo*. They are based on knowledge and information. The main success of the long-standing but largely somewhat sporadic debate of the possible theoretical underpinnings of digital archaeology (e.g. Zubrow, 2006; Wooldridge, 2013; Huggett, 2015b), including virtual (Forte & Beltrami, 2000) and cyber archaeologies (Forte, 2010), has probably been to show that the existence and use of a certain constellation of technologies alone is a problematic basis for theory formulation. In contrast to the technical possibilities of new tools, there has been considerably less discussion on what (information) and how (roughly, theory) they contribute to the making of new archaeological knowledge.

Even if some scepticism of whether the digital turn comes with new information is warranted, this volume has suggested that at least in some cases and to a certain degree, this may be the case. Löwenborg describes how the meagre results of small excavations can contribute new knowledge about the human past when they are pooled together. Also, Dell'Unto makes a strong case for that three-dimensional modelling leads to new information and new insights about the past. They both could represent something geographer Pickles (2003) has described as new cartographies in the context of archaeology, new "mappings-in-depth" (Pickles, 2003, 21) of topics of particular archaeological interest. However, the danger of making inflated claims of the power of new methods, approaches and technologies to yield new information is present even with the digital methods in archaeology. Even if some of the data has been there even before half-hidden as inscribed in paper documentation, the possibility to digitise it and to complement it with an increasing repertoire of digitally captured numeric and visual data takes archaeologists closer to a situation when it is possible to go back in the information process and try to reanalyse data and consider the plausibility of alternative conclusions. Earlier, this was possible almost only with finds that were the only part of surveyed and excavated sites preserved as such. The claims that this new information allows archaeologists to redo excavations should be dismissed as wishful thinking but re-examining them as Dell'Unto (in this volume) and other researchers (e.g. Powlesland, 2016) have suggested becomes certainly possible to an extent that was impossible before.

A relevant, simultaneously apparent and difficult, question posed by the critics of mainstream digital archaeology (Morgan, 2012) and the use of digital methods in humanities (e.g. Allington et al., 2016; Kirsch, 2014) in general, is whether these possibilities have actually helped researchers and others to create substantial new knowledge. In a sense, the algorithmic methods hold a promise of turning earlier 'noise' (Parmiggiani et al., 2016) into meaningful information. Even if the documentation was there, the information is new. From this perspective, the informing potential of this type of mass data is classable, using the term of Orlikowski and Scott (2015), as an algorithmic phenomenon that would not exist without digital technologies and imagination. Here goes undoubtedly the fine line between when it is appropriate to talk about new information and when the shift pertains to the choice of how the discipline prefers to inform and get informed. Instead of remaining as a question of new and old information, the latter turns back to the question of how a discipline is achieved and whether either 'information' (cf. Srinivasan et al., 2017; Kay, 1995), or lately, even more so, 'data' is becoming the new determinant of how archaeology is accomplished (Meyer & Schroeder, 2015; Borgman, 2015; Kristiansen, 2014a).

A parallel question to the emergence of new information for archaeological inquiry is whether digital turn comes with new information that can be informative for other stakeholders of the archaeological

enterprise. As Stenborg emphasises, the argument that the significance and meaning of information in general and specific objects differs on social and cultural background of their spectators is strong and this social life of information (Brown & Duguid, 2000) have direct consequences also on the novelty of archaeological information (Boast & Biehl, 2011). In this respect, much of archaeological information is somehow new or, at least, it has potential to provide new insights if it is properly contextualised and communicated in a form that makes it accessible.

The same applies to information that is not there. Löwenborg notes that the information about the lack of information, archaeological emptiness of a particular area is probably the most important piece of information for a land developer but useful also for archaeological research even if, from the archaeological perspective, the current lack of remains does not necessarily equate with emptiness in the past. Similarly to Löwenborg, also Petersson and Stenborg both demonstrate, how digital technologies can help to connect individuals with information that is new for them, something they have not been able to experience before because of the lack of possibilities to connect with it due to geographical, temporal or cognitive distance. The examples show that even if the longevity of archaeological information is one of the most crucial questions in archiving and preserving archaeological information, it is also pertinent to other types of distances whether they are spatial, social or individual. Leaning back to how Huvila portrays archaeological information work earlier in this volume, it could be argued that because of the perpetual making and taking, there is something new in all archaeological information all the time. The novelty of information is not only characteristic to digitalisation but to the very act of working with archaeological information. The digital turn comes with an impact but it is only one of the many and the real challenge is to understand what and how much of the change depends on digitalisation and what are the things that should be attributed to everything else.

Explaining the turn

After claiming that the premises and infrastructures of archaeological information work, the process of how archaeology is achieved, the topology of archaeological information practices, and finally, that what is considered to be archaeological information, and what things are informative of and for archaeology have changed, an obvious question remains, of whether and how these different shifts and oscillations are related or unrelated. This excursion to the intertwingularity of archaeological practices and information work have shown that even if it might not be wrong to refer to a paradigm shift, there are nuances in the influence of digitality. It has idiosyncracies of a paradigm but it has also characteristics of a social intellectual movement, a collective effort “to pursue research programs or projects for thought in the face of resistance from others in the scientific or intellectual community” (Frickel & Gross, 2005, 207). Rather than being abrupt, in archaeological knowledge-making the digital turn seems contentious, political and conditioned by a particular constellation of material and conceptual resources, tools and collective action (cf. Sheble, 2014). Our proposal is that in the context of archaeological information work, digitality itself does not have a direct impact on the making of the grand and less-prominent narratives of archaeology on the understanding of social organisation or the landscapes of the past or such issues as memory, time, gender, or identity. The digital itself does not make archaeological information work to become something else. Its impact comes from how it affects the premises and infrastructures of archaeological information work, its impact on how archaeology is achieved, how it influences the topology of archaeological information work, and through its repercussions on what is considered to be archaeological information. This does not imply that digital technologies would be neutral or without a certain agency of their own. They do have an

impact on what archaeology is and what it becomes. They do indirectly privilege particular research questions, alleviate old and create new inequalities, oppress opinions and perspectives by their presence and absence, and the presence and absence of opportunities and competences for engaging with digital technologies and digital information. An important next step after the discussion in this volume is to engage with the theory of the digital in and for archaeology.

One possible approach to explaining how digital technologies are changing archaeological work, is to turn to the concept of *lieux de savoir* (Jacob, 2014). Jacob describes it as a spatial and mobile place where knowing happens. Instead of claiming that the major impact of digital technologies would be on the knowing itself, we are inclined to suggest that much of the most prominent changes discussed in this volume and also in the earlier literature can be plausibly explained by a change of where archaeological information work takes place and where knowing about archaeology takes place. Similarly to how Berggren and Hodder (2003) have suggested as one of the foundational principles of reflexive archaeology that interpretation should take place at the trowel's edge and Dell'Unto writes how the 3D technologies have potential to become a new trowel with a new edge, also other stakeholders of archaeological information have their trowels that are changing, and that are changing the *lieux* of the ecology of information work. Even in Löwenborg's discussion of the possibilities of applying machine learning in the context of archaeology and earlier examples in the literature (e.g. van der Maaten et al., 2007), for instance, on automatic classification and retrieval of artefacts, the major change is not how knowing happens but that it happens in a digital, social and material *lieu de savoir*. The same observation applies to Dell'Unto's use of digital tools for explicating excavation contexts. The primary change might not be in that knowing changes per se but that the locus of that activity changes form. Stenborg shows further that the *lieux de savoir* not only change within a particular context of archaeological work but also widen to comprise additional perspectives and groups of people.

A part of the usefulness of the notion of *lieux de savoir* is in its spatiality that allows bringing together human and non-human things in overlapping, partly connected and disconnected constellations. The second aspect equally pertinent aspect is their temporality. They can be (nearly) permanent, durable or fleeting. Even if Jacob seems to have been sparse in making direct references to ecological thinking, they are ecological in similar sense than information work is. Pearson and Shanks (2001) remind that digital media are socio-technical (and socio-material) networks that make archaeology for us and, further, as Olsen (2012) continues, digital heritage (and archaeology) consists of events underway. Similarly, the digital itself is fleeting and instead of talking about one digital turn, the digital turns constantly making and remaking (digital) archaeological information work on and on again.

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