Art, creativity and automation: from charters to shared 3D visualization practices

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Editorial

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Art, Creativity and Automation. From Charters to Shared 3D Visualization Practices

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Abstract: In this study, we introduce the themes of the Special Issue on *Art, Creativity and Automation. Sharing 3D Visualization Practices in Archaeology*, and present the most important outcomes of a roundtable session involving prominent researchers in the field, organized by the authors during the Archon Winter School in February 2020. By assessing the diversity of research aims, artistic projects, creative practices and technology used in the contributions to the Special Issue, and drawing on the thoughts and perspectives generated during the roundtable discussion, we seek to identify shared challenges within the community of visualizers which could ultimately pave the way to shared practices. In this light, we assess whether established charters and guidelines are still relevant in a now matured digital archaeology, where visualization techniques have attained a central position in archaeological knowledge production. Although parts of the guidelines have become common practice, the remainder did not keep up with the fast pace of development of digital practice and its current fundamental role in archaeology, and as a result some of the guidelines risk becoming obstructive in archaeological creative practice.

Keywords: London Charter, Seville Charter, guidelines, community of practice, knowledge transfer

1 Introduction

What do a forensic archaeologist, a pottery specialist, and an archaeological 3D visualizer have in common besides being archaeologists with different areas of expertise? When the archaeological 3D visualizer was looking for people with similar interests in 3D visualization to co-organize a "winter-school", with the aim to unite practitioners in archaeological 3D visualization in the Netherlands, she quite expected self-described "digital archaeologists" to answer the call. Surprisingly, it was a mix of specialists using 3D technology in their research who responded. These researchers do not *define* their work in terms of "digital" or "virtual" archaeology but rather consider themselves archaeological specialists who routinely apply digital visualization techniques in their research. While their research foci differ greatly, they have in common a shared practice of visualizing archaeological data in 3D. Precisely this distinction has forged the core of this Special Issue on *Art, Creativity and Automation. Sharing 3D Visualization Practices in*

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Archaeology: the admission that archaeology has matured from doing digital archaeology to doing archaeology digitally (Costopoulos, 2016; Morgan & Eve, 2012; Perry & Taylor, 2018).

Several of the contributions gathered in this special issue were presented at the three-day Archon Winter School "Sharing Practices: Archaeological 3D Visualisation in the Netherlands" (20–22 February 2020), organized by the editors of this special issue in collaboration with Archon (the Dutch National Research School of Archaeology), the University of Amsterdam, Leiden University, and the Dutch Cultural Heritage Agency (RCE) (http://www.3dvisualisationpractices.nl/). The conference aimed to bring together 3D visualization practitioners in academic and commercial archaeology and to lay the foundations for a community of practice of visualizing archaeologists. Besides workshops with hands-on topics, commercial showcases and a symposium dedicated to current projects and research deploying 3D visualization technology, theoretical development was dealt with in a roundtable discussion. This discussion revolved around issues such as the current relevance of the London Charter and the Seville Principles, the black-boxing of technology and techniques, and creative practice. Together with the varied contributions to the symposium, the roundtable discussion paved the way to the present special issue, further strengthening the community of archaeologists from across the world who use 3D visualization technology in their daily practice.

This introduction to the Special Issue presents some of the outcomes of this roundtable discussion, particularly the ones related to the charters, which are subsequently compared with the shared themes we identified in the contributions to the Special Issue. These shared themes are then assessed to determine the position of the community of practice of archaeological visualizers in archaeology.

2 Turning Guidelines into Shared Practices

In the experience of the authors, previous guidelines provided by, for example, the London Charter, despite its intentions, turned out to be restrictive to creative thinking and reconstructive practice. The lack of a concrete, standardized best practice to implement into archaeological visualization, is one of the reasons that the charters were not widely adopted. The current desire is to find new or adapt the existing guidelines and a set of shared visualization practices that support the creative process and, ultimately, bolster innovation. We, as artistic archaeologists, believe that this is possible, even with a degree of standardization. The London Charter and Seville Principles did not address the role of the creative process, perhaps due to a technocentric approach to visualizations and less attention to the practice of creating them. Therefore, the roundtable discussion held at the Winter School and the resulting special issue is designed to evaluate several attempts to draft unifying norms and guidelines of the charters.

A quick survey on the guidelines of the London Charter and Seville Charters was carried out among the participants of the roundtable to establish which guidelines were still considered relevant.[1] For the London Charter, these were Sustainability, Access and Implementation, and for the Seville Principles Purpose, Scientific Transparency and Training and Assessment (Figure 1). Most discussants agreed that the guidelines are now too generic considering the increasingly complex digital practice. Few discussants still identify with the charters, whereas the technology essentially did not change much. Over the past two decades, visualization techniques assumed a central position in archaeological knowledge production. Yet, the available guidelines did not develop in tandem with this by now fundamental role of digital practice. To date, there is a lack of guidelines describing how bodies of information are constructed, how technology should be used to record and process data, or which paradata should be collected.[2]

1 The guidelines and principles of the London Charter and Seville Principles can be found here: https://www.londoncharter.org/ (last accessed 2 November 2021) and http://sevilleprinciples.com/ (last accessed 2 November 2021).

2 Indeed, over the years several initiatives successfully or less fortuitously launched recording kits and software to document, manage and share research data and sometimes workflows, however, these are not truly guidelines nor meant to reflect on practices. Examples are the Standardization Survival Kit (SSK, n.d., part of PARTHENOS); the Archaeological Recording Kit

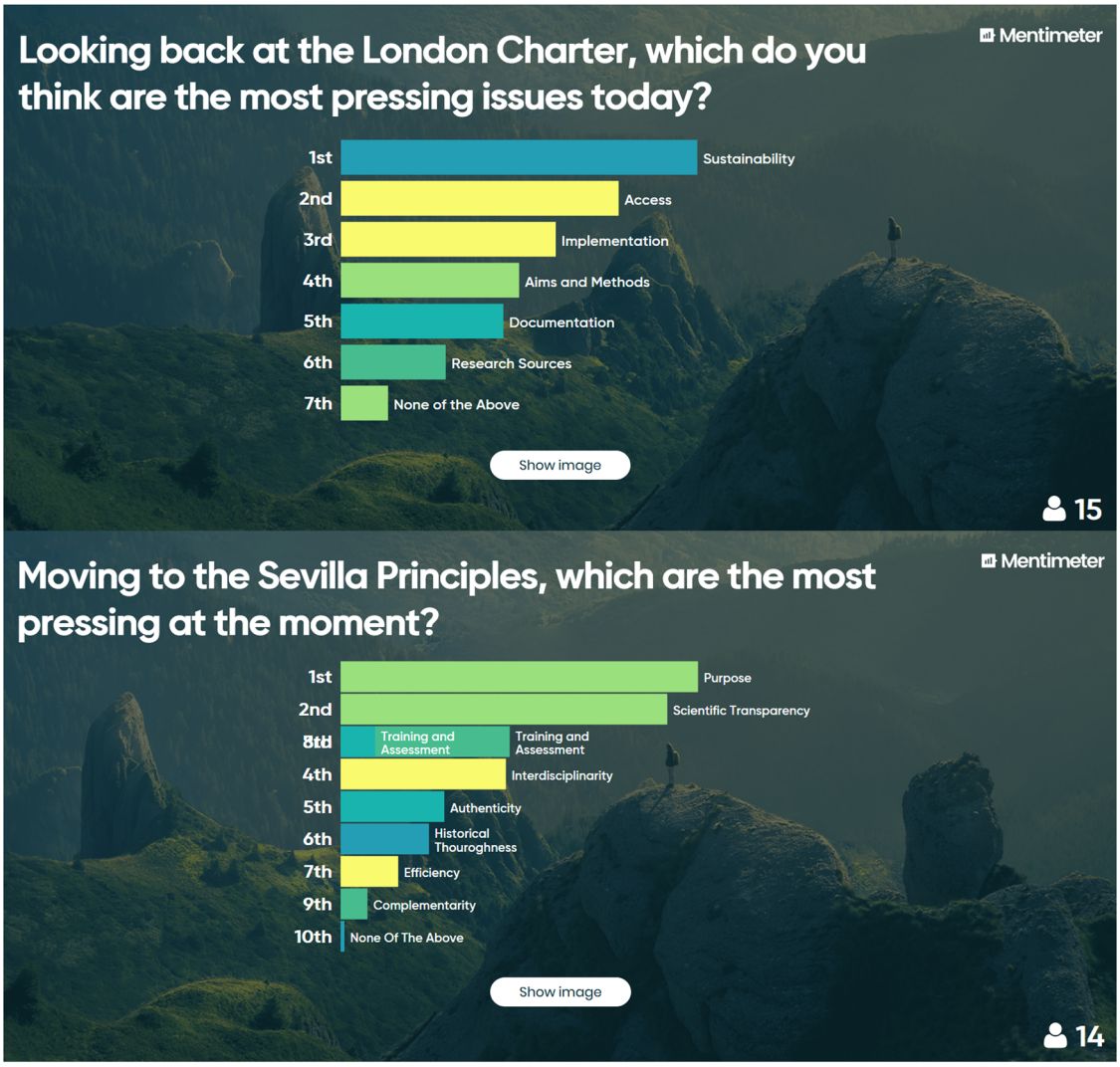

Figure 1: Outcomes of the survey among the roundtable participants. Image produced with Mentimeter by M. Revello Lami.

A subsequent open survey during the roundtable explored which topics were considered to be absent in the charters, but thought to be relevant today. This survey was visualized in a word cloud, which revealed that *Machine Learning*, *Data Sharing*, *Creativity*, *Peer-reviewed Publication* and *Teaching* were important shared themes (Figure 2). These outcomes seem particularly interesting in the light of the contributions gathered in this special issue, which all revolve around two broad themes: the related fields of pedagogy (education and outreach), knowledge production and archaeological reasoning with 3D tools on the one hand, and archaeological (creative) practice on the other. Emphasis within these themes is placed on transparency of both data and the visualization process, and how to display this kind of visual research in a democratic manner. Almost all contributions take a reflexive approach towards their practice, either explicitly or by critically assessing their tools, process, and outreach activities.

Around the turn of the millennium, 3D technology and computing power became more widely available and affordable to archaeologists at an exponential rate, and, more importantly, archaeologists could now operate the tools themselves (see Opgenhaffen in this special issue). This often uncritical and uncontrolled

(ARK, https://ark.lparchaeology.com/about/, last accessed 2 November 2021); and, specifically for virtual reconstruction, the Extended Matrix (EM, http://osiris.itabc.cnr.it/extendedmatrix/, last accessed 2 November 2021).

Figure 2: Wordcloud generated by the input of the roundtable participants. Image produced with Mentimeter by M. Revello Lami.

adoption of digital visualization tools in archaeological practice, but also in commercially driven 3D visualizations of heritage, became a growing concern of several scholars with longstanding expertise in this area. This concern is exemplified by the increasing number of research papers promoting the application of 3D (modelling) technology as a genuine research tool and with increased attention towards the impact of the new technology on methodology and knowledge creation (Barceló, Forte, & Sanders, 2000; Barceló, Frischer, Niccolucci, & Ryan, 2002; Forte, 2003, 2008; Frischer & Dakouri-Hild, 2008; Goodrick & Gillings, 2000; Hermon & Nikodem, 2007; Hermon, 2008; Huggett, 2004; Miller & Richards, 1995; Ryan, 1996, 2001). The need to "ensure methodological rigour in these still largely uncurbed computer-based visualizations was soon recognized, leading to the formulation of the first guidelines during a symposium at The British Academy in London in 2006 (London Charter, 2009). The London Charter was born and other specialized charters soon followed. Their appearance made a true difference in digital visualization methodology, as they created a critical awareness among the archaeological and heritage community about issues such as data transparency sustainability, topics of utmost relevance in current digital practice.

Exactly 15 years after the first release of the London Charter (Baker, 2012; Beacham, 2008; Beacham, Denard, & Niccolucci, 2006; Denard, 2012, 2013), time has come for archaeologists and heritage specialists to take stock and collectively reflect on the implications of the parameters as formulated by this and other charters. Specific attention is needed for the wider debate on which characteristics an archaeology performed within a digital society and as creative, visual practice, should feature. The ways in which visualization technology has impacted and enhanced knowledge production, and continues to transform our professional environments, should be reassessed in relation to the charters, which have not been updated in at least 10 years. Are the guidelines fostered by these agreements still valid and applicable today, when 3D visualization has become a familiar, perhaps standard analytical instrument in the archaeological toolkit? This is not the place to offer an extensive overview of the current state of the art of digital archaeological practice (see instead the thorough accounts in Averett, Gordon, & Counts, 2016; Daley & Evans, 2006; also Beale & Reilly, 2017; Tanasi, 2020; and for SfM, for example, Waagen, 2019), rather the analysis of the contributions gathered in this issue and the reflections that emerged during the roundtable may provide a head start to answer this complex question. The case studies presented here reveal that much attention has been dedicated to carefully recording visualization workflows, and that technical metadata and intellectual paradata – or technical and intellectual transparency and the documentation of the

reconstruction process – are implicitly and explicitly considered important aspects of the presentation of research outcomes. The charters, however, are rarely mentioned in these studies as the driving force behind such choices. Can we deduce from this trend that the guidelines of the charters have successfully become adopted into archaeological practice, to such an extent that they are no longer necessary? Unlike the initial success of the charters, admirable new initiatives such as the SSK, where existing workflows (or "scenarios") can be consulted and new ones deposited, seem unable to reach the visualization community, whereas we see in the contributions a clear need to present the used workflows. The fading authority of older and more recent attempts to standardize approaches towards scientific integrity and data transparency, may imply that intellectual transparency has become (and always has been) inherent to academic practice in general, thus not exclusively reserved to a digital practice. Lastly, an important tenet brought forward by the Seville Principles, revolves around the need to safeguard the authenticity of *original* artefacts (understood as "real anastylosis", Seville Principles, n.d.), while it does not touch upon the authenticity of the digital 3D artefact, implicitly devaluing the digital object as a meaning-making instrument (Jeffrey, 2015). The many ramifications of such a pressing matter are fortunately addressed by Minete Cardozo and Papadopoulos in this special issue, who successfully show based on the 3D models of two iconic artefacts currently displayed online, that models may also manifest aspects of aura and authenticity "intrinsically related to the physicality and materiality" of the original artefacts (Minete Cardozo & Papadopoulos, 2021, p. 519). Another recurring, recent theme that is not explicitly addressed in the charters, is how processes of documentation of research and its visualizations contribute to knowledge production and how this is transferred to the wider community and beyond. The next section summarizes how the authors of this special issue have applied 3D visualization to produce and transfer archaeological knowledge.

3 Communities of Practice: From Collecting Items to Transferring Knowledge

The habit of collecting seems to be almost universal, an innate instinct to most children and a trait shared by any community showing "an interest in preserving cultural memory, in understanding the world around us or, at the very least, in placating curiosity for exotica" (Ellis, 2006, p. 454). Collections are the material embodiment of humanity's knowledge across places and time and provide essential nourishment for museums, research institutes, libraries, schools, universities, and any organization dedicated to the creation, dissemination, and preservation of knowledge. Being able to identify, classify, and interpret, the items collected are a fundamental part of the work of heritage professionals and scholars alike to supervise the growth and evolution of an assemblage of objects, formulate new content for exhibitions or research projects, make connections among those objects and people by telling their stories to the public, with the ultimate goal of creating and transferring new knowledge.

The act of producing meticulous descriptions of artefacts, illustrating, and classifying them lies at the core of much archaeological practice. At the moment of discovery, an artefact is subjected to the visual and tactile examination that usually results in a preliminary morphological classification. As the artefacts then move to collections, they become part of more complex taxonomic systems that enhance and expand the process of visual comparison to discern similar from dissimilar features. In this sense archaeology is an intrinsically visual discipline (see Opgenhaffen in the present volume) and has relied on cutting edge technologies and visualization methods to facilitate the documentation of collected artefacts since its inception. Not surprisingly 3D technology has rapidly become a staple of modern archaeological documentation, not only for its inherent ability to reproduce an object in all its dimensions and greater detail, but more importantly because it allows one to virtually reach, analyse, and also restore that object regardless of its actual location. Unlike in the past when physical collections needed to be reached and investigated in person to visually compare different artefacts, digital 3D repositories enable the transfer of both the material data and knowledge to any interested party, be they archaeologists, their apprentices or students, local

stakeholders, marginalized groups and lay audiences.[3] Accessible, replicable, sharable, and implementable 3D collections provide essential aid to cross traditional boundaries in research as well as among specialists and non-specialists, to actively engage students and teachers, museum curators and visitors, easing the often daunting pedagogical task of communicating knowledge at different levels.

Several contributions gathered in this volume revolve around the added value of implementing 3D visualization systems in the documentation, classification, and analysis of archaeological collections and their potential to enhance the learning experience in higher educational systems (Derudas & Berggren, 2021; Ekengren et al., 2021; Nobles & Roosevelt, 2021; Scott et al., 2021). All authors demonstrate how a firmer embedding of such systems in our teaching activities and exchange of innovative ideas and experiences can pave the way to a more immersive, interactive, and inclusive archaeological training, testifying also to the importance of developing a wider community of practice in this domain.

One of the greatest strengths of the communities of practice framework as defined by Wenger (1998) is that it is not bound to a specific specialism or sub-discipline, but instead unites these by a given practice. This framework provides the perfect opportunity to move forward from previous attempts to standardize visualization methods and the tendency to equate the tools with the discipline. Despite the "digital turn" in the wider humanities, some archaeological fields still consider the use of digital approaches to be a distinct specialism (Nobles, Çakirlar, & Svetachov, 2019, p. 5714). Visualizing archaeologists stand to benefit from a more critical approach towards the adoption and deployment of new technology into existing research strategies. Overall, the contributions to this special issue demonstrate a reflexive approach towards visualization practices and the tools involved in archaeological research and outreach.

Ideally, when new techniques and tools are introduced into an existing visualization practice, and deployed *beyond* mere automation of this practice, the technology could truly disrupt a tradition and produce new knowledge (Huggett, Reilly, & Lock, 2018; Reilly, 2015). Three-dimensional technology requires new types of actions and adaptation of the current operational sequence of archaeological visualization. Over time, digital technologies have added layers of complexity to the archaeological process in the lab, in the field, and in the presentation of the findings to the general public (Olsen, Shanks, Webmoor, & Witmore, 2012). These technical acts are not performed in isolation but within the context of a community of specialists sharing a practice. This context, in turn, is affected by the introduction of new digital methods, as Nobles and co-authors' and Scott and co-authors' demonstrate in their contributions to this volume, which highlight a shift in relations in the field and the connection to the lab, and the disruption of familiar field practice due to the intervention of the SfM procedure. Increased dependence on (field) technicians, IT specialists, drone pilots and digital illustrators, and equipment such as computers, servers, drones, 3D scanners, and related software, accompanies these changes in traditional visualization routines.

The transfer of new knowledge acquired through the introduction of 3D visualization in teaching is apparent in the increasing number of curricula featuring a focus on digital tools and applications, as Ekengren and co-authors and Derudas & Berggren rightly point out in their studies. Technical knowledge, such as how to operate SfM software Agisoft Metashape or 3D modelling software Blender, was initially transferred through meticulously watching, following, and imitating the acts of real tutors or online tutorials. These somewhat "DIY" learning approaches developed by early adopters have now evolved into established procedures which have become embedded in pedagogic programmes aiming to transfer technical knowledge and practices to a fully digital generation. Scott and colleagues show that younger generations of students are often more able to absorb new techniques than senior staff members, and as a result move more easily from the digital lab to the field and vice versa. Learning, in this respect, should not be a unilinear transfer of knowledge and skills; both digital pioneers and experienced archaeologists stand to learn from their digitally versed apprentices. The embodied digital visualization routines of both practitioners and apprentices shape a dedicated community of practice that provides a sense of belonging and identity (Wenger, 1998).

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3 For recent overviews and assessments of 3D repositories and 3D publication systems, see Champion & Rahaman, 2020; Derudas, forthcoming; Scopigno, Callieri, Dellepiane, Ponchio, & Potenziani, 2017; Statham, 2019.

4 Visual Communication and Dissemination of Archaeology and Heritage

Visualization is not only a valuable research tool to guide and organize archaeological analysis and interpretation, it can simultaneously function as a means of communication to both specialists and the public at large. This dual role of digital visualization techniques is convincingly demonstrated in the contributions of Grau González-Queved and co-authors, and Huurdeman and Piccoli. On the one hand, Grau González-Queved and colleagues successfully apply SfM technology not only to document and digitally preserve Caribbean rock-art and excavations, but also to virtually reunite fragments kept in museums overseas with their local siblings: remarkably such digital intervention allowed them to identify new inscriptions. The resulting virtual tours that walk visitors through the adorned caves enabled the local community as well as foreign stakeholders to get acquainted with this important pre-colonial native heritage.

On the other hand, by virtually reconstructing a seventeenth-century Amsterdam canal house in 3D, Huurdeman and Piccoli have developed a unique system to virtually explore and interrogate the visible and invisible data used to reconstruct this building. This promising, interactive system allows both specialized and lay users to acquire new insights about the interior of a particular canal house, but also to query the material, technical metadata, and intellectual paradata exploited thus to engage actively in the discussion. This work shows that creating a virtual environment demands a substantial amount of academic research, revealing the duality that visualizers – as scholar and technician/operator/visualizer – and 3D visualizations embody.

Virtual solutions mainly targeted at public outreach for key heritage sites in Italy and China, can be found respectively in the contributions by Bertoldi and Wei Ren. An interesting push forward to true democratization of data from research to heritage comes from the projects by Huurdeman & Piccoli as well as Wei Ren, who carried out extensive research on the actual experiences of users, rather than producing a unilateral presentation of data to a lay audience. In this sense, the ever-growing application of digital technologies developed by the University of Siena in the archaeological park of Poggibonsi (Bertoldi, 2021) shows the fundamental role of digital systems and archives presented by scholars and experienced by non-specialists in safeguarding and virtually preserving sites and monuments through these archives. Perhaps the most striking outcome of the ongoing project in Poggibonsi is that it clearly shows us how digital technology and its visual output stand a much better chance to survive when they are used. And for an archive to be actively used it needs to be findable, maintained, customized, and updated to current visual standards. Without such practice, digital artefacts will wither faster into virtual oblivion than their material siblings. An example of an almost lost but fortunately rediscovered 3D model of a cultural heritage artefact from the 1980s is perceptibly described by Dawson and Reilly (2019). The technology in which it was once designed had become obsolete and soon became "buried within layers of unsupported code" (Dawson & Reilly, 2019). An active and clearly structured data system used by peers and lay persons would have demanded continued access and update of 3D formats, and prevented its presumed loss.

This volume demonstrates that the community of visualizers is aware of and concerned about issues concerning data archiving, data sustainability and accessibility, to safeguard scientific transparency by elaborating on existing guidelines for the documentation of the course of the creative process. Limitations of budgets, facilities, and the duration of projects, however, often prevent visualizers from meeting all of these important requirements. Fortunately, the system of the Dutch Virtual Interiors-project, the Chinese OVRWCHT and the Italian/Danish C.A.P.I., and Swedish Dynamic Collection systems, initiatives such as PURE3D[4] and European,[5] and the increasingly available storage space for archiving digital 3D data, provide ways for 3D visualizers to preserve and publish their outputs and datasets.

4 https://dans.knaw.nl/en/current/news/pure3d-an-infrastructure-for-the-publication-and-preservation-of-3d-scholarship (last accessed 26 April 2021).

5 https://www.europeana.eu/nl (last accessed 26 April 2021).

Although most of the 3D applications presented in this special issue were in the development stage for a longer period of time, some, in particular, experienced an unforeseen boost by the COVID-19 pandemic – such as the work of Ekengren and co-authors, Bertoldi and Wei Ren. 3D visualization technology proves to be an indispensable tool and, moreover, a solution in times when physical access to heritage and education is restricted.

5 Automating Creative Practice?

As the title suggests, an important aim of this special issue was to emphasize the relationship between the artistic skills and archaeological creative practice necessary to reconstruct the past, and the search for methods to automate archaeological data visualization. Based on the contributions to the volume and the reflections emerged during the roundtable discussion, we found that visualizers prefer, despite the current potential for automation, a human role in the creative process. Practices may be performed digitally and in 3D entirely, and the introduction of these new technologies undeniably has added complexity to our interpretations; however, they do not automate our visualization practice in the sense of the assembly line. The authors in this volume use digital visualization methods to assess past human behaviours. Gillikin Schoueri and Teixeira Bastos, for example, analyse the use, experience, and perception of a Roman lararium by thoroughly re-creating the spatial organization and lighting conditions, an exercise carried out fully manually, albeit digitally. Similarly, yet from a completely different disciplinary perspective, Mickleburgh and co-authors have developed a new 3D protocol to visualize taphonomic processes based on visual legacy data of human remains, to study and ultimately reconstruct the (burial) rituals performed by the living communities. The question as to whether such human behaviours can be automatically generated by a machine looms on the horizon: machines might be artificially intelligent, but are currently unable to process, or "understand", paradata and intellectual processes and experiences. Despite this, Nobles and Roosevelt introduce a completely new protocol in volumetric recording and analysis, which revolves around an entirely automatic pipeline, and represents a completely new practice of visualizing archaeological contexts and features volumetrically that has the potential to truly change archaeological analytical and interpretative processes, having ultimately a greater impact on the production of new knowledge.

By taking an historical approach towards visualization practices, Opgenhaffen illustrates the strong tradition that archaeological visualization carries in adopting and adapting new technology and in borrowing artistic methods and techniques. By assessing the mechanisms behind such a rich tradition, the author concludes that current digital visualization practice does not break with past (and still active) analogue methods, but builds upon familiar representational protocols instead; in archaeological visualization the "tradition is in transition", and has not yet been fully changed by digital technology. More importantly, Opgenhaffen's contribution highlights how firmly archaeological visualization practice is rooted in art, and still moves on a tangent plane with artistic practice (for a more detailed discussion, see, for example, Bailey, 2017; Beale & Reilly, 2017; Cochrane & Russell, 2007; Gant & Reilly, 2018; Renfrew, 2003; Russell, 2011). Similarly, in the contribution by Dawson and Reilly, the authors foster the emergence of a radically new creative and phygital practice in our discipline. They manage to strike a fine balance between art and archaeology, mediated by a phygital approach through the affordances of digital technology, facilitated and yet restricted by bubbles that enfold artefact, digital replica, new and old contexts, and completely re-combined and repurposed visual artefacts based on all of the aforementioned. Within this framework, archaeology is a creative practice (see also Beale & Reilly, 2017), which does not need to be understood in the artistic sense alone, but also in the practice of re-creating or re-constructing a fragmented past.

6 Concluding Remarks

Visualizations are able to mediate the "dynamics between presence and absence" (Svabo & Shanks, 2013, p. 425). Three-dimensional technology enables us to simultaneously visualize material absence as well as archaeological material remains, and allows abstract knowledge to be both virtually present and presented. As a discipline with a strong visualizing tradition, archaeology (academic and commercial) has over the years expeditiously adopted a range of 3D technologies to enhance research methods, publication, and valorization. This has resulted in a dazzling array of methods, strategies, and protocols being used within the field. Amid this diversity of digital archaeologies, a common ground in the use of 3D technology to visualize historical processes and to build explanatory models, or its mobilization for public engagement, is yet to be identified. Rather than allowing 3D techniques and methods to define the field of 3D visualization in archaeology, the development of shared practices and establishing a community of practice for visualizing archaeological data could define archaeological visualization and its position within the discipline itself. Therefore, with the Special Issue on "Art, Creativity and Automation. Sharing 3D Visualization Practices in Archaeology" we aim to bring together current practices from a wide range of specialisms for visualizing archaeological heritage. In this community of practice 3D visualization is not an end in itself but is solidly embedded within the research process, from design to data acquisition, analysis, and interpretation. And although keeping pace with the rapid development and adoption of methods and techniques is an admirable undertaking, the ambition that most authors of the special issue seem to share, is instead to move closer to a research-driven, reflexive methodology that combines digital technology with creative thinking.

Returning to the beginning of this paper and our call for a reassessment of the London Charter and the Sevilla principles, it appears that most of the issues deemed so important in the early 2000s, when 3D technology was in its applicative infancy in archaeology and heritage, have matured and become commonplace in archaeological visualization practice. As a result, archaeological visualizers today tend to identify only to a certain extent with the guidelines drawn up in the charters. They are often considered too broad, which makes it hard to successfully embed them into specific projects. Moreover, attempts to standardize practices may even risk restraining the creative process. This is not to say that the charters did not fulfill at least partially their original purpose, on the contrary: as this special issue demonstrates many of the matters raised at the time are now overcome, they became commonplace or have been solidly embedded in innovative research programmes. Documents such as the London Charter and the Sevilla Principles have contributed to creating a critical awareness among practitioners regarding their practice, and added more systematically digital visualization techniques into the archaeological toolkit. Most importantly, those initiatives gave fundamental input to the formation of a community of professionals sharing the same challenges.

Likewise, the Winter School and the resulting proceedings have provided an important platform for discussion within that very same community, and new, pressing issues have moved to the centre stage. The relationship between 3D visualization practices and knowledge transfer has come to the fore as one of the most delicate, yet promising areas in need of attention: archaeology is by its very nature visual and so are its datasets. To guarantee accessibility, manageability, shareability, and implementability which are essential components to everlasting archives, archaeologists and heritage professionals need to transcend their comfort zone and cross boundaries not only between specialisms, but also between the different actors involved in the process of learning, be they students and teachers, apprentices and experienced professionals, museum visitors, and curators. In this sense, 3D visualization has proved to be a key factor to enhance inclusivity, thus providing equal access to learning opportunities and resources remains central to the development of a sustainable form of knowledge exchange.

Closely related to a more sustainable notion of science dissemination is transparency: guaranteeing openness and accountability when modelling an heritage object calls again for an interdisciplinary effort to build a common language, share datasets, and more generally make visible not only the final outcome but also the journey leading to it.

Finally, increasing attention is currently given to strike a balance between automated documentation procedures and the artistic skills necessary to complete a reconstruction of any heritage object. The process of visualizing artefacts, buildings, cities, and ancient landscapes can be automated almost entirely and in so doing archaeologists and heritage professionals have been at the forefront and also contributed to the development of 3D technology itself. As much as the perspective of reaching full automation in the process of documenting, interpreting, and visualizing archaeology could have sounded appealing not long ago, the current and certainly future approaches to 3D visualization will keep a strong focus on the mediation between art and automation, where archaeology remains an inherently creative shared practice.

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