

Chapter 6

A New Introduction to The London Charter

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Introduction

The London Charter for the Computer-based Visualisation of Cultural Heritage was conceived, in 2006, as a means of ensuring the methodological rigour of computer-based visualization as a means of researching and communicating cultural heritage. Also sought was a means of achieving widespread recognition for this method.

In 2006, Beacham, Denard and Niccolucci published a concise account of the origins and rationale of The London Charter, concentrating on the issue of ‘intellectual transparency’.¹ The lack of transparency had been identified, along with the epistemological problems posed by hyperrealism, as a burning issue by scholars from the mid 1990s.² An early introduction, subsequently reproduced on

1 Richard Beacham, Hugh Denard and Franco Niccolucci, ‘An Introduction to The London Charter’, in Marinós Ioannides et al. (eds), *The e-volution of Information Communication and Technology in Cultural Heritage*, Proceedings of VAST 2006 (Budapest, 2006), pp. 263–9.

2 Nick Ryan, ‘Computer-based Visualization of the Past: Technical “Realism” and Historical Credibility’, in Peter Main, Tony Higgins and Janet Lang (eds), *Imaging the Past: Electronic Imaging and Computer Graphics in Museums and Archaeology*, British Museum Occasional Papers, 114 (1996), pp. 95–108; Jonathan C. Roberts and Nick S. Ryan, ‘Alternative Archaeological Representations within Virtual Worlds’, in Richard Bowden (ed.), *Proceedings of the 4th UK Virtual Reality Specialist Interest Group Conference*, Brunel University, Uxbridge, Middlesex, November (1997), pp. 179 – 88, available at <<http://www.cs.kent.ac.uk/people/staff/nsr/arch/vrsig97/vrsig.html>>; Franco Niccolucci, ‘Virtual Reality in Archaeology: A Useful Tool or a Dreadful Toy?’, *Proceedings of the Medi@terra Symposium*, Athens, November (Athens, 1999), pp. 238f.; Glyn Goodrick and Mark Gillings, ‘Constructs, Simulations and Hyperreal Worlds: The Role of Virtual Reality (VR) in Archaeological Research’, in Gary Lock and Kayt Brown (eds), *On the Theory and Practice of Archaeological Computing* (Oxford, 2000), pp. 41–58; Bernard Frischer, Franco Niccolucci, Nick Ryan and Juan A. Barceló, ‘From CVR to CVRO: The Past, Present, and Future of Cultural Virtual Reality’, in Franco Niccolucci (ed.), *Virtual Archaeology* (Oxford, 2002), pp. 7–18; Peter Jablonka, Steffen Kirchner and Jordi Serangeli, ‘Troia VR. A Virtual Reality Model of Troy and the Troad’, in Martin Doerr and Apostolos Sarris (eds), *The Digital Heritage of Archaeology* (Athens, 2003), pp. 13–20; Maria Roussou and George Drettakis, ‘Photorealism and Non-photorealism in Virtual Heritage Representation’, in David Arnold, Alan Chalmers and Franco Niccolucci (eds), *Proceedings of VAST2003 Fourth International Symposium on Virtual Reality, Archaeology*

The London Charter website (<<http://www.londoncharter.org>>), has proven to many readers an essential starting point for understanding both the urgent needs that The London Charter seeks to address and the implications of its principles for those seeking to draw upon them in creating or evaluating computer-based visualizations of cultural heritage. There is a need to reconcile heritage visualization with professional norms of research, particularly the standards of argument and evidence.

Through extensive consultation with expert communities and the ensuing publication of successive drafts, The London Charter has had considerable success in acting as a catalyst for establishing international consensus on the principles that should inform best practice in heritage visualization across disciplines. It is now widely recognized as the de facto benchmark to which heritage visualization processes and outputs should be held accountable. The Charter has been translated into German, Italian, Japanese, Polish and Spanish,³ and additional translations, including French and Russian, are pending. The Charter has won formal endorsement from national and international bodies including adoption as an official guideline by the Italian Ministry of Culture. It has also been the subject of, and widely cited in, numerous publications and grants have been awarded to study its application. The Charter has also given birth to a new charter, the Seville Charter, which will propose specific London Charter implementation guidelines

and *Intelligent Cultural Heritage* (Aire-La-Ville, 2003), pp. 51–60; Torre Zuk, Sheelagh Carpendale and William D. Glanzaman, ‘Visualizing Temporal Uncertainty in 3D Virtual Reconstructions’, in Mark Mudge, Nick Ryan, and Roberto Scopigno (eds), *Proceedings of VAST 2005, The 6th International Symposium on Virtual Reality, Archaeology and Cultural Heritage* (Aire-La-Ville, 2003), pp. 99–106; Hugh Denard, ‘“At the foot of Pompey’s Statue”: Reconceiving Rome’s *Theatrum Lapidium*’, in Alan K. Bowman and Michael Brady (eds), *Images and Artefacts of the Ancient World* (Oxford, 2005), pp.69–76; Sorin Hermon and Franco Niccolucci, ‘A Fuzzy Logic Approach to Reliability in Archaeological Virtual Reconstruction’, in Franco Niccolucci and Sorin Hermon (eds), *Beyond the Artefact. Digital Interpretation of the Past* (Budapest, 2006), pp. 11–17.

³ *Die Londoner Charta für die Computergestützte Visualisierung von Kulturellem Erbe*, the German-language version of The London Charter (2.1), trans. Susanne Krömker, April 2009; *La Carta Di Londra per la Visualizzazione Digitale dei Beni Culturali*, the Italian-language version of The London Charter (2.1), ed. Enrica Salvatori, November 2009; *ロンドン憲章文化遺産の研究とコミュニケーションにおける3次元ビジュアルライゼーションの利用のために*, the Japanese-language version of The London Charter, Draft 1.1, trans. Go Sugimoto and Rieko Kadobayashi, November 2007; *Karta Londyńska. Zasady dotyczące komputerowych metod wizualizacji dziedzictwa kulturowego*, the Polish-language version of The London Charter (2.1), ed. and trans. Anna Bentkowska-Kafel, Agnieszka Seidel-Grzesińska and Urszula Wencka, May 2010; *La Carta de Londres para la Visualización Computarizada del Patrimonio Cultural*, the Spanish-language version of The London Charter (2.1), ed. and trans. Alfredo Grande León and Víctor Manuel López-Menchero, November 2009.

for the archaeological community.⁴ Both the history of The London Charter and its various translations are freely available online.

The aims of this chapter are: to provide a brief commentary on the current version of The London Charter,⁵ which encapsulates the benefits of what has been learned in the few years since the publication of Draft 1.1 of the Charter;⁶ to suggest the value of the Charter not only as an indicator of methodological rigour but also as a means of achieving significant efficiencies in teaching and training as well as in the research and communication of cultural heritage; and finally to indicate some of the issues and opportunities that still face the visualization community. What follows is a review of version 2.1 of The London Charter with reference to changes from version 1.1.

Commentary on The London Charter, 2.1

Preamble and Objectives

The Preamble to the Charter notes that ‘a set of principles is needed that will ensure that digital heritage visualization is, and is seen to be, at least as intellectually and technically rigorous as longer established cultural heritage research and communication methods’. This notion of demonstrable parity guides much of the thinking underlying the Charter. Previous approaches to this problem were similar in this respect, for example likening the process of archaeological visualization to that of philological textual analysis.⁷ The challenge of the scholarly validation of heritage visualization can most simply be illustrated by considering how one evaluates scholarly print publications: authors are expected, as a minimum, to situate their questions and arguments in relation to prior scholarship; to present and assess their sources, duly referenced in footnotes and bibliographies; and to remain within a range of currently acceptable logical and stylistic norms. These criteria draw upon continually evolving conventions that reflect the prevailing assumptions, at any given moment, about (inter alia) the nature and purpose of scholarship as defined by the various disciplines. The inherently linear nature of textual exegesis renders the author’s very process of interpretation visible to the

4 *The Seville Charter: International Charter for Virtual Archaeology*, revised version, July 2010 published on the International Forum of Virtual Archaeology website, <<http://www.arqueologiavirtual.com/forumcronogramaing.php>>.

5 The current version 2.1 of The London Charter is available at <<http://www.londoncharter.org>> and is reproduced in full following this chapter.

6 *The London Charter for the Use of 3D Visualisation in the Research and Communication of Cultural Heritage*, Draft 1.1, June 2006.

7 See, for example, Frischer Bernard, Niccolucci, Franco, Ryan, Nick and Barcelò, Juan A., ‘From CVR to CVRO: The Past, Present, and Future of Cultural Virtual Reality’, in Franco Niccolucci (ed.), *Virtual Archaeology*, Proceedings of the VAST Euroconference, Arezzo, 24–25 November 2000, Bar International Series 1075 (Oxford, 2002), pp. 7–18.

community, which, in turn, allied with the listing of sources, allows the argument to be evaluated.

Consider, by contrast, a visualization. Some subjects, and arguments, do not so readily lend themselves to verbal expression, not only because they may rely on intensive, detailed reference to visual or spatial materials that resist textual description, but because the subject matter and understandings that the author wishes to communicate are inherently non-linear or synthetic – for example, a building or event. If communicating by means of text, the author must force a synchronic perception into a diachronic narrative; that is, must strip the object down into a sequence of layers, to be presented sequentially rather than simultaneously, thereby negating the very cognitive experience that the author ultimately wishes to evoke. In such cases, a visualization – whether static image, real-time model or printed object – might well become the expressive medium of choice, conveying, all at once, the complete, synthetic image of the author's idea.

However, although for certain purposes visualization can exceed text in expressive power, its explanatory value may be less. No matter how thoughtfully a research question is posed in relation to the existing field of knowledge, how painstakingly available sources are researched and interpreted, how discerningly or creatively an argument is elaborated visually, to the viewer, a finished image alone does not reveal the process by which it was created. Even a real-time model, while it allows the user to explore a space in linear time, if it lacks an account of the evaluation of sources or of the process of interpretation, does not, in itself, render the research process visible to the visitor and thus fails to allow the viewer to assess it as part of an argument. Such visualizations, solipsistically adrift in cyberspace, can only slip, unremarked, through the continuum of scholarly discourse. The empirical opacity of the synchronous image, then, is the crisis that threatens to isolate visualizations from meaningful disciplinary dialogue. For a heritage visualization to match the rigour of conventional research, its rigour must be visible. That is why, at the heart of *The London Charter* is the principle that heritage visualizations: 'should accurately convey to users the status of the knowledge that they represent, such as distinctions between evidence and hypothesis, and between different levels of probability.'

Visibility is also at the centre of the Charter initiative itself: by calling itself a 'Charter' (rather than, say, a co-authored article) the document seeks to draw a certain kind of attention to itself, so that its encapsulation of expert thought on best practice in heritage visualization will be recognized as a common reference point spanning nations and academic and professional contexts. Agreement on an internationally agreed benchmark that insisted on intellectual accountability, it has been realized, could be the single most effective means of enabling heritage visualization methods to become an equal and valued part of communities engaged in the research and communication of human culture. With this in mind, the principles of the Charter are, for the most part, deliberately conservative – no more than a consolidation of existing consensus so that the document might legitimately demand 'wide recognition and an expectation of compliance within

relevant subject communities'. Once accepted, its value would be to provide a set of principles that, if adhered to, would virtually guarantee the methodological integrity of a heritage visualization project and act as a common yardstick for professional evaluation – an essential tool enabling the integration of visualization efforts into the process of mainstream peer evaluation and, thereby, scholarly debate.

Indicators of success in establishing the Charter in this role are many and varied. The Charter forms the basis of an EU MINERVA workgroup on standards for the use of 3D technologies in capturing and representing cultural heritage, while Franco Niccolucci, joint chair of The London Charter and Director for Dissemination and Standards of the EU EPOCH Network of Excellence, has written:

EPOCH considers The London Charter to be one of its most important achievements. The Network believes that this document and the related activity is a much needed milestone as far as the use of 3D visualization in archaeological interpretation, presentation and reconstruction is concerned. After several years of theoretical debate on this issue, the Charter finally proposes robust and authoritative guidelines for this important interdisciplinary subject. Not only has the large EPOCH partnership (90 research, higher education and cultural institutions across Europe) fully accepted and is supporting and implementing the Charter, but also the project reviewers nominated by the European Commission confirmed the validity and usefulness of the policies that the Charter dictates. The Charter has received great attention in EPOCH's Research Agenda Report. Acceptance and support of The London Charter is now spreading beyond the borders of EPOCH.⁸

Between March 2006 and February 2009, *The London Charter for the Use of 3D Visualisation in the Research and Communication of Cultural Heritage* (Draft 1) evolved into *The London Charter for the Computer-based Visualisation of Cultural Heritage* (2.1), reflecting a broadening of scope and ambition. Draft 1's strict focus on '3D visualization' was expanded to encompass 'computer-based visualization' – embracing 2D, 3D, 4D and even hard-copy printouts or computer-generated physical objects such as replicas of museum artefacts. In addition, at a meeting of the Advisory Board in Brighton in November 2007, following much vigorous debate, it was agreed that the Charter should aspire to influence the use of visualizations not only in academic and curatorial contexts, but also in 'those aspects of the entertainment industry involving the reconstruction or evocation of cultural heritage' although omitting 'the use of computer-based visualisation in [...] contemporary art, fashion, or design' (see Preamble). Computer-generated imagery, it was argued, plays an increasingly influential role in shaping public perceptions of the past even when, as so often, it is factually erroneous. Audiences understand that studios are bound to take creative licence. However, such is the persuasive power of visualizations, especially when photorealism is used, that alongside their

⁸ <<http://www.londoncharter.org>>.

entertainment value, they also often lend an unjustifiable impression of historical accuracy. If we agree – as those with a professional interest in cultural heritage are surely bound to do – that it is a matter of no small importance whether or not a generation's impressions of the past conform to the contours of historical understanding, then it follows that we should take an active role in encouraging and urging the commercial sector to make available, through documentaries and other formats, sufficient information to enable their audiences to distinguish between fact and fiction. An awareness-raising effort of this kind, aiming to raise producers' and audiences' expectations of historical accountability, including an emphasis on the additional frisson that integrity brings to our encounters with the past, would require significant resources and further research. But even in the absence (to date) of a concerted attempt to realize this ambition, this broadening of the scope of the Charter's validity raises numerous questions which are likely to become more, rather than less, publicly and energetically explored in time.

This development also highlights the importance of writing the Charter in a style that is accessible to the widest possible audience, spanning not only a variety of professional and disciplinary contexts, but also all levels of expertise, from the seasoned expert to the general public. This is appropriate given that the Charter addresses issues that affect such diverse stakeholders, from journalists to researchers, and from museum curators to international organizations. This stylistic accessibility is possible because the Charter, rather than making highly specific technical recommendations, addresses methodological issues at quite an abstract level. Having said that, communication across disciplines and languages has presented formidable challenges. A comparative study of the translation issues that The London Charter has encountered, which I shall not attempt here, could deliver fascinating insights into the diversity of cultural approaches that an international Charter relating to cultural heritage must support. Certain key terms such as 'accessibility' and 'sources', for example, mean different things in different academic contexts, and equally crucial concepts, such as 'cultural heritage', 'intellectual transparency' and 'subject communities', have no obvious linguistic or cultural equivalent in different languages. Several of the terminological changes from Draft 1.1 to version 2.1 of the Charter are the result of translators and community members drawing our attention to such issues. Indeed, Principle 3 was renamed 'Research Sources' because of the different connotations the term 'sources' had in humanities disciplines from those in computer science and the other sciences. The effects of this learning process are also registered in Principle 4.9, which draws attention to the importance of making explicit, in an interdisciplinary project, the 'implicit knowledge' that each expert community holds, as well as of 'identifying the different lexica of participating members from diverse subject communities'. The visualization community is deeply indebted to the care and integrity of those who have acted as editors, translators and correspondents in the collaborative search for successful linguistic and cultural analogues for the Charter.

Principle 1: Implementation

In order to retain cross-context relevance, the Charter addresses only fundamental methodological principles that will, by their nature, remain valid even as technologies or technical standards evolve. For this reason, the Charter acknowledges the need for more detailed, discipline- and technology-specific Implementation Guidelines that map out the technical implications of these methodological principles (1.1):

Each community of practice, whether academic, educational, curatorial or commercial, should develop London Charter Implementation Guidelines that cohere with its own aims, objectives and methods.

One consequence is that one should be able to envisage, in the not too distant future, a definitive text of the Charter. Implementation guidelines, however, will continue to be needed, and revised on an ongoing basis. Daniel Pletinckx's chapter in this volume could be viewed as one guideline of this kind (see Chapter 17). A further example of work on developing implementation guidelines is The Seville Charter, by the International Forum of Virtual Archaeology which, currently at its preliminary draft stage, explicitly aims:

[...] to increase the conditions of applicability of The London Charter in order to improve its implementation specifically in the field of archaeological heritage, including industrial archaeological heritage, simplifying and organising its bases sequentially, while at the same time offering new recommendations taking into account the specific nature of archaeological heritage in relation to cultural heritage [...]⁹

The International Forum of Virtual Archaeology is seeking contributions from international experts working in the field of digital archaeology to ensure that the outcome is a robust, consensus-based document. The Seville Charter initiative is led by Victor Manuel López Menchero Bendicho and Alfredo Grande Leon, with the author and Donald Sanders acting as liaison between the Seville Charter and The London Charter Advisory Boards.

Technologies such as multi-user virtual worlds and the increasing ubiquity of portable devices represent specific challenges to implementation. Addressing these successfully will require a combination of technological and conceptual development. Such work has begun – for example, The London Charter in Second Life (LCSL) project jointly funded by the British Council and the Italian Ministry for Research and Universities which will soon publish a detailed set of guidelines and technical tools for implementing The London Charter in collaborative online

⁹ *The Seville Charter: International Charter for Virtual Archaeology*, revised version, July 2010 published on the International Forum of Virtual Archaeology website <<http://www.arqueologiavirtual.com/forumcronogramaing.php>>.

environments, and which has also contributed to our understanding of the role that The London Charter can play in education and training.¹⁰

Having undergone an extensive process of consultation within subject communities, and having achieved significant recognition, The London Charter is well placed to explore formal endorsement by heritage and research funding bodies at a national level, and international organizations including UNESCO and ISO. This will further increase its visibility and influence, and will help to stimulate additional research and the development of implementation guidelines for specific disciplines and methods.

Principle 1.2 of The London Charter states: 'Every computer-based visualisation heritage activity should develop, and monitor the application of, a London Charter Implementation Strategy.' Extensive experience of developing, and helping others to develop Charter implementation plans has unfailingly demonstrated the Charter's value as a coherent conceptual framework that is quickly and easily understandable by people from diverse professional and disciplinary contexts. When used as a set of prompts in the project planning phase, the Charter saves significant amounts of time in designing a robust, structured visualization methodology, and subsequently, during the life of the project, provides a clear and concise agreed reference point for project participants, guaranteeing that the project both is, and is seen to be, methodologically rigorous.

Principle 2: Aims and Methods

The principle that 'a computer-based visualisation method should normally be used only when it is the most appropriate available method for that purpose', while it articulates an enduring and fundamental methodological tenet, can also be seen as the expression of a specific moment of epistemological crisis precipitated by technological change. The London Charter initiative arose as a response to the increasingly widely recognized need to ensure the ever-increasing expressive power of computer graphics become accountable to the rigorous standards of historical research. Those archaeologists, classicists and historians of various denominations who had perceived the enormous potential of digital 3D visualization for fashioning intuitively understandable representations of spatial arguments also, as mentioned above, from the mid 1990s, began to signal, each

10 Marco Bani, Francesco Genovesi, Elisa Ciregia, Flavia Piscioneri, Beatrice Rapisarda, Enrica Salvatori and Maria Simi, 'Learning by Creating Historical Buildings', in Judith Molka-Danielsen and Mats Deutschmann (eds), *Learning and Teaching in the Virtual World of Second Life* (Trondheim, 2009); Hugh Denard, Erica Salvatori and Maria Simi, 'Learning by Building in Second Life: Reflections on Interdisciplinary and International Experiences', in Giovanni Vincenti and James Braman (eds), *Multi-User Virtual Environments for the Classroom: Practical Approaches to Teaching in Virtual Worlds* (IGI Global, 2011), pp. 134-58; and the King's College London MA Digital Culture and Technology 'Alkedo' project <<http://www.cch.kcl.ac.uk/teaching/madct/projects/alkedo/wiki/>>.

in their own disciplinary contexts and terms, concern about how this means of representation could so beguilingly elide distinctions between information and speculation.

According to the conventional narrative of the ‘evolution’ of computer graphics, we were destined to develop increasingly lifelike synthetic simulacra of reality which would, in turn, be experienced in increasingly ‘immersive’ ways. Indeed, the capacity of 3D computer visualizations to conjoin geometrical information with ‘textures’ that suggested, or even photographically reproduced, the surface appearance of actual objects, seemed one of the most compelling arguments for the application of computer graphics to the representation of cultural heritage: one day, we dreamed, we might create complete experiences of long-lost places and periods that would be virtually indistinguishable in appearance from actuality. We may at times struggle to distance ourselves from the assumption that methodological advancement is an inevitable sequitur of technological progress, particularly when both our quotidian and our professional lives increasingly rely on and constantly anticipate the emergence of digital technologies. It was a key realization, therefore, that the headlong career towards hyperrealism, photorealism, virtual reality and other such graphical innovations might actually be taking us further away from, not nearer to, accountable knowledge representation. What was needed was a forceful interruption of the flow of teleological assumptions. This realization gave rise to the principle (2.3) that:

[...] the choice of computer-based visualisation method (e.g. more or less photo-realistic, impressionistic or schematic; representation of hypotheses or of the available evidence; dynamic or static) or the decision to develop a new method, should be based on an evaluation of the likely success of each approach in addressing each aim.

A common misconception is that the Charter prescribes absolute precepts governing which particular method or approach should be used in each given circumstance. Nothing could be further from the truth: the Charter consistently, and insistently, throws the ball back into the court of those about to undertake computer-based heritage visualization, asking them to articulate the particular aims and requirements of each strand of each project, and to make decisions appropriate to each of their specific requirements. Thus, for instance, recognizing that there is a potentially infinite range of valid aims and methods, the Charter asks only that (2.2): ‘A systematic, documented evaluation of the suitability of each method to each aim should be carried out, in order to ascertain what, if any, type of computer-based visualisation is likely to prove most appropriate.’

Principle 3: Research Sources

In Principle 3 – which stipulates that, ‘in order to ensure the intellectual integrity of computer-based visualisation methods and outcomes, relevant research sources

should be identified and evaluated in a structured and documented way’ – the comparison with conventional textual scholarship is most in evidence. Visual resources, as Daniel Pletinckx discusses in Chapter 17, pose particular challenges for precisely the same reason that visualizations themselves do: they are inherently non-linear entities that, although they may, as the saying goes, be worth a thousand words, do not tell their own story. Thus (3.3): ‘Particular attention should be given to the way in which visual sources may be affected by ideological, historical, social, religious and aesthetic and other such factors.’

Principle 4: Documentation

This principle is a much streamlined form of what, in Draft 1.1, was distributed across three principles (‘Transparency Requirements’, ‘Documentation’ and ‘Standards’), and its heading-level formulation is in some senses the beating heart of the Charter as a whole, stating: ‘Sufficient information should be documented and disseminated to allow computer-based visualisation methods and outcomes to be understood and evaluated in relation to the contexts and purposes for which they are deployed.’ The Charter goes on to elucidate the various areas in which documentation should operate in order to (4.2): ‘enable rigorous, comparative analysis and evaluation of computer-based visualisations’; (4.4) ensure that audiences can understand what each visualization seeks to represent; (4.5) publish research sources and (4.7) explain the methodological rationale of a visualization. It also makes recommendations on documentation formats and standards (4.11–12).

For the present volume, however, the principle regarding Documentation of Process (‘Paradata’) is of particular interest (4.6):

Documentation of the evaluative, analytical, deductive, interpretative and creative decisions made in the course of computer-based visualisation should be disseminated in such a way that the relationship between research sources, implicit knowledge, explicit reasoning, and visualisation-based outcomes can be understood.

Again, this principle necessitates a flexible and relational, rather than rigid and absolute, approach. The Charter emphatically does not provide a checklist of tasks, but rather, in effect, a structured set of prompts that asks us to determine what specific measures are appropriate for each individual project relative to its own particular aims and circumstances. The level of documentation that is appropriate may, for instance, be proportionate to the quality of sources upon which a visualization is based as well as the weight of importance that a visualization has within an argument. Thus, a minimal record may suffice for a speculative visualization based on very limited evidence that aims to do no more than give a sense of the possible approximate size of an artefact, structure or site; whereas a model designed to carry the burden of a detailed reconstruction hypothesis, and

which is based on extensive, precise site measurements and a weighty corpus of *comparanda*, will require meticulous documentation of both its sources and interpretative processes if others are to be able to understand and evaluate the quality of the underlying empirical analysis and argument being advanced.

However, documenting ‘the evaluative, analytical, deductive, interpretative and creative decisions’ is a tall order. As Drew Baker, in Chapter 14 of this volume, shows, no visualization is completely ‘objectively’ true to fact; despite the aspiration that a 3D model’s geometry should be an accurate record of that of the cultural artefact, it is even truer of computer-based visualizations than of photographs that digital surrogates, within the constraints of a particular technology, *represent*, rather than accurately *reproduce*, some aspect of reality. Interpretation is ineluctably involved at every stage: 3D scanning and processing convert the infinitely granular surface of artefacts into point clouds or polygon meshes; digital cameras and video recorders ‘capture’ analogue waves as binary sequences; while display surfaces – monitors, screens, print illustrations – attempt to convey on two-dimensional planes the impression of three-dimensional space.

Visualization creation involves, and visualization outputs invite, multiple perspectives: technological, optical (including the human eye), cultural, aesthetic (including connoisseurship) and epistemological (within disciplines, but increasingly also within ‘intra-disciplines’ such as digital humanities or archaeological computing), right down to the real-time model user’s choice of path, viewing-point or interaction. In short, visualizations are technical, personal and cultural memory structures, with all the instability that implies, upon which we stage our narratives of the past. Indeed, the whole London Charter is predicated upon the absence of objectivity: tracking the interpretative trail, consensus around methods and representational conventions, are only necessary and meaningful because of the inescapable elusiveness of pure fact.

We are forcibly confronted with this elusiveness when we consider the challenge of documenting dependency relationships. The Charter’s glossary defines a dependency relationship as:

A dependent relationship between the properties of elements within digital models, such that a change in one property will necessitate change in the dependent properties. (For instance, a change in the height of a door will necessitate a corresponding change in the height of the doorframe.)

A visualization is essentially a complex set of dependency relationships, and it is this which makes a visualization at once such a powerful empirical instrument – a means of exploring what the implications of each piece of knowledge might be for each other piece of knowledge – and an entity that is very difficult to render amenable to intellectual accountability. The Charter therefore proposes (4.10):

Computer-based visualisation outcomes should be disseminated in such a way that the nature and importance of significant, hypothetical dependency

relationships between elements can be clearly identified by users and the reasoning underlying such hypotheses understood.

When this kind of approach is adopted, computer-generated graphics, by enabling us systematically, iteratively and precisely to explore and record the reciprocal interpretative implications of pieces of evidence and hypotheses, remain a uniquely enabling means of constructing knowledge. The spatial specificity that digital visualizations demand, when exploited intelligently and rigorously, far from being a fatal, Siren seduction, becomes a fertile ground of enriched understandings.

The requirement to document process has an impact on working practice that requires consideration, from the lab book's sometimes intrusive interruption of the flow of visual interpretation, to its essential role in providing the detailed record that provides the necessary basis of publication. The Charter proposes that (4.1): 'Documentation strategies should be designed and resourced in such a way that they actively enhance the visualisation activity by encouraging, and helping to structure, thoughtful practice.'

Absorbed by the visualization process, we make an infinite number of moment-by-moment decisions, each shaped by a host of factors, not least the deep, acquired subject and technical knowledge that at any given moment may represent itself to us as little more than 'instinct' – a feeling for what is and what isn't right. As visualizers we need to be as aware as possible of the kinds of decisions that we make on 'instinct' so that we can monitor their validity, but we must also be realistic about what level of detail about the interpretative process it is possible, or even appropriate, to capture. By the same token, as consumers, we must be sophisticated enough to recognize, and accept, the unavoidable role of subjectivity in influencing the style, aesthetics and interpretative choices that we find manifested in heritage visualizations.

A simple reading could view The London Charter as limiting scope for creativity by seeking to tie everything down to the most minute detail. But that would be to forget that heritage visualization is, above all, a hypothesis machine. One may know, for example, that a certain object was part of a greater structure, but lack sufficient information to determine precisely how it fitted into the whole. In such cases, the process of visualization, when documented, gives us in fact greater, not lesser, liberty to try out possibilities, because when a hypothesis is published along with its rationale and evidence base, it acquires a recognizable standard of *methodological* validity. This remains the case even if the visualization output takes the form of an interactive tool rather than a static image or fixed model; one that allows others dynamically to test hypotheses by altering variables within a digital environment. The London Charter encourages manifold interpretative interventions, each being just one of multiple possible stories we might tell about the past. Documentation, while it does not, in itself, legitimize outcomes or conclusions as historical hypotheses, nevertheless allows us to present even highly speculative experiments, and entitles us to expect that they be evaluated on their own terms. Taken further, documented visualization is not only a hypothesis

engine, it is an epistemological engine: one that, by licensing ludic intervention as a means of producing knowledge, could ultimately contain the potential to affect our assumptions about the nature, aims and methods of historical research and of the communication of cultural heritage.

Principle 5: Sustainability, and Principle 6: Access

If Principle 4 is the heart of the Charter, then Principles 5 and 6 are its conscience; and if the earlier sections of the Charter represent consensus on achievable best practice, with these two Principles on Sustainability and Access, the Charter steps forward into a space of principled aspiration.

Principle 5, 'Sustainability', draws attention to the fact that computer-based visualizations themselves constitute, in their own right, part of our common 'human intellectual, social, economic and cultural heritage'. Considerable resources, often drawn – directly or indirectly – from the public purse, flow into the creation of heritage visualizations. It therefore behoves the visualization community to behave as good stewards of that investment, both through ensuring that this work is preserved and that it reaches those public audiences to whom it may have genuine value.

Principle 5 therefore stipulates that 'strategies should be planned and implemented to ensure the long-term sustainability of cultural heritage-related computer-based visualisation outcomes and documentation' in order to avoid their loss, and further notes that analogue as well as digital formats should be considered (5.1) depending on which has the best prospects of being successfully sustained.

In a similar vein, Principle 6 advises:

The creation and dissemination of computer-based visualisation should be planned in such a way as to ensure that maximum possible benefits are achieved for the study, understanding, interpretation, preservation and management of cultural heritage.

These two principles raise all kinds of challenging issues, particularly for the public-funding models that frequently underwrite heritage visualization initiatives. Extensive effort is being made, at present, to develop data models that will enable the integration of 3D content into digital repositories. However, even with such initiatives, the long-term sustainability of digital heritage visualization outputs is far from guaranteed.

Similarly, while national-level public funding bodies tend to concentrate on content creation, and transnational bodies such as the EC invest in the development of new technologies, there remains a critical shortage of funding for promoting the visibility of, access to, and deployment in diverse contexts of visual, digital heritage assets. Principle 6.1 urges stakeholders to consider:

[...] how such work can enhance access to cultural heritage that is otherwise inaccessible due to health and safety, disability, economic, political, or environmental reasons, or because the object of the visualisation is lost, endangered, dispersed, or has been destroyed, restored or reconstructed.

This gives only a hint of the vast unlocked potential that a well-wrought heritage visualization can have if made available for use in new contexts, including uses beyond those envisaged by its creators. Principle 6.2 further extends the vision, asking us to:

[...] take cognizance of the types and degrees of access that computer-based visualisation can uniquely provide to cultural heritage stakeholders, including the study of change over time, magnification, modification, manipulation of virtual objects, embedding of datasets, instantaneous global distribution.

There is, partly for this reason, increasing recognition for the need to develop an online index of heritage visualization projects, building for instance on the 3DVisA index by Anna Bentkowska-Kafel (<<http://3dvisa.cch.kcl.ac.uk/projectlist.html>>), but extending its international coverage in a way that both promotes exemplary London Charter implementation documentation, including through peer review processes, and critically increases the visibility of visualisation projects and their benefits across a range of contexts. Initiatives such as the Virtual Museums Transnational Network (V-MUST), recently funded under the EU 7th Framework Programme, which itself relies on common understandings embodied by The London Charter, are likely to provide vehicles for advancing this kind of work.

As the Charter's methodological principles become increasingly commonly understood and adopted, Sustainability and Access are likely to become increasingly viewed as the central, burning, issues in heritage visualization. Methodological rigour will ensure that heritage visualizations have excellent prospects of being of enduring intrinsic quality; however, it remains for us to take the difficult steps needed to secure their survival and fully to realize their value in a shared future.

Conclusion

This emphasis, at the close of the Charter, on the issue of 'Access' begins to bring us full circle. The London Charter was born out of an anxiety that serious heritage visualization was suffering, in prestige and perceived integrity, by its superficial similarities to computer-generated imagery seen in ahistorical popular games and films. We now find ourselves, however, gravitating towards a, perhaps wiser, recognition of interconnectedness: an observation that computer-based visualizations are valuable in part precisely because they collapse boundaries between the mysteries of rarefied academic research and popular understanding. A visualization may at once embody deep and complex specialist knowledge and

at the same time make the contours of that knowledge intuitively accessible to a non-expert audience in a way that a text-based publication never could.

We need collectively to think through the implications of these new parameters, in relation to wider debates about the characteristics and prospects of a 'digital society' and the ways in which the language of 'impact' and 'knowledge transfer' is affecting our professional environments. Our challenge is to shape these exchanges and transactions, and the language we use, in ways that actively enhance the integrity of deep and rigorous scholarly enquiry, including through dialogue with more diverse kinds of stakeholders and audiences than heretofore.

Heritage visualization, as an engine of intensely demanding interdisciplinary research and of lively public engagement, can make a persuasive contribution to the cultivation of popular understanding of the essential role that cultural heritage plays in generating a healthy, changing and self-aware culture. High-integrity, computer-based heritage visualizations can be focal points, equally accessible to all, around which we aggregate debates about what is at stake in the images, experiences and narratives we construct about the past, and by extension the present, of human culture.

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