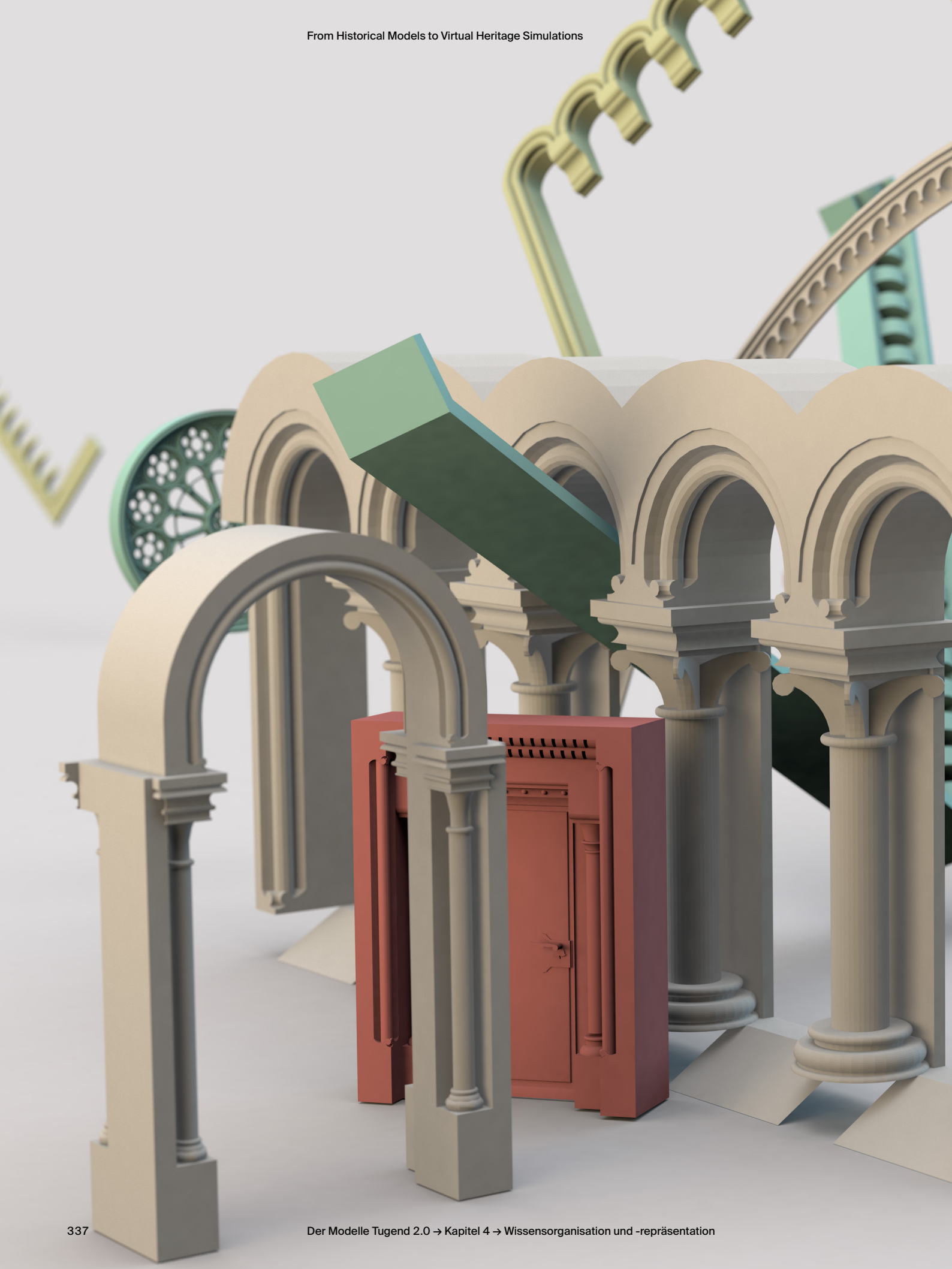


Erik Malcolm Champion

P. From Historical Models to Virtual Heritage Simulations

→ 3D models, digital history, theory, virtual heritage

This chapter analyses the gap between digital historical models, and proposes that instead of developing stand-alone models that we design in terms of components, components of scholarly ecosystems and audience-oriented learning systems. The focus here is not on individual projects or technological limitations but on the lack of clear and replicable explicit terminology, methodology, assessable, replicable evaluation, and scholarly infrastructure. The success of virtual heritage projects as both a communication and preservation medium depend on community involvement, including scholars, students, the wider public, but also the original shareholders.

There is also great potential for more focussed usability studies to verify the effectiveness of interaction and contextual learning. How interaction is intended, what actually takes place and how to archive it separately from the model are difficult issues, but they need to be solved. I will also briefly discuss four major themes potentially of great import to a virtual heritage repository: consumer VR; research groups attempting to avoid the problems of silo projects; publication of 3D models in journals; and real-time streaming of distributed components in a game engine. This chapter also suggests ten criteria to determine whether and to what extent virtual heritage models can solves these issues.

P.1 Introduction

This chapter is primarily an analysis of the gap between digital historical models and their effective and efficient use of components of scholarly ecosystems and audience-oriented learning systems. The focus will not be on individual projects or technological limitations but on the lack of clear and replicable explicit terminology, methodology, assessable, replicable evaluation, and scholarly infrastructure. 01

■ 01
Alonzo Addison, Emerging Trends in Virtual Heritage, in: MultiMedia, 7 (2), 2000, pp. 22–25.

P.2 Issues

Despite the proliferation and uptake of digital technology and social media, experts have warned us of the disappearance of digital models, especially those used for virtual heritage projects. While there are various examples of digital heritage projects and tools virtual projects that promise reliable infrastructure, 02 there are still too few examples of effective use and deployment of 3D models and related media for cultural heritage. 03

To demonstrate this issue, try this simple exercise: which 3D digital model project can satisfactorily answer the following questions?

→ Capacity to distribute different levels of quality of content but communicate accuracy of the data and the intentions that drove the creation of the simulation?
→ Ability to connect to archives and to other external sources and track the usefulness and effectiveness of the data?
→ Results in guaranteed meaningful and significant feedback from communities and shareholders?

All three questions may appear to be predicated on technical solutions but they also depend on agreed terminology.

■ 02
Ignacio San Jose, Jose Martinez, Noelia Alvarez, Juan Fernandez, Francisco Delgado, Ruben Martinez, Julio Puche, Javier Finat, An Open Source Software Platform for Visualizing and Teaching Conservation Tasks in Architectural Heritage Environments, Proceedings of the ISPRS-International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences 1(2) 2013, pp. 367–372.

■ 03
Maria Economou, Laia Pujol, Educational Tool or Expensive Toy? Evaluating VR Evaluation and Its Relevance for Virtual Heritage, in: Yehuda Kalay, Thomas Kvan, Janice Affleck (Eds.), New Heritage: New Media and Cultural Heritage, Routledge, London 2008, pp. 242–60.

P.3 Terminology

Although terminology may be considered in many academic disciplines to be an exercise in pedantry, in the field of heritage it could and should be of crucial import. 04

Digital models of historical buildings and historical landscapes are typically hypothetical and partial models. They are also rhetorical or pedagogical, but according to Clark, 05 they are not **actually** reconstructions, instead, they are constructions, and, if digital, simulations, more of a **simulation slice**. In a spirit of academic debate, although it differs from the title of this book, I counter-argue that current digital heritage projects are models rather than simulations, they are not predictive tools, as they don't create, question or demonstrate hypothetical situations or imaginative possibilities.

For example, a sophisticated weather simulation does not just copy a physical object, it does not simply create a simplified physical or digital distinction all differ: a digital copy, a conceptual simplification, a model that replicates a process rather than just the object itself, or a simulation that can only predict a potential outcome once it runs. Despite this, the words used to describe them in the field are interchangeable. The relevant scholarly communities need to agree on the definitions of model and simulation, as different fields define them differently, and some fields use either term without distinction.

We also require more theoretical and practical research into how digital models can explain intangible heritage values or communicate layers and levels of archaeological uncertainty, 06 but such an aim is problematic if we do not agree on key meanings and usages.

Digital simulations are often introduced to academic audiences at virtual heritage conferences and virtual heritage exhibitions, but the purpose and aims of virtual heritage are typically vague. While virtual heritage was initially described as a fusion of virtual reality technology with cultural heritage content, 07 Stone and Takeo emphasized the pedagogical aspect:

»... the use of computer-based interactive technologies to record, preserve, or recreate artifacts, sites and actors of historic, artistic, religious, and cultural significance and to deliver the results openly to a global audience in such a way as to provide formative educational experiences through electronic manipulations of time and space.« 08

The most famous charter on virtual heritage, the **London Charter** defined computer-based visualization as »the process of representing information visually with the aid of computer technologies« 09 but it does not explain the cultural significance of the object or process simulated, and reasons for why it should be preserved and communicated.

■ 04
Anna Bentkowska-Kafel, Hugh Denard, Drew Baker, Paradata and Transparency in Virtual Heritage, Ashgate, London 2012.

■ 05
Jeffrey Clark, The Fallacy of Reconstruction, in: Maurizio Forte (Ed.), Cyber-Archaeology, Archaeopress, Oxford 2010, pp. 63–73.

■ 06
Konstantinos Papadopoulos, Efi Kefalaki, At the Computer's Edge the Value of Virtual Constructions to the Interpretation of Cultural Heritage, in: Archeomatica 4, 2010, pp. 46–51.

■ 07
Alonzo C. Addison, Virtual Heritage: Technology in the Service of Culture in: Arnold, David Arnold, Alan Chalmers, Dieter Fellner (Eds.), The Proceedings of the 2001 Conference on Virtual Reality, Archeology, and Cultural Heritage, Athens, Greece, 28–30 November 2001, pp. 343–354.

■ 08
Robert Stone, Takeo Ojika Virtual Heritage: What Next? In: Multimedia, 7 (2) 2000, pp. 73–74.

■ 09
Hugh Denard, The London Charter for the Computer-Based Visualisation of Cultural Heritage, in: London Charter, 2009, http://www.londoncharter.org/.

I have argued that the purpose and significance of virtual heritage is clearer if we define it as

»the attempt to convey not just the appearance but also the meaning and significance of cultural artefacts and the associated social agency that designed and used them, through the use of interactive and immersive digital media.« [10]

Now this is not the only use for architectural models, [11] but it is particularly important for cultural heritage as a communication process.

When virtual heritage showcases the latest technology, in order to integrate both new media and digital heritage; it is unlikely to satisfy the requirements of both, at least not in fixed project form. Virtual heritage has been a (sometimes) successful communication medium but seldom has it succeed as a preservation medium. [12]

Why? Due to the lack of scholarly debate, and agreed terminology. [13] The definition of virtual heritage is highly contentious, yet there is little literature either in book or journal form that consistently and progressively argues for standardized terms.

■ 10
Erik Champion, Explorative Shadow Realms of Uncertain Histories, in: Yehuda Kalay, Thomas Kvan, Janice Affleck (Eds.), New Heritage: New Media and Cultural Heritage, Routledge, London 2008, pp. 185–206.

■ 11
Sander Münster, W. Hegel, Cindy Kröber, A Model Classification for Digital 3D Reconstruction in the Context of Humanities Research, in: Sander Münster, Mieke Pfarr-Harfst, Piotr Kuroczyński, Marinos Ioannides (Eds.), 3D Research Challenges in Cultural Heritage II: How to Manage Data and Knowledge Related to Interpretative Digital 3D Reconstructions of Cultural Heritage, Springer, Cham 2016, pp. 3–31.

■ 12
Erik Champion, Entertaining the Similarities and Distinctions between Serious Games and Virtual Heritage Projects, in: Entertainment Computing 14, 2016, pp. 67–74.

■ 13
Hazel Tucker, Elizabeth Carnegie, World Heritage and the Contradictions of Universal Value, in: Annals of Tourism Research 2014, pp. 63–76.

P.4 Method versus Methodology

An even more fundamental issue is the lack of clear methodology (as distinct from method). In the English-speaking world, methodology has often been conflated with method but there is a crucial distinction. While methodology can be seen as a framework of methods, I suggest the more useful definition is as a study and critique **of** methods.

I invite the reader to review papers in the field and see for herself or himself the number of papers in virtual heritage that clearly and comprehensively describe and discuss the range and effectiveness of methods in virtual heritage before describing the method they chose in their virtual heritage project. Without clearly examining the field of relevant research, and explaining **why** they chose the methods they use, the field of virtual heritage will uncritically repeat itself. [14] A community portal providing key papers and projects and shared tools and terminology would go some way to addressing this issue.

■ 14
Sander Münster Thomas Koehler, 3d Reconstruction of Cultural Heritage Artefacts, in: Stephan Hoppe and Stefan Breitling (Eds.), Virtual Palaces, Part II: Lost Palaces and Their Afterlife, Palatium, Munich 2016, pp. 87–102.

P.5 Scholarly Effectiveness

This is also an issue of inadequate infrastructure, which is not helped by the tendency of research funding bodies to support new advances rather than to maintain and update infrastructure. Because of the emphasis on standalone models, interaction design patterns (and mechanics) are not standardized, and not preserved, let alone separated from the 2D and 3D media assets. [15] There have been recent European and North American moves [16] to create archives and digital humanities infrastructures [17] but 3D models have not yet been fully incorporated into these new infrastructures while allowing full public access. [18]

There are also challenges of access: models are hard to find, impossible to download and edit, in unusual, unwieldy or obsolete formats. Many are standalone 3D meshes with no accompanying metadata or information on how the data was acquired, how the models can be shared (and if they can be edited), and how accurate the scanning or modelling process was, or the scholarly documents, field reports, photographs and site plans that allowed the designers to extract enough information (including copyright and legal information) for their models.

15
Erik Champion, The Missing Scholarship Behind Virtual Heritage Infrastructures, in: Chiara Eva Catalano, Livio De Luca (Eds.), GCH '16 Proceedings of the 14th Eurographics Workshop on Graphics and Cultural Heritage, Genoa 5–7 October 2016, pp. 57–65.

16
3D ICONS, 3d -ICONS, in: 3D-ICONS 3D Digitisation of Icons of European Architectural and Archaeological Heritage, Undated, http://3dicons-project.eu/

17
Jennifer von Schwerin Heather Richards-Rissetto, Fabio Remondino, Giogio Agugario, Gabrio Girardi, The Mayaarch3d Project: A 3d WebGIS for Analyzing Ancient Architecture and Landscapes, in: Literary and Linguistic Computing 28 (4), 2013, pp. 736–753.

18
Jeremy Huggett, Promise and Paradox: Accessing Open Data in Archaeology, in: Clare Mills, Michael Pidd, Esther Ward (Eds.), Digital Humanities Congress 2012, Sheffield, 6–8 September 2012.

P.6 Evaluation

Experts have argued [19] that a major issue in the development of high quality and effective virtual heritage projects has been a corresponding lack of evaluation methods. Due at least in part to the lack of interactivity, the pedagogical benefits of teaching heritage and archaeology and architectural history via 3D digital heritage models, is also problematic.

More work is required to provide access to the models, sites and paradata (which the London Charter [20] defines as **Information about human processes of understanding and interpretation of data objects**). Although there are charters such as the London Charter and the Seville Charter, as there are few publicly accessible models [21] there is also no shared standardized evaluation data, and many scholars have complained about user experience issues and a scarcity of suitable pedagogical material [22] or data that conveys the accuracy, authenticity and authorship of the simulated material. [23]

19
Athanasis Karoulis, Stella Sylaiou, Martin White, Usability Evaluation of a Virtual Museum Interface, in: Informatica 17 (3), 2006, pp. 363–380.

20
Denard.

21
Sara Barsantia, et al., Critical Factors and Guidelines for 3d Surveying and Modelling in Cultural Heritage, in: International Journal of Heritage in the Digital Era 3 (1), 2014, pp. 141–158.

22
Economou and Pujol.

23
De Reu et al., 2012. Towards a three-dimensional cost-effective registration of the archaeological heritage, Journal of Archaeological Science 40 (2): 1108–1121.

Usability studies, evaluations of user experience, and standardized ways to demonstrate what interaction is expected to happen or not happen in virtual heritage projects need to be better investigated, communicated and verified in order to verify the effectiveness of interaction. How interaction is intended, what actually takes place and how to archive it separately from the model (so it can be easily extracted) are difficult issues but some projects attempt to address this (**https://idre.ucla.edu/research/active-research/vsim**).

P.7 Gaps in Preservation Infrastructure

Hal Thwaites summarized key critical issues for virtual heritage infrastructure:

»In the very near future some critical issues will need to be addressed; increased accessibility to (and sharing of) heritage data, consistent interface design for widespread public use and re-presentations of work, the formalization of a digital heritage database, establishment of a global infrastructure, institutionalized, archival standards for digital heritage and most importantly the on-going curation, of work forward in time as the technology evolves so that our current digital, heritage projects will not be lost to future generations. We cannot afford to have our digital heritage disappearing faster than the real heritage or the sites it seeks to ›preserve‹ otherwise all of our technological advances, creative interpretations, visualizations and efforts will have been in vain.« 24

■ **24**
Harold Thwaites, Digital Heritage: What Happens When We Digitize Everything? In: Eugene Ch'ng, Vincent Gaffney, Henry Chapman (Eds.), Visual Heritage in the Digital Age, Springer, London, 2013, pp. 327–348.

Virtual heritage projects display new uses and potential of technology for cultural heritage, but the funding models and composition of project teams have had minimal usability evaluations and preservation strategies. Publications are found in journals such as **Internet Archaeology, Journal of Computing and Cultural Heritage,** and **Digital Applications in Archaeology and Cultural Heritage,** but actual virtual heritage models are not so common. There are very few online and library-accessible depositories for virtual heritage models, and many of the academic research projects lack long-term infrastructure and preservation strategies. Yet infrastructure is critical if we are to sustain scholarly communication, enrich public involvement and consolidate the currently promised — rather than proven — **heritage** component of **virtual heritage.**

If we are serious in our aim to help the public understand and be involved in virtual heritage then the public need to understand the potential and limita-

tions of the technologies as well. Workshops on 3D tools and software are required, which will allow communities, heritage groups and classrooms to learn from developing their own models and artefacts using free and open source game engines and 3D modeling tools. Further, the research and support of these infrastructures should be supported and rewarded by the academic community.

Key features of 3D models should be that they engage the audience, are formative (allowing the audience to create test and share hypotheses), can be recycled and reconfigured, and are amenable to preservation. However, researchers [25] have cast doubt on the ongoing reliability of 3D data for long-term preservation and they have warned:

»The possibility exists for precious and costly data sets to be lost on failed hard-drives, destroyed in floods or fires, or simply thrown out.« [26]

Despite recent European and North American moves to create archives and digital humanities infrastructures, 3D models have not yet been fully incorporated into these new infrastructures while allowing full public access.

Although there are interesting prototypes and selective web-based prototypes (such as **http://vcg.isti.cnr.it/3dhop/** and **http://www.3dicons.ie/3d-content**) and online commercial suppliers of 3D models of varying quality and accuracy, in many other regions there are very few accessible 3D models of heritage sites that use a common, stable format. Recent European trends are to create archives and digital humanities infrastructures but 3D models have not kept up with the progress achieved for other formats of cultural heritage, they are still silos.

There are exciting new developments: such as topoi, which provides citable research data (**http://repository.edition-topoi.org/**); the inclusion of 3D data in the Archaeology Data Service ADS), United Kingdom (**http://archaeologydataservice.ac.uk/**); Sketchfab, which publishes a large range of 3D interactive models that can be viewed in different contexts including Google CardboardVR (**https://sketchfab.com/**); **www.patrimonium.net**; [27] and 3Dhop, an

»open-source software package for the creation of interactive Web presentations of high-resolution 3D models, oriented to the Cultural Heritage field«

(**http://3dhop.net/**). However, we still need these portals and repositories to provide clearer examples and workflows or demonstrate how to demarcate levels of accuracy and authenticity.

■ 25
Sven Havemann, Intricacies and Potentials of Gathering Paradata in the 3d Modelling Workflow, in: Anna Bentkowska-Kafel, Hugh Denard, Drew Baker (Eds.), Paradata and Transparency in Virtual Heritage, Ashgate, London 2012, pp. 145–162.

■ 26
Kelly Greenop, Justin Barton, Scan, Save, and Archive: How to Protect Our Digital Cultural Heritage, in: The Conversation, 2014, https://theconversation.com/scan-save-and-archive-how-to-protect-our-digital-cultural-heritage-22160

■ 27
Piotr Kuroczyński, Oliver Hauck, Daniel Dworak, 3D Models on Triple Paths – New Pathways for Documenting and Visualizing Virtual Reconstructions, in: Sander Münster, Mieke Pfarr-Harfst, Piotr Kuroczyński, Marinos Ioannides (Eds.), 3D Research Challenges in Cultural Heritage II: How to Manage Data and Knowledge Related to Interpretative Digital 3D Reconstructions of Cultural Heritage, Springer, Cham 2016, pp. 149–172.

P.8 Solutions

The above issues are directly related to a more fundamental problem, the design, maintenance 01 and circulation of the digital models themselves and how they could and should link to both the interactive experience and the documentation required to communicate, debate and preserve archival and scholarly resources. To address at least some of these problems, the virtual heritage community needs to debate and adopt a scholarly ecology (an overall system and community that provide feedback, management and impact for virtual heritage research).

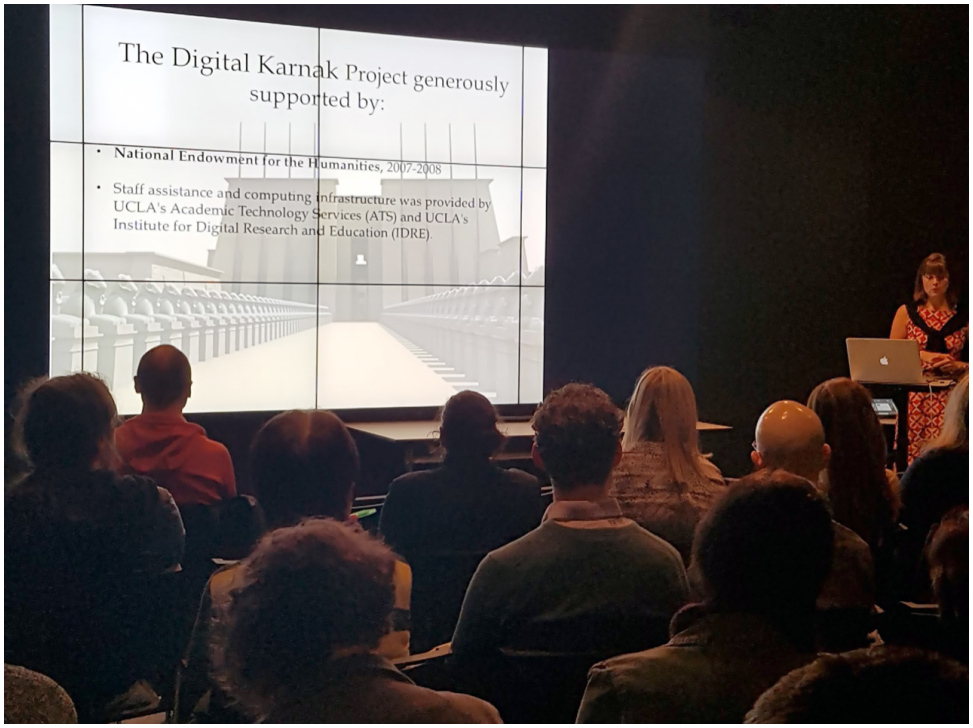
Tost and Champion 28 argued that virtual heritage projects should demonstrate: care, accuracy, sensitivity, effective and inspirational pedagogical features, collaborative, and evaluation-orientated. Extrapolating from these aims, the following features are desirable for designing 3D virtual heritage models or developing an infrastructure that can support virtual heritage models for the purpose of classroom teaching and public dissemination: 02

- → Data accuracy: the level of accuracy and type of data capture method should be associated with the model, as well as the geographical location.
- → Format limitations: any known limitations or required conditions due to the digital format or way in which the data was created, should also be associated with the model.
- → Provenance: the record of ownership and scholarship and community input should be recorded and accessible (the source and the ownership rights).
- → Community protocols: social, cultural and institutional protocols that guide who accesses the sourced cultural heritage and how that should affect the transmission, distribution and dissemination of the digitally simulated model.
- → Authenticity: the known, extrapolated, omitted, simplified and imagined areas and components of the model should be identified in some form of thematic (and preferably standardized) schema.

■ **28**
Laia Pujol Tost, Erik Champion, Evaluating Presence in Cultural Heritage Projects, in: International Journal of Heritage Studies, 18 (1), 2011, pp. 83–102.

☐ 01
The Advanced Challenges in Theory and Practice in 3D Modeling of Cultural Heritage Sites Workshop, at UCLA, 20–23 June 2016, noted the failure to preserve many Augmented Reality projects.

P.9 Features of 3D Formats



☐ 02
Dr Elaine Sullivan, Digital Karnak project on the challenges in publishing 3D models (GLAMVR 2016 event, Curtin University).

Any file format is supported should be robust, durable and open (with minimum data loss) to various import and export formats. However, these features are not enough if the file format is too limited to support the aims of virtual heritage models. As an initial tentative suggestion, a 3D file format for virtual heritage should provide the following features:

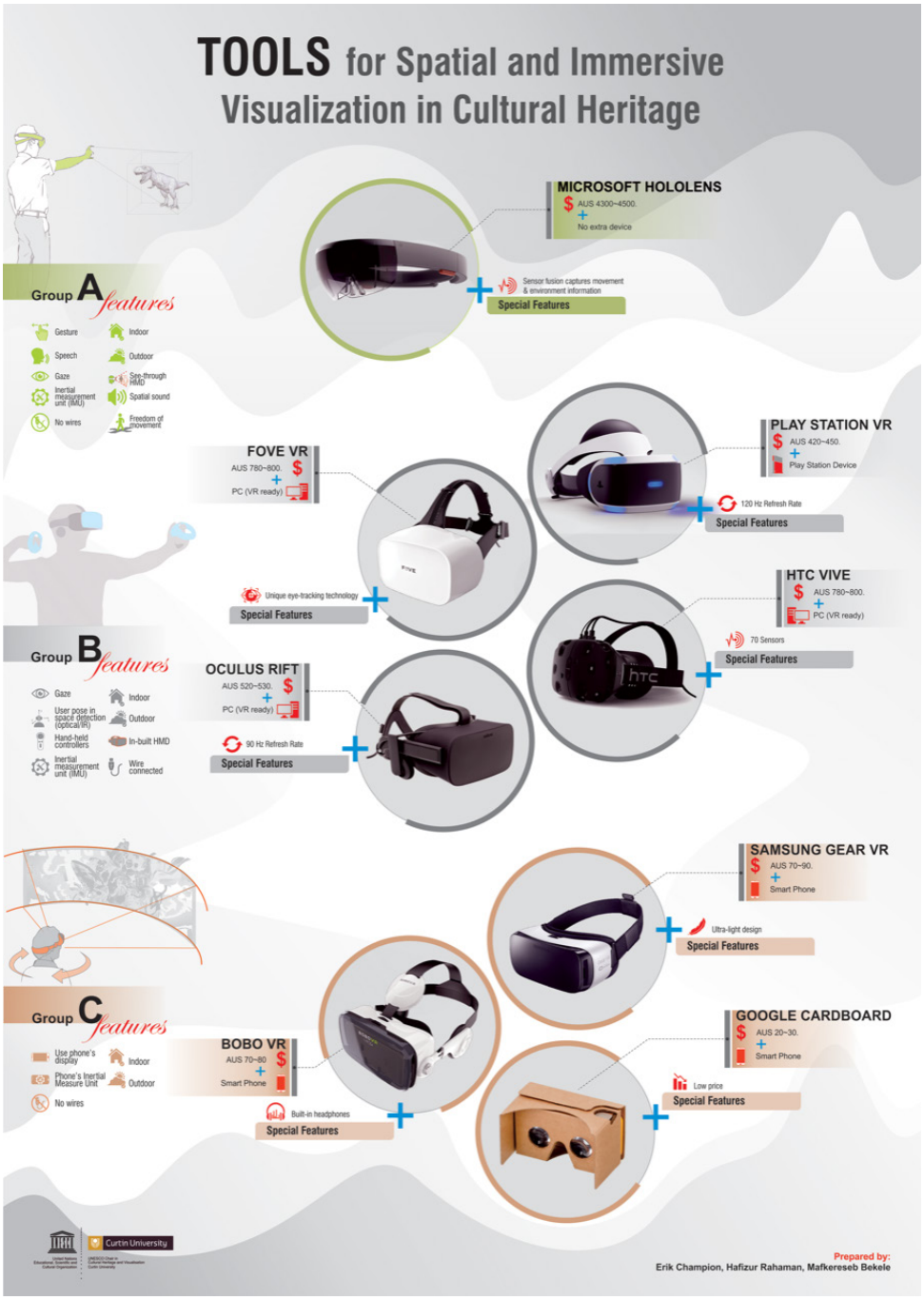
- → Zoom in, zoom out, rotate, and walk around.
- → Certain points in the text can link to camera views.
- → Can remove or add parts of the model (as components, areas, layers, or in terms of authenticity).
- → Can change from wireframe to textured view.
- → Can take screenshots.
- → Can incorporate annotations.
- → Can pose and change the field of view.
- → Can measure between parts of the online model.
- → Can handle large file sizes.
- → Has many import and export options.
- → Can work with timelines, so that the model can show changes over time.

When hosted with other data online, the historical and hypothetical simulations could require the following features:

- → As a core part of a scholarly ecosystem, the historical simulation as a 3D model should be traceable; it should link to previous works and to related scholarly information.
- → The model should be component-based so that parts can be directly linked and updated. Web models would be dynamically created at run-time.
- → The model should be engaging, thus extensive play-testing and evaluation will be required to ensure that it actually does engage its intended audience.
- → As part of a scholarly infrastructure, the 3D model format (and all related data formats) should be easy to find and reliable.
- → The model should not require huge files to download, or it should at least provide users with enough information to decide whether and what to download.
- → Metadata should record the completeness, measurement methodology and accuracy of the models.

P.10 From Stand-alone Models to Flexible Component-based Systems

There are four major themes here of great import to a virtual heritage repository. Firstly, as was noted above, VR equipment 03 is moving towards the consumer level and as a component-based system where your smartphone is both the stereoscopic viewer, and the computer (such as the Samsung Gear). These consumer technology frameworks will help VR technology and related content become far more accessible.



☐ 03
A range of consumer MR / VR headsets available in 2018 (Hafizur Rahaman, Erik Champion).

Secondly, there are research groups now so concerned at the silo mentality of earlier virtual heritage projects that they are developing technology that either allows people to create their own content using free and open source technology such as the EU Chess project. 29 or they are developing technical exemplars using free software that others can download and modify and thus learn from, for example, CINECA's APA reusable game assets-serious game project using the free Blender 3D software. 30

Thirdly, a few journals provide technology that allows authors to add 3D models inside or next to text-based articles. Two journals that come to mind are Internet Archaeology, (**http://intarch.ac.uk/**) and Digital Applications in Archaeology and Cultural Heritage (**http://www.journals.elsevier.com/digital-applications-in-archaeology-and-cultural-heritage/**).

Fourthly, if a game engine (a real-time rendering engine) is required, then a solution would be to have the game engine or application add the components (assets) dynamically, requiring the model to be broken up into sub-components and then the computer would stream and connect to these subcomponents (packages) at runtime. There may also be a compromise solution that allows both a robust but limited 3D format for archived models and a more interactive format available either via a browser or as a downloadable application.

Could virtual heritage researchers further the development of a digital heritage journal with support from a community of specialists? Can tools, methods, projects, scholarly communities and an open-access online journal-publishing system exist to communicate between and beyond digital research infrastructures, versed in text or in 3D models? How to encourage communities to adopt and extend this **›ecosystem‹**?

■ **29**
Laia Pujol, Maria Roussou, Stavrina Poulo, Oliver Balet, M. Vayanou, Y. Ioannidis, in: Graeme Earl, Tim Sly, Angeliki Chrysanthi, Patricia Murrieta-Flores, Constantinos Papadopoulos, Iza Romanowska, David Wheatley (Eds.), Personalizing Interactive Digital Storytelling in Archaeological Museums: The Chess Project, Archaeology in the Digital Era, Proceedings of the 40th annual conference of Computer Applications and Quantitative Methods in Archaeology, Southampton, 26–29 March 2012, pp. 77–90.

■ **30**
Antonella Guidazzoli, Maria Chiara Liguori, Mauro Felicori, Sofia Pescarin, Creating New Links among Places through Virtual Cultural Heritage Applications and Their Multiple Re-Use, in: Mediterranean Archaeology and Archaeometry 14 (4), 2014, pp. 17–24.

P.11 Scholarly Appraisal of VH Infrastructure

Bilder and Neylon wrote:

»What should a shared infrastructure look like? Infrastructure at its best is invisible. We tend to only notice it when it fails. If successful, it is stable and sustainable. Above all, it is trusted and relied on by the broad community it serves. Trust must run strongly across each of the following areas: running the infrastructure (governance), funding it (sustainability), and preserving community ownership of it (insurance).« 31

A successful scholarly virtual heritage infrastructure could be assessed in terms of how it supports the development of new research and grants and how it is used to provide evidence for academic esteem and promotion. How could a virtual heritage infrastructure help scholarly review of the projects

■ **31**
Geoffrey Bilder, Jennifer Lin, Cameron Neylon, Principles for Open Scholarly Infrastructures, Science in the Open, 2015, http://dx.doi.org/10.6084/m9.figshare.1314859.

themselves? It could provide a systematic way to show changes over time, allow for viewing on different formats for varying input mechanisms and learning mediums, allow counterfactual exploration, log user responses, track user preferences and share insights and personal feedback from distributed audiences. And it could help content creators assess impact, usability and usefulness automatically, and help make comparisons to other projects.

Ideally, it would also augment **scholarly research of the content**, as well as educational source material, providing associated tools, interpretative mediums and careful references as well as usage data that could provide evidence for solid scholarly arguments.

Above all, it would be an **ecosystem**. All its parts would be interdependent, and it would hopefully be greater than the sum of its parts. A review community would be summoned to discuss and add to the models via publications and related links, and future publications could, in turn, integrate the community feedback into new research findings, improved critiques, and an enhanced research base.

These solutions include:

- → Adoption of a 3D file format that allows the separation of both archive and online display.
- → Agreed-upon ontology disseminated widely.
- → Wizards to create metadata easily and conveniently following agreed charters; lucid scenarios and examples of 3D workflows with community feedback forums.
- → Design of digital models as combinations of components that can incorporate Linked Open Data, connections with academic publication frameworks, digital archives and other media assets.
- → Variable levels of detail of resolution to provide copyright holders with some level of control and authorship.
- → The fostering of prizes and awards via national and international communities for best practice projects and to promote scholarly 3D models as academic outputs.
- → Cultural presence: models should aim towards explaining the cultural significance of the original site, and give an impression of the situated cultural value of the place as experienced by the original inhabitants.
- → Evaluation Data: these aims should be clearly explained and any evaluation data of participants should be linked to (or otherwise associated with) the models.
- → Purpose: the generic ways in which original creators and shareholders intended the models could be edited or otherwise modified, should be described.
- → The model must provide some degree of access and feedback from the wider public or specialized interest groups and shareholders.

P.12 Conclusion

Virtual heritage is not a dependable and demonstratively effective communication medium; the field contains too few examples of accessible useful and engaging models that one can test, verify, experience and learn from. Virtual heritage urgently requires more usability research, but the biggest issue is the preservation of the research data and 3D models. To solve this, virtual heritage requires a systematic pipeline featuring open source software, a well-organized online archive of 3D models in a robust open format, and globally accepted metadata. But it also requires a community who reviews, critiques, augments and maintains suitable content. In short, a digital scholarly ecosystem for cultural heritage.

It may appear that the overall number and difficulty of technical issues is the major problem to resolve, but if there is no public involvement, understanding and appreciation, the virtual heritage project has failed despite any technical brilliance or infrastructure support. Indeed, infrastructure that is not used is not really infrastructure; it is merely equipment. Previous writers have written convincingly about the importance of archives [32] but there is another important step, ensuring the archive is effectively used. As Garnett and Edmond have declared, [33] there are many issues with APIs, but one critical issue is how to get enough people to use them. The success of virtual heritage projects as both a communication and preservation medium depends on community involvement, which includes scholars, students, the wider public, but also the original shareholders and owners of the cultural content simulated. Shared understanding requires clear aims, methods and terms, but above all, it requires a comprehensive methodology. Otherwise, the field will not scale, and it will not progress.

■ 32
W. F. Limp, A. Payne, S. Winters, Adam Barnes, Jackson Cothren, Approaching 3d Digital Heritage Data from a Multi-Technology, Lifecycle Perspective, in: Francisco Contreras, Mercedes Farjas, Francisco Melero (Eds.), Proceedings of the 38th Annual International Conference on Computer Applications and Quantitative Methods in Archaeology (CAA), Granada 6–9 April 2010, pp. 15–22.

■ 33
Vicky Garnett and Jennifer Edmond to Impact of Social Science blog, of the London School of Economics, 13 Vicky Garnett and Jennifer Edmond, Building an API is no t enough! Investigating Reuse of Cultural Heritage Data, in: LSE Impact Blog, 2014, http://blogs.lse.ac.uk/impactofsocialsciences/2014/09/08/investigating-reuse-of-cultural-heritage-data-europeana.