International Guidelines for Virtual Archaeology: The Seville Principles

16

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16.1 Virtual Archaeology: Definition and Term

Our ancestors, whether individually or as a group, knowingly or unknowingly, left a trail of evidence of their existence, of their time on this planet. This evidence is nothing more than a small set of fragments of an infinitely broader and more complex reality that becomes increasingly more obscure as we go further back in time. So there is far less evidence dating back to over 5,000 years which has survived up to the present day than there is dating back scarcely 200 years. For decades now, the work of archaeologists has been to search for all these traces, regardless of their age, size or geographical location, so that, through study and examination, they can endeavour to rebuild the complex puzzle that is history, to uncover the evolution of past human societies. With this purpose in mind, archaeologists use whatever scientific advances and knowledge are available to them at any given time. So, for example, the latest breakthroughs in chemistry or physics enable us to detect substances in archaeological sites that, until very recently, had gone completely unnoticed. The application of the latest advances in geophysics or remote sensing can reveal the location and shape of underground objects, even before excavation begins. The methodical anthropological studies of human groups in the present make it easier for us to understand human groups in the past, and all this evolves in parallel with a society that is becoming ever more interested in discovering and

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understanding the past. It is precisely this new relationship between archaeologists and the society in which they work that has brought about substantial changes in archaeological theory and practices. In this way, the practice of archaeology is no longer confined to the field of research, but is now involved in the conservation and dissemination of its results, by means of its most visible formula: archaeological heritage. The material remains of the past are conserved as irrefutable proof of historic discourse, but they are also held up as teaching tools and for the dissemination of the knowledge generated through archaeologists' work. The need to know, to discover and to better understand what our ancestors were like and how they lived has led archaeologists to refine their methods and techniques. It is no longer enough just to vaguely explain what a Roman city may have looked like or what happened at the Battle of Gaugamela. People want to see what happened with their own eyes while also calling for material remains that have survived the passing of time to be conserved for future generations. Such demands surpass the classical conception of archaeology and open the door to the birth of new scientific disciplines. And so virtual archaeology is born.

It seems correct to say that virtual archaeology is a scientific discipline with its own identity, despite feeding on expertise from different areas of knowledge, as it has its own objectives and methods that are different from other disciplines. This condition does not make it a science or a completely independent field of learning as it is directly dependent on the archaeological discipline, just as archaeology has a direct relationship with historical science and anthropology. To this effect, just as archaeology is either history/anthropology or it is nothing, virtual archaeology is either archaeology or it is nothing.

Precisely for this reason, virtual reconstructions that include a large number of elements that have not been verified either archaeologically or historically cannot be considered as virtual archaeology, but rather as historical narrative, in other words, a genre in which reality and fiction become blurred, in which it is impossible for the viewer or the public to distinguish between the two. The same thing occurs between history books and historical novels or between documentaries and films based on historical facts. Obviously this does not mean that any virtual reconstructions and their applications must have a total degree of certainty, as the study of the past is inherently subjective and partial, but rather that they must be based on empirical hypotheses that are constructed through a detailed study of the past and its remains.

From a purely nominative point of view, the use of the term virtual archaeology is intrinsically wrong if we understand it to be the sum of two already existing words (virtual + archaeology), and it would probably be more correct to say digital archaeology or cyber-archaeology. However, if we choose to approach the term as if it were a single item, its meaning is more or less clear, in so far as it is widely used by the international scientific community. In this case, we understand language to be a social construct that is arranged around words or expressions that are used by a community of speakers, and on the basis of that circumstance, we accept the use of virtual archaeology as a valid term. This does not, however, prevent many experts from preferring to speak of digital archaeology or cyber-archaeology when referring to the same concept.

16.2 Historical Background to the Creation of an International Charter of Virtual Archaeology

All scientific disciplines are evidently characterised by the existence of a community of experts that research, and at the same time disseminate, the results of their studies. In the case of virtual archaeology, this community of experts has been gradually growing since the 1990s, to the point where it is now large enough to have national societies. This is the case of the Spanish Society of Virtual Archaeology (SEAV) which, since it began in the year 2008, has brought together over 23 research groups and 21 private Spanish companies concerned about the future of virtual archaeology. For this reason, one of the first

measures that the SEAV has set up is the International Forum of Virtual Archaeology (IFVA), aimed at laying the theoretical foundations for the international future of virtual archaeology. The Forum's primary objective has been to lead the transnational creation of the International Charter of Virtual Archaeology, also known as the Seville Charter, or the Seville Principles. To facilitate this process, the SEAV created the International Meeting of Archaeology and International Meeting on Graphic Archaeology and Informatics, Cultural Heritage and Innovation (ARQUEOLÓGICA 2.0), which was held for the first time in La Rinconada (Seville) in June 2009. At that time, both the meeting and the Forum proposed that it was a primary objective to establish a debate between some of the leading experts worldwide about whether or not it is relevant to create an international charter aimed at adapting the general principles of the London Charter to the field of virtual archaeology, as all scientific knowledge is based on criteria that are accepted by the majority of that scientific community.

With this purpose in mind, a monographic session was held during ARQUEOLÓGICA 2009 entitled "Reflections on the London Charter", in which three of its signatories, Richard Beacham of King's Visualisation Lab., King's College; Sorin Hermon of the Digital Cultural Heritage and Archaeological Sciences of Cyprus; and Juan A. Barceló of the Universidad Autónoma de Barcelona, explicitly showed their support for the SEAV initiative to create a new document that should be capable of achieving broad international agreement. After this monographic session, a plenary session was held, entitled "Bases of Virtual Archaeology", in which 30 prestigious experts and researchers in this field of expertise took part, reaffirming the need to suitably define and give shape to the field of virtual archaeology, taking into account that nothing of this kind had been possible up until that moment, despite the discipline's growing popularity and the frequent use of the term around the world (Fig. 16.1).

The conclusions drawn from the first meeting of the International Forum of Virtual Archaeology left no doubt: there was an urgent need to start work on creating an international charter of

Fig. 16.1 Session entitled "Reflections on the London Charter". First International Meeting on Graphic Archaeology and Informatics, Cultural Heritage and Innovation (ARQUEOLÓGICA 2.0)

virtual archaeology. In the words of Dr. Almagro, "We cannot overlook the need to establish or define certain rules or guidelines – not legal impositions – to attempt to contain the indiscriminate production of 3D models with no basis or criteria whatsoever, which, thanks to the visual attraction and potential of their means of dissemination, can inundate a market demanding this type of product" (Almagro 2008, 43).

Intense efforts then began at the SEAV to produce a first draft of what would go on to be the International Charter of Virtual Archaeology. This work, in which many members of the SEAV collaborated, was presented in June 2010 in La Rinconada (Seville) during the second meeting of the International Forum, within the framework of the 2nd International Meeting on Graphic Archaeology and Informatics, Cultural Heritage and Innovation (ARQUEOLÓGICA 2.0), and it was warmly received by all participants in the Forum.

In parallel to the ARQUEOLÓGICA 2010 meeting and in keeping with one of the main objectives of the International Forum of Virtual Archaeology, the international scientific journal *Virtual Archaeology Review* (VAR) was launched, with the aim of becoming established as a prestigious international journal that would be capable of reaffirming virtual archaeology as an independent and recognised field of research, as all scientific knowledge aims to divulge its research

studies via specialist publications (http://varjournal.es). Since 2010, the creation of VAR has been playing an important role in drawing up the Seville Charter. So, for example, issue number four of the journal is exclusively dedicated to dealing with the theoretical aspects of the discipline, something which is essential to be able to set genuine scientific standards.

Furthermore, in order to improve dissemination and the knowledge that the international scientific community has about the process involved in drawing up the Seville Charter, a website has been created: www.arqueologiavirtual.com. This site offers information not only about the International Charter of Virtual Archaeology but also about other activities, such as the International Forum, ARQUEOLÓGICA 2.0 and the Spanish Society of Virtual Archaeology itself.

The third and fourth meetings of the International Forum of Virtual Archaeology, held during ARQUEOLÓGICA 2011 and 2012, respectively, have enabled a basic document to be established, in collaboration with eminent members of the CIPA-ICOMOS such as José Luis Lerma, Ana Almagro and Mario Santana. The experience provided by these researchers and the valuable recommendations offered by eminent members of the scientific community, such as Alonzo C. Addison (UNESCO) or Jean-Louis Luxen (ex-president of ICOMOS), have enabled a first and final international draft to be approved, under the category of Principles, instead of Charter. This document, which has already been put into practice in many countries, will be discussed below.

16.3 Principles of the Charter

The London Charter (http://www.londoncharter.org) is currently the most advanced international document in this direction. Its various updates reveal the overwhelming need to find a document with recommendations that can serve as a basis for designing new projects with greater rigour in the field of cultural heritage but also to propose new recommendations and guidance tailored to the specific needs of each branch of learning and community of experts. For this reason, the objectives set out in the London Charter aim to "offer a robust foundation upon which communities of practice can build detailed London Charter Implementation Guidelines". And we must not forget the immeasurable scope of the concept of cultural heritage, which encompasses such broad areas as monumental, ethnographic, documentary, industrial, artistic, archaeological and oral heritage. The London Charter takes full account of the cultural heritage as a concept and therefore the specific needs of each of its constituent parts. For this reason, the Preamble to the London Charter recognises these needs: "as the aims that motivate the use of visualization methods vary widely from domain to domain, Principle 1: 'Implementation', signals the importance of devising detailed guidelines appropriate to each community of practice". Principle 1.1 recommends, "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". It therefore seems obvious that given the importance of archaeological heritage as part of cultural heritage, and since many recognise the existence of a community of experts who focus specifically on the concept of virtual archaeology, consideration must be given to the preparation of guidelines, documents and recommendations that, following the general guidelines established by the London Charter, take into account the specific nature of virtual archaeology. The principles discussed below aim 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.

16.3.1 Principle 1: Interdisciplinarity

"Any project involving the use of new technologies, linked to computer-based visualisation in

the field of archaeological heritage, whether for research, documentation, conservation or dissemination, must be supported by a team of professionals from different branches of knowledge". "Given the complex nature of computer-based visualisation of archaeological heritage, it can not be addressed only by a single type of expert but needs the cooperation of a large number of specialists (archaeologists, computer scientists, historians, architects, engineers etc.)" (1.1). Under a traditional classification of scientific knowledge, virtual archaeology is a blend of social/human sciences (anthropology, history, didactics, etc.) and natural/exact sciences (geography, biology, chemistry, geology, IT, engineering, etc.). This hybrid nature, a result of the overlap between many different existing sciences, is typical of the astounding growth produced by scientific knowledge throughout the twentieth and early twenty-first centuries, which has led to numerous sciences being born out of the juxtaposition of segments that had already been established by previous sciences. We need look no further than the case of biochemistry, which arose out of the union between chemistry and biology, or electrochemistry, a result of electricity and chemistry coming together. Roughly speaking, we could say that virtual archaeology is a result of the union between archaeology and IT, although it relies on collaboration from many other scientific disciplines.

"A truly interdisciplinary work involves the regular and fluid exchange of ideas and views among specialists from different fields. Work divided into watertight compartments can never be considered interdisciplinary even with the participation of experts from different disciplines" (1.2). The dialogue and ideas that arise in any attempt to share information between professionals from different fields of expertise are always more rewarding and enriching than a mere sum of isolated ideas, as they promote critical thinking and a diversity of perspectives.

"Among the experts who must collaborate in this interdisciplinary model, it is essential to ensure the specific presence of archaeologists and historians, preferably those who are or were responsible for the scientific management of the excavation work or archaeological remains to be reconstructed" (1.3). The reasoning that justifies and recommends the presence of the archaeologists who took part in the excavation process is related to the paradox of archaeological destruction/investigation (Wheeler 1979, p. 9; Carandini 1997, p. 256), according to which any excavation is synonymous with destruction as it is the same as "burning the pages of the only existing copy of a book, immediately after reading it" (Carandini 1997, p. 256). Excavating entails selecting, rejecting, destroying, conserving and establishing hierarchies and priorities of certain details over others. During the excavation process, many details are not recorded in the corresponding reports, photographs or drawings, simply because it is impossible to document everything. Nevertheless, such details always remain in the excavator's mind. This is why there is no more comprehensive report or more detailed documentation about an excavation than that which is captured in the memory of the archaeologist in charge of that excavation. That information can be priceless, for example, when carrying out a virtual reconstruction.

16.3.2 Principle 2: Purpose

"Prior to the development of any computer-based visualisation, the ultimate purpose or goal of our work must always be completely clear. Therefore, different levels of detail, resolutions and accuracies might be required". "Any proposed computer-based visualisation will always aim to improve aspects related to the research, conservation or dissemination of archaeological heritage. The overall aim of the project must be encompassed within one of these categories (research, conservation and/or dissemination). The category concerning dissemination includes both educational projects, whether formal or informal education, and recreational projects (cultural tourism)" (2.1). Establishing in advance what the main objective of our intervention is may represent significant time and money savings; for example, the level of detail required to consider a virtual reconstruction for research purposes will never be the same as

that required for a virtual reconstruction for the purposes of recreation. In the first case, referring to research, the most important thing is to generate working hypotheses that are particularly in line with reality, i.e. accurate and precise, without worrying too much about the superficial quality of the generated image, while in turn offering the archaeologist the chance to move freely around the recreated virtual setting in order to verify or reject the interpretative model. In contrast, in the second case referring to dissemination, even respecting the principle of historical rigour, we would need to work much harder on the finishes to achieve the most realistic image possible of the past, generating credible virtual shots that are easily understood by an audience that is not specialised in this subject. In this second case, it is probably not necessary for the viewer to have the chance to move around the virtual space, as the reconstructions and recreations will generally be used in non-interactive media, such as documentaries, fixed panels and leaflets (López-Menchero 2011).

"In addition to clarifying the main purpose of computer-based visualisation, more specific objectives must always be defined in order to obtain more precise knowledge of the problem or problems to be resolved" (2.2). Breaking the principal objective down into smaller, more accessible objectives will enable the work on the project to be arranged in order and hierarchy more efficiently, while at the same time making it easier to carry out a subsequent assessment of the project once it has been completed, as it will be easier to see, in detail, whether or not the proposed objectives have been met.

"Computer-based visualisation must be always at the service of archaeological heritage rather than archaeological heritage being at the service of computer-based visualisation. The main objective of applying new technologies in the comprehensive management of archaeological heritage must be to satisfy the real needs of archaeologists, curators, restorers, museographers, managers and/or other professionals in the field of heritage and not vice versa" (2.3).

"Ultimately, the main purpose of virtual archaeology will always be to serve society as a whole and contribute to increase the human knowledge" (2.4). Virtual archaeology only makes sense if it is developed to improve people's quality of life through culture: firstly, for ethical reasons, but secondly for practical reasons, as most virtual archaeology projects are funded by public financing. If people do not perceive any benefit in their everyday life, they will stop financing this type of project; if, however, they consider the project to be something useful and valuable for societies' progress and development, they will increase the funds available for this purpose.

16.3.3 Principle 3: Complementarity

"The application of computer-based visualisation for the comprehensive management of archaeological heritage must be treated as a complementary and not alternative tool to other more traditional but equally effective management instruments". To this effect, "Computer-based visualisation should not aspire to replace other methods and techniques employed for the comprehensive management of archaeological heritage (e.g., virtual restoration should not aspire to replace real restoration, just as virtual visits should not aspire to replace real visits)" (3.1). A marvellous example of complementarity can be found in the restoration of the famous fountain in the Court of the Lions in the Alhambra (Granada, Spain), where 3D digitalisation was firstly carried out with a laser scanner covering the entire complex and was later used to analyse the most damaged areas and their possible restoration on the computer. The restorers did not start on the real restoration until the virtual restoration of the complex was completed. This method avoided subsequent complications and gave the restoration team great confidence when it came to tackling the real restoration, as they had prior experience of having carried out the same work in a virtual way (Cano et al. 2010).

"Computer-based visualisation should seek forms of collaboration with other methods and techniques of a different nature to help improve current archaeological heritage

Fig. 16.2 Santimamiñe virtual cave. Developed by the Spanish company Virtualware – www.virtualwaregroup.com

research, conservation and dissemination processes. To do so, compliance with "Principle 1: Interdisciplinarity" will be fundamental" (3.2). "Nevertheless, computer-based visualisations might be an alternative approach when original archaeological remains have been destroyed (e.g., due to the construction of large infrastructures), are placed in areas with difficult accessibility (e.g., without roads) or at risk of deterioration due to the huge influx of tourists (e.g., rock paintings)" (3.3). In these exceptional circumstances, the virtual solution is the only possible answer, whether to conserve the archaeological heritage (3D digitalisation guarantees the heritage is conserved, albeit digitally) or for its dissemination (see the case of virtual caves, such as Santimamiñe: Barrera and Baeza 2010) (Fig. 16.2).

16.3.4 Principle 4: Authenticity

"Computer-based visualisation normally reconstructs or recreates historical buildings, artifacts and environments as we believe they were in the past. For that reason, it should always be possible to distinguish what is real, genuine or authentic from what is not. In this sense, authenticity must be a permanent operational concept in any virtual archaeology project". However, we must always bear in mind that the methods used to increase the 3D models' levels of scientific transparency must differ according to the sector in question. So, for example, the method used for conventional users, i.e. the general public, must be simple, fast and intuitive, as is the case with the system developed by the "Troia VR" project. In contrast, when the end recipients are other researchers, the level of precision must be much higher, providing as much information as possible.

"Since archaeology is complex and not an exact and irrefutable science, it must be openly committed to making alternative virtual interpretations provided they afford the same scientific validity. When that equality does not exist, only the main hypothesis will be endorsed" (4.1). Unfortunately, in many 3D visualisations aimed at the public, a monolithic, almost positivistic idea of archaeological knowledge is conveyed, without leaving any room for alternative interpretations that, in many cases, afford the same scientific validity as the principal hypothesis. This attitude breaks with the principles of authenticity, rigour and transparency that any scientific research study must uphold, as it prevents the visitor from understanding the complexity and scope of archaeological research (San Martín 1994: 15). In the Roman town of Treignes (Viroinval, Belgium), one of the explanatory panels shows two possible reconstructive hypotheses about the appearance that the town's main façade may have had, awarding equal validity to both possibilities. In this way, the visitor can discover the real status of the research, with all its certainties but also with its uncertainties.

"When performing virtual restorations or reconstructions, these must explicitly or through additional interpretations show the different levels of accuracy on which the restoration or reconstruction is based" (4.2). One of the best systems of scientific transparency (levels of veracity) for researchers that has been developed to date is that of the Vendicari Tower (Sicily, Italy). This system was developed by the Italian company NoReal, under the direction of the architect Davide Borra (2009), and considers its primary premise that any virtual 3D reconstruction must be based on a set of historical and archaeological hypotheses (Fig. 16.3). Those hypotheses are gradually configured, architectural element by

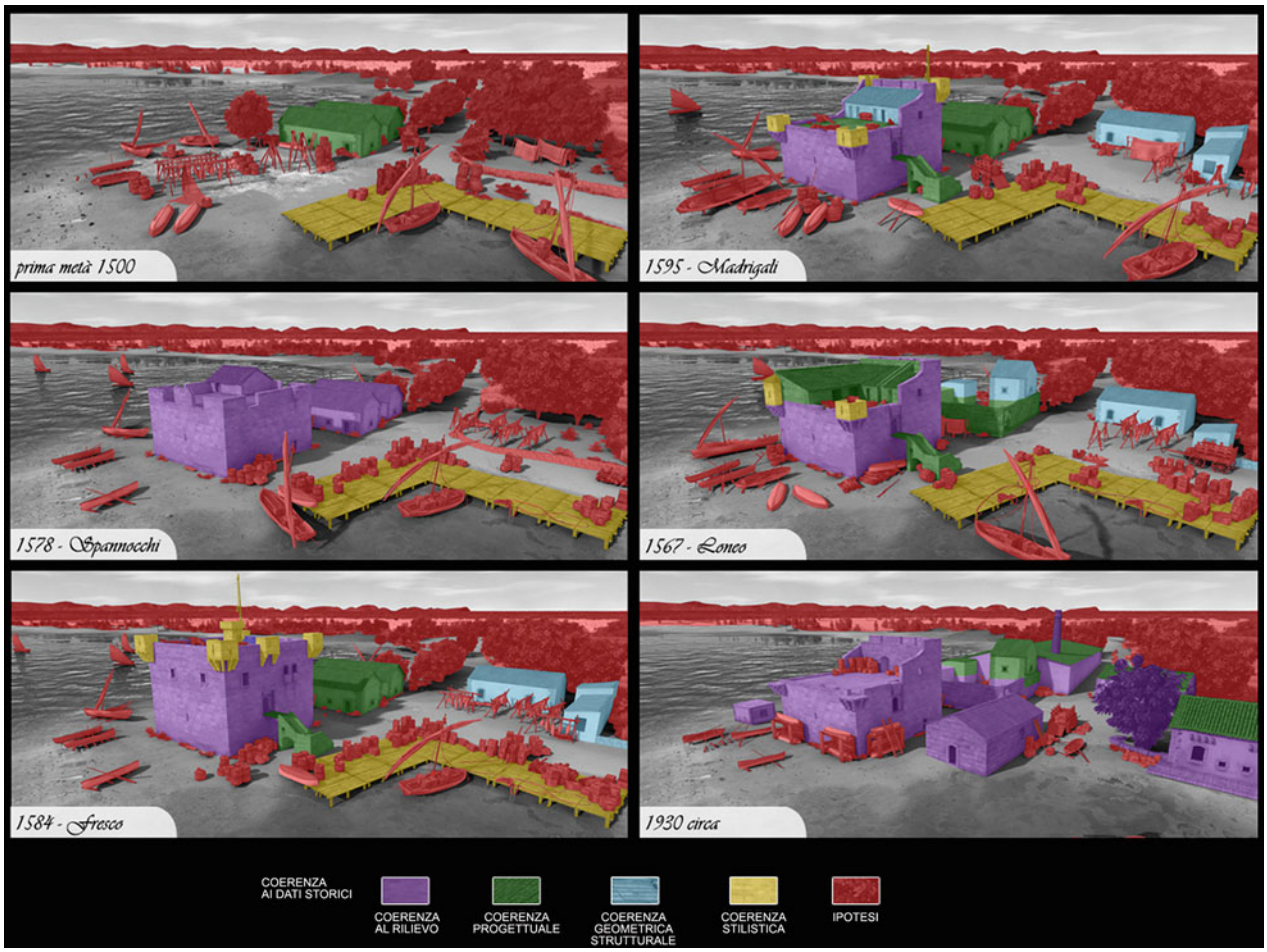

Fig. 16.3 Davide Borra system of scientific transparency (levels of veracity). Vendicari Tower (Sicily, Italy). Developed by the Italian company NoReal

architectural element, object by object, stone by stone, until they finally reach the complete virtual hypothesis, which is habitually known as a virtual reconstruction. In order to discern the 3D model's degree of authenticity, five levels or degrees of certainty are established, each represented by a different colour. For this purpose, a colour scale is defined in which the cold colours represent those elements that have a greater degree of certainty, while the warm colours refer to those elements about which there is less historical or archaeological information available. The colour representation on the 3D model itself enables the degree of certainty to be quickly and intuitively identified, without losing depth and relevance in the information provided. The five levels proposed by Borra are:

Relief (purple). This represents those parts of the 3D model based on archaeological or historical remains that are still visible or reproduced in "objective" iconographic sources.

Project or design coherence (green). This represents those parts of the 3D model that, even if not based on archaeological or historical

remains that are still visible or reproduced in "objective" iconographic sources, may be deduced on the basis of those iconographic sources or remains or by studying written sources.

Geometric/structural coherence (blue). This represents those parts of the 3D model whose existence can be felt using the principle of geometric and structural continuity, with regard to the remains that are still visible or reproduced in "objective" iconographic sources.

Stylistic coherence (yellow). This represents those parts of the 3D model whose existence is presupposed out of a similarity with other structures or objects that have been found in similar archaeological or historical contexts.

Hypothesis (red). This represents those parts of the 3D model whose existence in the past is merely conjecture that cannot be defended through the study of written, iconographic or archaeological sources, but which can, however, be reasonably considered to have existed, by sheer common sense.

"In so far as many archaeological remains have been and are being restored or reconstructed, computer-based visualisation should really help both professionals and the public to differentiate clearly among: remains that have been conserved "in situ"; remains that have been returned to their original position (real anastylosis); areas that have been partially or completely rebuilt on the original remains; and finally, areas that have been virtually restored or reconstructed" (4.3). Digital 3D documentation through the use, for example, of a laser scanner enables us to differentiate between what is currently visible and a possible reconstructive hypothesis; however, what we can see today may have undergone major changes as a result of restorers' work, as they often reconstruct or reincorporate lost parts in the archaeological artefacts and structures. In such cases, for the benefit of authenticity, the 3D models need to provide additional information about which zones have been physically reconstructed and which have been conserved just as they were found during the excavation process.

16.3.5 Principle 5: Historical Rigour

"To achieve optimum levels of historical rigour and veracity, any form of computer-based visualisation of the past must be supported by solid research, and historical and archaeological documentation". "The historical rigour of any computer-based visualisation of the past will depend on both the rigour with which prior archaeological research has been performed and the rigour with which that information is used to create the virtual model" (5.1). As Marcelo Martín (2003, p. 21) has pointed out, we must always bear in mind that "conservation alone means a museum without a public, and dissemination on its own means advertising", as it is research that gives purpose and meaning to the field of archaeological heritage in so far as it is responsible for generating the necessary contents to be able to proceed with its restoration and dissemination. In this sense, investment in archaeological research is fundamental in ensuring the rigour and veracity of any virtual archaeology project. Insufficient funding of research moves virtual archaeology away from science and closer to the world of fiction and entertainment.

"All historical phases recorded during archaeological research are extremely valuable. Thus, a rigorous approach would not be one that shows only the time of splendour of reconstructed or recreated archaeological remains but rather one that shows all the phases, including periods of decline. Nor should it display an idyllic image of the past with seemingly newly constructed buildings, people who look like models, etc., but rather a real image, i.e., with buildings in varying states of conservation, people of different sizes and weights, etc." (5.2). Respect for the value of all the phases and additional elements of a monument or other heritage has been defended for decades now by numerous international documents (Venice Charter, art. 11; Burra Charter, art. 15.4; Ename Charter, art. 3.2 & 3.3). Restricting virtual reconstructions to moments of "maximum splendour" detracts from historical reality, offering a still image of the past that does not correspond to the truth; for if anything characterises human societies, it is precisely their capacity for constant transformation (Figs. 16.4).

Fig. 16.4 Virtual reconstruction of the *Carnuntum* landscape in both summer (*top*) and winter (*bottom*). Developed by the Austrian company 7Reasons Medien GmbH

Fig. 16.5 This installation in the Ename Church (Belgium) is a fantastic example of how to develop economically and technologically sustainable systems. Developed by the Belgian company Visual Dimension

"The environment, landscape or context associated with archaeological remains is as important as the ruin itself. Charcoal, paleobotanical, paleozoological and physical paleoanthropological research must serve as a basis for conducting rigorous virtual recreations of landscape and context. They cannot systematically show lifeless cities, lonely buildings or dead landscapes, because this is an historical falsehood" (5.3). On this point, it is worth recalling the words of Sir Mortimer Wheeler (1979 p. 7), the founder of modern archaeology, when he claimed, "the archaeologist is digging up, not things, but people. If the fragments and pieces with which he works are not alive for him, it would be better if he had looked for another occupation […] Dead archaeology is the driest dust that blows".

"Archaeological heritage recording is extremely important not only for archiving, documentation, analyses and dissemination but for management. New techniques such as photogrammetry or laser scanners can be used to increase the quality of the scientific documentation. In this way, the better the metric documentation of archaeological heritage is carried out, the greater will be the chance to monitor and obtain historically and valuable replicas" (5.4).

16.3.6 Principle 6: Efficiency

"The concept of efficiency applied to the field of virtual archaeology depends inexorably on achieving appropriate economic and technological sustainability. Using fewer resources to achieve steadily more and better results is the key to efficiency". If the new technological means used are excessively complicated, heavy or expensive to run, the archaeological heritage managers and the archaeologists themselves will reject them and keep to their traditional methods. This is currently one of the main challenges facing new technologies, including computer-based visualisation, to make its way in the field of archaeological heritage (Fig. 16.5).

"Any project that involves the use of computer-based visualisation in the field of archaeological heritage must pre-screen the economic and technological maintenance needs that will be generated once installed and operative" (6.1). "Priority must be given to systems that may initially require high investments but yield long term profit, with minimum maintenance cost and high veracity, i.e., low-consumption, resistant, easy to repair or modify systems will be preferred" (6.2). If we are talking about research or conservation, the means used must be as inexpensive and uncomplicated as possible, as they will, to a great extent, have to be totally or partially transported to the excavation site. Likewise, the information generated in a given programme or format must be able to be easily extrapolated to another more modern programme to prevent a definitive loss of that information, as is often the case when information gets trapped in obsolete formats (Howell 2007). On this point, it is advisable to follow the guidelines set by the UNESCO Charter on the preservation of digital heritage (2003).

"Whenever possible, draw on the results obtained by previous visualisation projects, avoiding duplicity, i.e., performing the same work twice" (6.3). Constantly wanting to reinvent the wheel is not only absurd but an unnecessary expense. Logically, in order to make the most of the results obtained in previous projects, those projects must meet some minimum

requisites of scientific transparency, as specified in Principle 7 of this document.

16.3.7 Principle 7: Scientific Transparency

"All computer-based visualisation must be essentially transparent, i.e., testable by other researchers or professionals, since the validity, and therefore the scope, of the conclusions produced by such visualisation will depend largely on the ability of others to confirm or refute the results obtained".

"It is clear that all computer-based visualisation involves a large amount of scientific research. Consequently, to achieve scientific and academic rigour in virtual archaeology projects it is essential to prepare documentary bases in which to gather and present transparently the entire work process: objectives, methodology, techniques, reasoning, origin and characteristics of the sources of research, results and conclusions" (7.1). The more exhaustive the report, the greater the scientific transparency, which will make the results easier to reuse in the future. For the specific case of virtual reconstructions, the recording method put forward by Daniel Pletinckx (2007) could be very useful.

"Without prejudice to the creation of such databases it is essential to promote the publication of the results of virtual archaeological projects in journals, books, reports and editorial media, both scientific and popular science, for information, review and consultation by the international scientific community and society in general" (7.2). Virtual archaeology will find it hard to reach the status of scientific discipline if it does not pay attention to scientific publications, as, at this moment in time, they enable us to assess the quality and impact of a researcher's work. Furthermore, given that most of the funding for virtual archaeology projects comes from public administrations, the recipients of that funding must take on an ethical obligation to the society that allows them to carry out their work. This obligation must include publishing articles in journals that are accessible to the general public.

"The incorporation of metadata and paradata is crucial to ensure scientific transparency of any virtual archaeology project. Paradata and metadata should be clear, concise and easily available. In addition, it should provide as much information as possible. The scientific community should contribute with international standardization of metadata and paradata" (7.3) (Bentkowska-Kafel et al. 2012). While this standardisation is in process, "in general, the registration and organisation of all documentation relating to virtual archaeological projects will be based on the Principles for the recording of monuments, groups of buildings and sites ratified by the 11th ICOMOS General Assembly in 1996" (7.4).

"In the interests of scientific transparency, it is necessary to create a large globally-accessible database with projects that offer optimum levels of quality (Art 8.4), without undermining the creation of national or regional databases of this type" (7.5). The compilation of good practices can considerably help the discipline's progress, which is often marred by the abundance of ongoing projects and the inability to discern their quality.

16.3.8 Principle 8: Training and Evaluation

"Virtual archaeology is a scientific discipline related to the comprehensive management of archaeological heritage that has its own specific language and techniques. Like any other academic discipline, it requires specific training and evaluation programmes". The training programmes that have been run to date are clearly not enough, both due to the lack of programmes and to the number of training hours offered. Among the most interesting initiatives are the International Summer School course "3D modelling in archaeology and cultural heritage" organised by Dr. Fabio Remondino since 2008 in different locations: Ascona (Switzerland), Trento (Italy), Durham (UK) and Grosseto (Italy); the Italian School of Virtual Archaeology (Scuola Italiana di Archeologia Virtuale) organised by the CNR ITABC since 2009; and the Specialisation

Fig. 16.6 Specialisation Course in Virtual Heritage and Archaeology run by Professor Alfredo Grande since 2009 at the Centre for Virtual Archaeology Research and Development (CIDAV) in La Rinconada (Spain)

Course in Virtual Heritage and Archaeology run by Professor Alfredo Grande since 2009 at the Centre for Virtual Archaeology Research and Development (CIDAV) in La Rinconada (Spain) (Fig. 16.6).

To counteract this deficit, "high-level postgraduate training programmes must be promoted to strengthen training and specialisation of a sufficient number of qualified professionals in this field" (8.1). The launch of a training programme under the European project V-Must (www.v-must.net) and the ambitious programme started up by the Spanish Society of Virtual Archaeology (www.seavtraining.com) are aiming to remedy this situation, although there is clearly still a long way to go.

"When computer-based visualisations are designed as instruments for edutainment and knowledge of the general public, the most appropriate method of evaluation will be visitors' studies" (8.2).

"When computer-based visualisations are intended to serve as an instrument for archaeological research and conservation, the most appropriate archaeological evaluation method will be testing by a representative number of end users, i.e. professionals" (8.3). It makes no sense to develop programmes and products for professional groups, such as archaeologists or restorers, without knowing these groups' real needs. The end user must always be the one who determines the problem to be solved. Besides, it is particularly advisable to involve the end user in the process of creating the solution.

"The final quality of any computer-based visualisation must be evaluated based on the rigour of the measures and not the spectacularity of its results. Compliance with all the principles will determine whether the end result of a computer-based visualisation can be considered "top quality" or not" (8.4).

16.4 Definitions

To conclude this chapter, we have felt it appropriate to pause for a moment to look at the question of terminology, as recent decades have seen the appearance of a specialist jargon in the field of virtual archaeology. This new technical language has grown and evolved alongside the new technological and heritage realities, often without its community of speakers even fully realising the process. The main problem with this reality is the manifold meanings that have arisen around many words (Abejón et al. 2006: 471–472). A better understanding of the language we use in the present is crucial to encouraging the progress of any scientific discipline in the future, as words intrinsically possess a performative value that helps to build realities. Probably one of the first international documents to take on board this statement was the Australia ICOMOS Charter for cultural significance sites (the Burra Charter) that set 17 definitions in its first article. Given that the London Charter already has an extensive glossary of terms, the Seville Principles only highlight those concepts that are specifically associated with virtual archaeology, endeavouring to find a direct correlation between terms and definitions that already exist in other international documents dealing with archaeological or architectural heritage and the terms and definitions inherent in the virtual discipline. So, for example, the definition of virtual anastylosis is closely related to the definition of anastylosis given by the Venice Charter in 1964.

The terms defined by the Seville Principles are as follows:

Virtual archaeology: the scientific discipline that seeks to research and develop ways of using computer-based visualisation for the comprehensive management of archaeological heritage.

Archaeological heritage: the set of tangible assets, both movable and immovable, irrespective of whether they have been extracted or not and whether they are on the surface or underground or on land or in water, which together with their context, which will also be considered a part of archaeological heritage, serve as a historical source of knowledge on the history of humankind. The distinguishing feature of these elements, which were or have been abandoned by the cultures that produced them, is that they may be studied, recovered or located using archaeological methodology as the primary method of research and using mainly excavation and surveying or prospection techniques, without compromising the possibility of using other complementary methods for knowledge.

Comprehensive management: this includes inventories, surveys, excavation work, documentation, research, maintenance, conservation, preservation, restoration, interpretation, presentation, access and public use of the material remains of the past.

Virtual restoration: this involves using a virtual model to reorder available material remains in order to visually recreate something that existed in the past. Thus, virtual restoration includes virtual anastylosis.

Virtual anastylosis: this involves restructuring existing but dismembered parts in a virtual model.

Virtual reconstruction: this involves using a virtual model to visually recover a building or object made by humans at a given moment in the past from available physical evidence of these buildings or objects, scientifically reasonable comparative inferences and in general all studies carried out by archaeologists and other experts in relation to archaeological and historical science.

Virtual recreation: this involves using a virtual model to visually recover an archaeological site at a given moment in the past, including material culture (movable and immovable heritage), environment, landscape, customs and general cultural significance.

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