The Scientific Dimensions of the Digital Model

Mario Centofanti

The representative model

All of our activities of *Surveying, Documenting, Analyzing, Interpreting, Planning, Communicating* necessarily converge or rotate around the 'representation model', whether it be of 'restitution' (from a survey), of 'reconstruction' (of a non-existing reality and/or design aims) or of prediction (restoration, project).
Survey is the full expression of disciplinary specificity and autonomy, as regards methods and techniques, but still an integral part of the more complex process of "historical-critical analysis." An analysis that must lead to an integral and integrated knowledge of the architectural specifics, of the clustered buildings, or of the urban reality subject to observation, and to the expression of a "value assessment" in relation to aesthetic and historical instances [Brandi 1977]. The result of a survey has never been just a "restitutive model." In a preliminary phase (pre-gained knowledge) and then in parallel to the survey, the researcher deals with the collection of archival documents, historical iconography, photographs, etc., building up the philological-critical *corpus*; he also plans mapping campaigns with decay analysis, the documentation of constructive values (techniques and materials); he executes critical elaborations, synchronic and diachronic historical sections, reconstruction of non-existing configurations, proportion analysis, metrology.

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The researcher thus builds a "complex representative model" of the reality he observes. All of which in order to pursue the fundamental and undeniable aim of his research: to reach a greater level of knowledge than at the beginning.
But the representative model thus generated also constitutes the fundamental support for the construction of a Restoration project (as a cultural act and a creative act) given a fundamental specularity between survey and project [Carbonara 1977]. And this also applies to the project for new buildings, where it implies the knowledge and, therefore, the survey of the context.

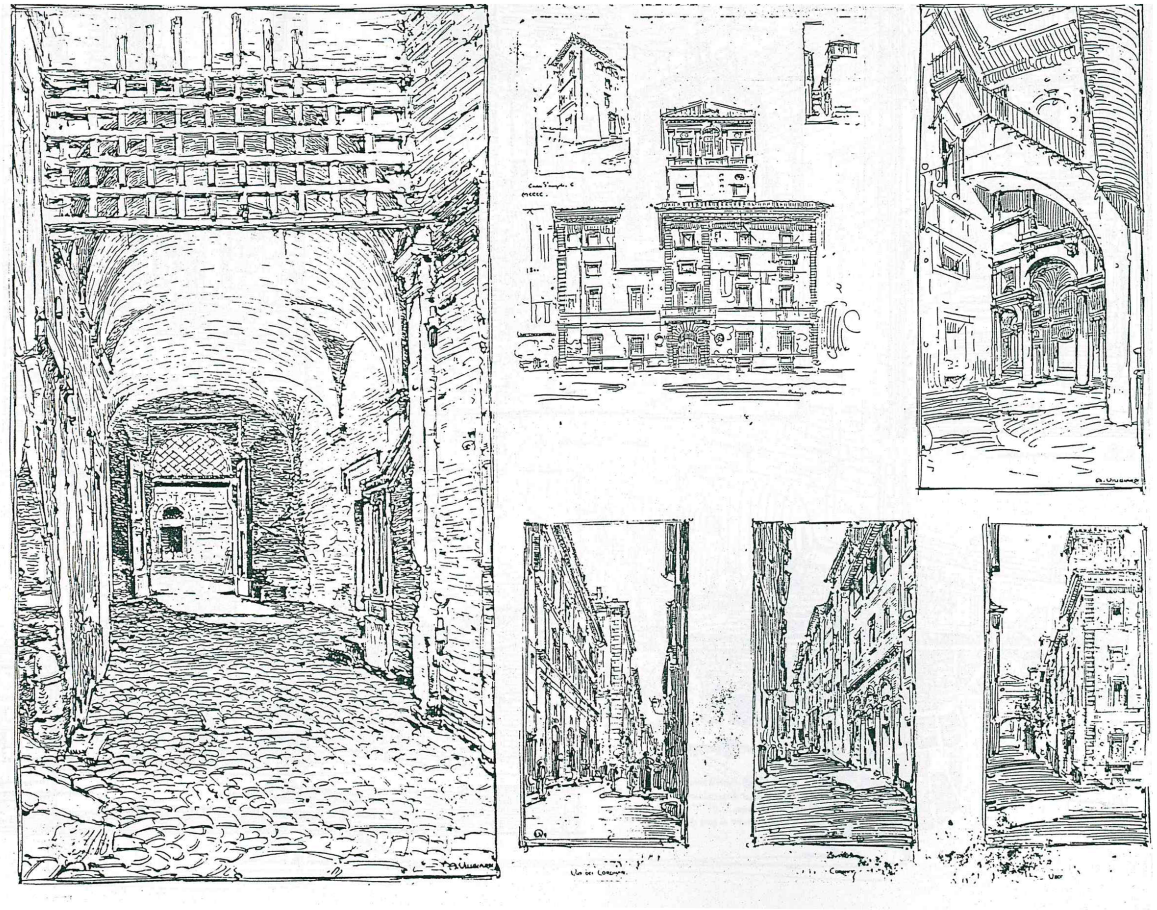
The nature of the model

Modern epistemology defines modeling as a cognitive and communication strategy, as well as a creative one [centofanti 2016; Centofanti 2013; Centofanti 2012; Centofanti 10a; Centofanti, Brusaporci 2012; Centofanti et al. 2011]. In reality representation, the model faces the prerogative of "similarity". With reference to semiological studies [Eco 2015] there is a difference between iconic and non-iconic models (mathematical or diagram). But the concepts of structure, function and form also have to be considered. In this sense a model can be considered: "homologous" (structure correspondence), "analogous" (structure and function correspondence), "isomorphous" (form correspondence). More in general, the model can be defined as "text form," itself made up of multiple forms of text and image-text.

The traditional representative representative model

We propose a rather old historical reference, but which illuminates (in terms of conceptual opposition) some qualities of the contemporary digital representative model.
It is a rather well-known example, relative to a significant experience of Gustavo Giovannoni (1873-1947) at the *International Exposition in Rome*, in 1911, specifically at the *Roman Topography Exhibition at Castel Sant'Angelo* [Centofanti, Cifani, Del Bufalo 1985]. In room 1, *Building studies*, at numbers 11 and 12, Giovannoni presented, in two exhibition panels, the "*Rilievi e studi per la sistemazione di Via dei Coronari e adiacenze*." To comprehend the meaning of this operation, it is important to recall that Giovannoni had published an article in *Nuova Antologia* in 1908 with the emblematic title "*Per le minacciate demolizioni nel centro di Roma*" [Giovannoni 1908], later reprised more systematically, again in *Nuova Antologia* in 1913 [Giovannoni 1913].
The critical discourse of 1908 was targeted to the proposals contained in the Urban Development Plan by Sanjust di Teulada, that Giovannoni considered to be destructive for the peculiar characteristics of the historic urban fabric, with particular reference to Via dei Coronari.
His idea was that of juxtaposing the "gutting" of the city with what he defined as "*diradamento*", that is, the "thinning out" of the urban fabric: «in some extremely narrow points of the old streets, and if hygienic reasons should suggest bringing air and light, we could thin out the houses here and there, by removing some factories or unimportant blocks and placing small squares or small gardens in their place; by opening in certain places, without letting oneself be seduced by the geometric regularity of a wide street, without changing the environment with new constructions» [Giovannoni 1908, p. 319].
Let us briefly examine the exhibition he set up. The first panel (fig. 1) contains four drawings by Arturo Viligiardi [1] and includes a series of perspective views of urban spaces and buildings' interiors with entrance halls and courtyards: Perspective views of the entrance of Palazzo del Drago, of the façade of Palazzo Montanara, of Via dei Coronari and Via Vecchiarelli and of Palazzo Vecchiarelli's courtyard.
The second panel (fig. 2) contains part of Via dei Coronari's site plan, signed by Giovannoni, with the proposal for Via dei Coronari's restoration and four perspective view drawings by Viligiardi, related to the plan, of Via dei Coronari, Piazza San Salvatore in Lauro, Via and Palazzo Vecchiarelli, Tor Sanguigna.
Images and prefigured reality are reciprocally related and the representative model chosen conjugates the two representative codes of orthogonal projection and perspective. The plan identifies the urban fabric "thinning" interventions and indicates the "cornerstones," which are the buildings meant to be the most important morphologic elements of the urban structure.
The composition of the "*Quadri*", that is, the control of the new figurative and perceptive values consequent to the prefigured intervention of modification of the urban environmental context, is entrusted to the perspective views created by the skillful hand of Arturo Viligiardi.
There is no doubt of the representation's technical quality, that even gains an artistic value in the case of the perspective views. The model is surely the iconic herald of symbolic values as it aims at transmitting a mental image of

Fig. 1. Reconstruction of the panel exhibited at the Roman topography exhibition in Castel Sant'Angelo in 1911. Gustavo Giovannoni (1873-1947), Proposal of restoration for Via dei Coronari and its surroundings. Arturo Viligiardi (1869-1936), Perspective views, ink on paper: Perspective sketch of Palazzo Montanara, 18x23; Elevation sketch of Palazzo Montanara, 18x23; Perspective sketch of Palazzo Vecchiarelli's internal court, 12x24; Perspective views of Via dei Coronari and Via dei Vecchiarelli), 42x27. CSSAr Centro di Studi per la Storia dell'Architettura di Roma - Archivio Disegni Gustavo Giovannoni, 43, Quartiere del Rinascimento, Roma, 1911/1935, [c.1.43, 2- 6].



beauty, the "artistic atmosphere" of the urban space; and, properly correlated with the essays, it has a great level of narrativity and communicability.
But the model of representation does not allow operative interactions, and it only suggests perceptive and interpretative values. In fact, it is important to understand that the observer is not one external from the reality represented (the visitor at the exhibition), while he is functional to that representation, crystalized by the choice of that specific perspective point of view.
«The image, as well as each text, in fact, builds inside itself, beyond the contents that it represents, the simulacrum of its spectator, the abstract projection of its receiver. Who is not an empirical recipient but his simulation within the text» [Marrone 2015].

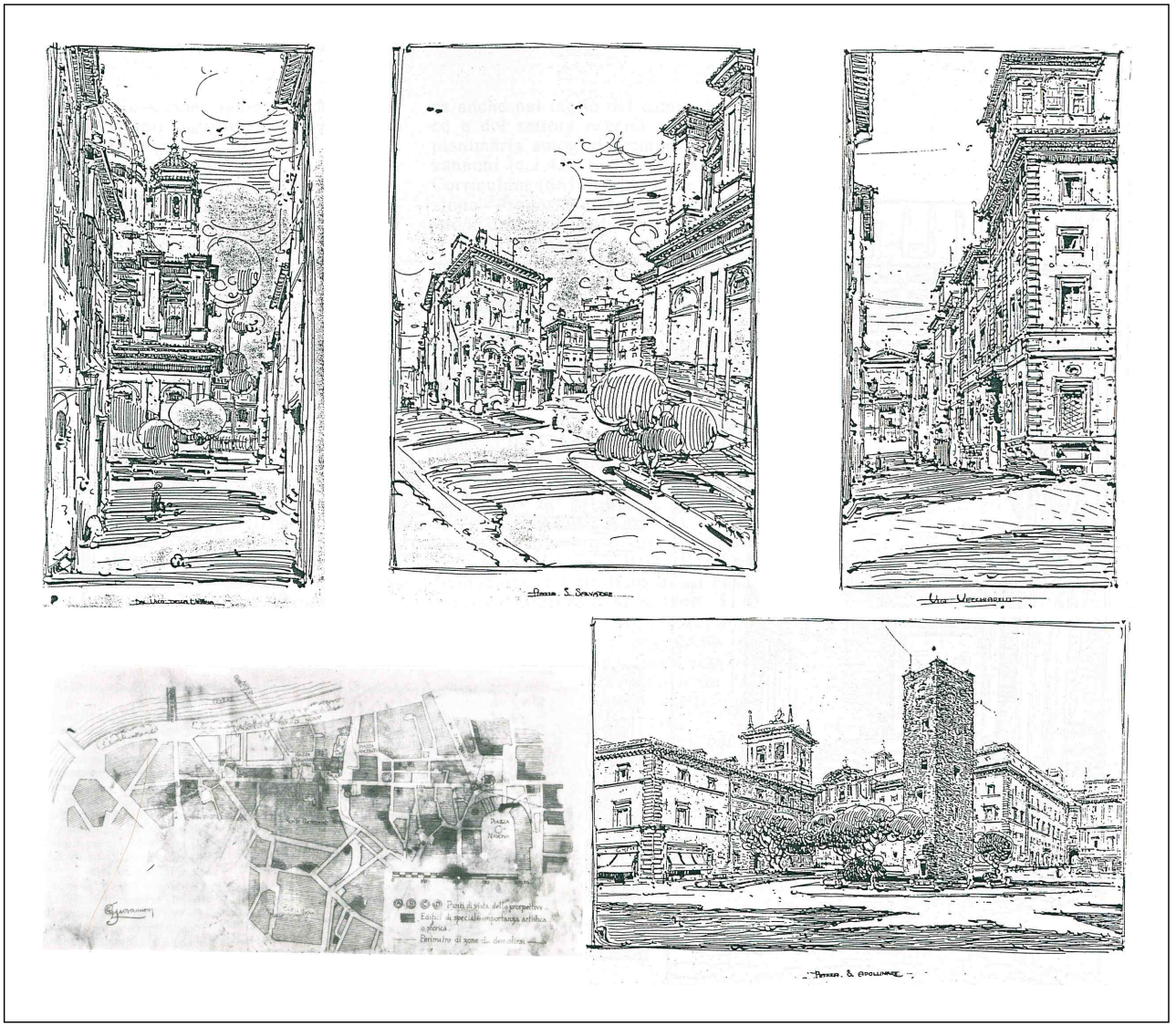
The digital model of representation

The "digital model" covers all the possible models, from the iconic to the non-iconic ones, associating the modes of emulation replica, of dissimulation, of mathematical formalization [Maldondo 2015 (1994); Gaiani 2016]. The digital model has all the prerogatives of the "traditional model of representation" together with important added values, which are interactivity and alterability, because it can be object of analysis, simulation, prefiguration, experimenting, as, for instance, the verification of technical plausibility and organizational and functional adequateness of projectual interventions, which are beyond the model, on reality itself. It supplies quick survey and modeling procedures, even automatic ones, with high precision, exhaustivity of information, similarity with the observation object.
Its immersiveness (model browsing) and augmented reality overturn the external observer's condition, on both an experiential and conceptual level, as a certain degree of autonomy in the choice of the immersive route is possible, to the point of actually interacting in augmented reality, without necessarily being connected to a monitor, but being able to count on friendly devices (smartphones, tablets, wearables…) that favor the logic of immediate transparency.
The "digital model of representation" concept itself gains complex connotations: on the one hand, the data system, on the other hand, their visualization, both based on spatial logics [Brusaporci 2017].
"Immediateness" is conjugated with the characteristic of "hyper-media." The "model of representation" is a "digital environment system" in which the three-dimensional spatial model conjugates a corresponding integrated database, in its constitution defined by a succession of heterogeneous data and information (text, graphic, video, sound, etc.), structured on multiple visualization windows.
«Unlike a perspective painting or a three-dimensional computer graphics space, these windowed interfaces do not attempt to unify the space around any one point of view. Instead, each text window defines its own verbal and graphic window with its own point of view» [nCh'ng 2015, pp. 32, 33].
Operational interactive interfaces are the place in which "visual computing" becomes an interrelation and interpretation of information, and where information becomes knowledge. The most important consequence deriving from this is: the concept of visualization changes, meaning that it is no longer a product but qualifies itself as a process [Bolter, Grusin 1999].

Scientific method and quality standardas

Another crucial node related to methods, procedures and techniques is still to be solved.
A first level regards the survey process [Bianchini 2012; Docci 2016; Docci, Bianchini 2016] [2], even considering the specific distinction between traditional survey procedures and photo-modeling procedures on a photographic base [Gaiani 2015; Apollonio, Gaiani, Foschi 2016], to the one, with active sensors, of 3D laser technology: «The rigorous definition of the survey process (whether traditional or advanced) allows the defining of a procedure that is replicable separately by different researchers in order to verify a specific result: with this, the operation is brought back to the field of scientific research» [Docci, Bianchini, Ippolito 2011].
Again: «survey represents […] a powerful means of scientific investigation […] but it has to be used correctly, keeping in mind the inescapable subjective contribution, which characterizes the discretization phase (to be explicitly declared in the survey project…) and the need of proposing, together with results, the 'raw' data on which such results are based and especially the punctual discretization of the methods and tools used» [1Docci, Bianchini, Ippolito 2011, p. 39].
A second level regards the "model of representation" for which quality standards should be defined in terms of: iconic character and sign structures; formal and technical

Fig. 2. Reconstruction of the panel exhibited at the Roman topography exhibition in Castel Sant'Angelo in 1911. Gustavo Giovannoni (1873-1947), Proposal of restoration for via dei Coronari and its surroundings. Project site plan, 1:2000, 45x26, ink on clear paper, self-made; Arturo Viligiardi (1869-1936), Perspective views, ink on paper: A - Tor Sanguigna square, 35x24; B - New street crossing Via dei Coronari, 22x43; C - Via dei Coronari and Piazza San Salvatore in Lauro, 29x43; D - Via dei Coronari and Palazzo Vecchiarelli, 22x43. CSSAr Centro di Studi per la Storia dell'Architettura di Roma - Archivio Disegni Gustavo Giovannoni, 43, Quartiere del Rinascimento, Roma, 1911/1935, [c.1.43, 6-10].



quality; similarity with the object of observation; usability (controlled interaction between user and model); implementation of knowledge in simulated reality; manipulability, technical and semantic interoperability; communication.
Each representative model and the procedure that allowed its generation should carry the characteristics of scientific experimenting: to offer the possibility of repeating the experiment, the eventual proof of "falsification" [Popper 1935], and eventually the possibility of knowledge implementation, starting from the product itself, if scientifically conformed.
But in this sense, a significant reference is represented by the *London Charter for the Computer-based Visualisation of Cultural Heritage*, completed in 2009 after a three-year gestation period [3] and promoted, amongst others, by the *European Network of Excellence in Open Cultural Heritage* EPOCH [4] that at the end of a long phase of elaboration, has triggered an open process of orientation, adhesion, sharing and specialization in several scientific communities [Brusaporci, Trizio 2013]. An ongoing process, as a misalignment between progress in the 3D visualisation of cultural heritage and the development of virtual technologies continues to exist. With particular reference to the articulation of basic metadata, in a transparent manner, and to the digital systems' capability of transmitting the non-assertiveness of critical-interpretative processes in architecture and in history of architecture [5].

The Preamble to the *London Charter* states: «While computer-based visualisation methods are now employed in a wide range of contexts to assist in the research, communication and preservation of cultural heritage, a set of principles is needed that will ensure that digital heritage visualisation is, and is seen to be, at least as intellectually and technically rigorous as longer established cultural heritage research and communication methods. At the same time, such principles must reflect the distinctive properties of computer-based visualisation technologies and methods» [6].
The *Charter* proposes 8 fundamental principles: Subject communities, Aims and Methods, Sources, Transparency requirements, Documentation, Standards, Sustainability and Access.
Excerpts from the *Charter*: «*Principle 2 – Aims and Methods*. […] 2.3. While it is recognized that, particularly in innovative or complex activities, it may not always be possible to determine, a priori, the most appropriate method, 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.»
«*Principle 3 – Sources*. In order to ensure the intellectual integrity of computer-based visualisation methods and outcomes, relevant research sources should be identified

Fig. 3. Render. Abbey of Santa Lucia in Rocca di Cambio, L'Aquila (XIV century). Conservation and seismic improvement.
Graduate thesis by Manuele De Vitis. Mario Centofanti (rapporteur), Antonello Salvatori and Stefano Brusaporci (co-rapporteurs), 2016.

and evaluated in a structured and documented way. 3.1 In the context of the Charter, research sources are defined as all information, digital and non-digital, considered during, or directly influencing, the creation of computer-based visualisation outcomes.»
«*Principle 5 – Documentation*. 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. Documentation strategies should be designed and resourced in such a way that they actively enhance the visualisation activity by encouraging, and hel-

Fig. 4 . Render. Abbey of Santa Lucia in Rocca di Cambio, L'Aquila (XIV century). Conservation and seismic improvement.
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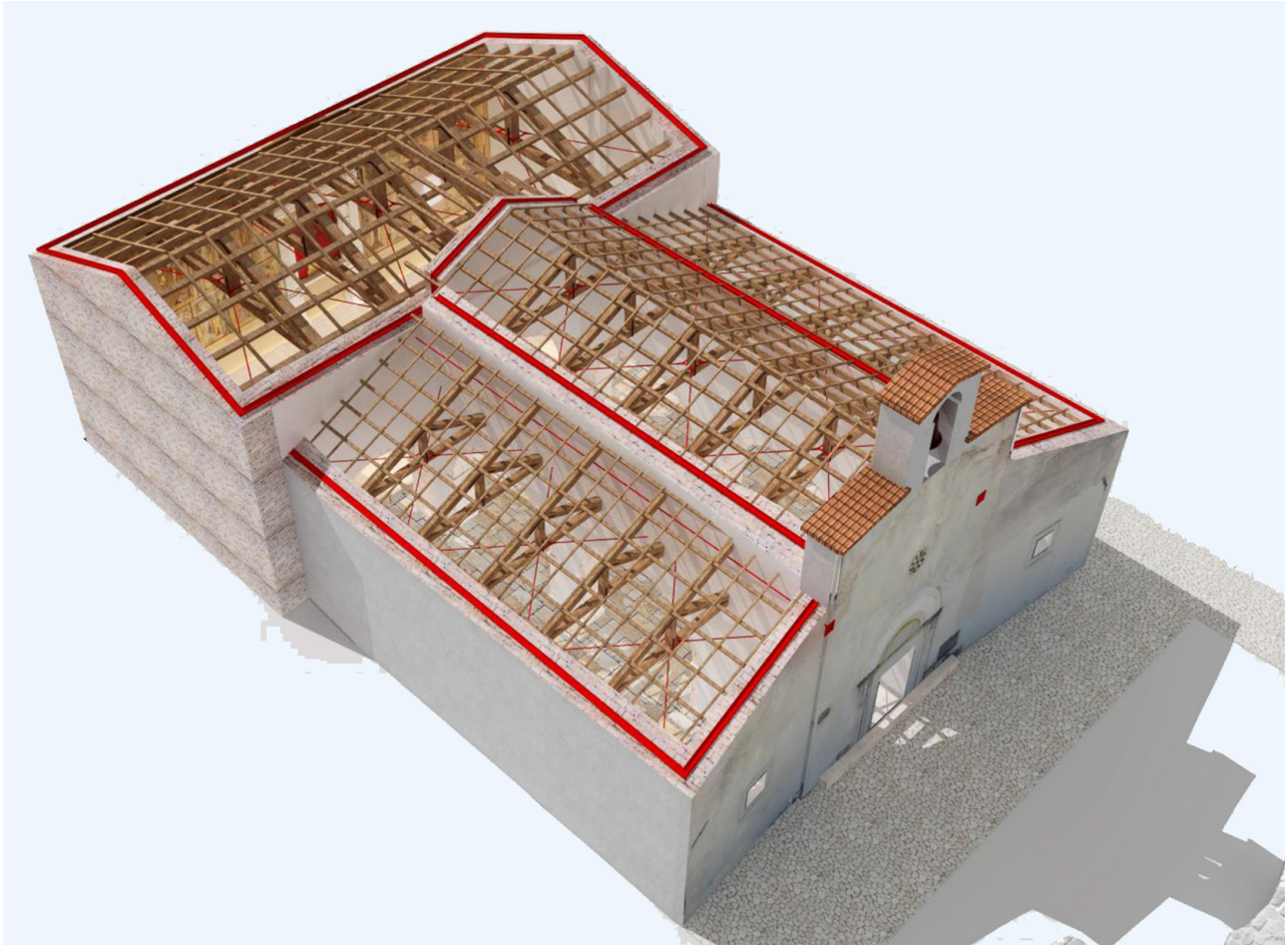

ping to structure, thoughtful practice. Documentation strategies should be designed to enable rigorous, comparative analysis and evaluation of computer-based visualisations, and to facilitate the recognition and addressing of issues that visualisation activities reveal […].»
«*Principle 7 – Sustainability*. […] where digital archiving is not the most reliable means of ensuring the long-term survival of a computer-based visualisation outcome, a partial, two-dimensional record of a computer-based visualisation output, evoking as far as possible the scope and properties of the original output, should be preferred to the absence of a record.»
Sustainability is linked to the idea that even virtual products are heritage, assets to be transferred to future generations as indicated by the *Charter on the Preservation of Digital Heritage* issued by UNESCO in 2003: «The digital heritage consists of unique resources of human knowledge and expression. It embraces cultural, educational, scientific and administrative resources, as well as technical, legal, medical and other kinds of information created digitally, or converted into digital form from existing analogue resources. […] Many of these resources have lasting value and significance, and therefore constitute a heritage that should be protected and preserved for current and future generations» [7].

A metaphor

In this sense I would like to use, operating a declared conceptual transposition, a rhetoric image linked to the tradition of words that speak of images. The word is rhetorical experience that is other than the perceptive and cognitive experience of images. But our constructions of the architectural model of representation should hold, as a global qualitative attribute, that of *èkphrasis*: «The name that Greek rhetoricians gave to the description of an object, of a person, or to the circumstanced exhibition of an event, and more in particular, to the description of places and artworks with a style elaborated with great virtuosity in order to compete with the expressive strength of the described thing» [8].
The strength of *èkphrasis* lies in the fact that it can survive the disappearance of the described object itself, conserving its memory.
Umberto Eco [Eco, Augè, Didi-Huberman 2015, pp. 11, 12] mentions the episode of the discovery, in January 1506, in an area called the Seven Halls, on the Esquiline Hill in Rome, of the important Greco-Hellenic marble group of the *Death of Lacoon*. The masterpiece was believed lost. But the finders were capable of recognizing it because certain *èkphrases* existed, such as the one written by Pliny the Elder in *Naturalis Historia* [9].

Conclusion

I would like to conclude by repeating a cornerstone of the *London Charter*, which in the first *Principle* states: «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.»
According to this orientation, in 2011 the *International Forum of Virtual Archaeology* has elaborated, in implementation of the *London Charter*, the Seville Principles, which discipline the efficiency of the best practices in "archaeological visualisation," based on computers for the complete management of archaeological heritage [10].
In skimming over the stated principles, we find an emphasis on significant, interesting aspects, given that in the Drawing sector there are many qualified contributions dedicated to architectural survey. But also because there are important analogies with architectural survey from the perspective of procedures and techniques.
The eight principles set forth are:
1. Interdisciplinarity;
2. Purpose;
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.»
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.»
5. Historical rigour;
6. Efficiency;
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.»
8. Training and evaluation: «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. The final quality of any computer-based visualisation must be evaluated based on the rigor 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 or not 'top quality'.»
In the direction indicated by the *London Charter* and the *Seville Principles*, our scientific Community could take charge of internationally promoting the definition of principles for both digital and traditional architectural survey and modeling. Along the routes of a specificity necessary because architecture, historical city, historicized city, urban landscape, and landscape/territory show much more complex problems. It would be an important passage to aim at higher levels in the quality of our area's scientific research, and especially for its fundamental new orientation towards interdisciplinarity and internationalization.

Notes

[1] Arturo Viligiardi (1869-1936), painter, sculptor, architect.

[2] For reference about fundamental studies and research on architectural survey within the Drawing segment, see the paragraph Centofanti 2010b, pp.10, 11.

[3] *London Charter for the computer-based visualization of cultural heritage*: <http://www.londoncharter.org/downloads.html> (accessed 2018, March 21).

[4] EPOCH - *European Network of Excellence in Open Cultural Heritage*, financed by the European Commission, EU. Aim of the network is to supply a clear organizational and disciplinary frame to increase the efficiency of the work at the interface between technology and cultural heritage of the human experience represented in monuments, sites and museums. This frame includes all work processes and streams of information.

[5] *The Future of the Virtual Past: Prospects for the 3D Visualization of Cultural Heritage and Archaeology*. Workshop, 23 February 2017, convened by Dr Donald Cooper in the University of Cambridge's Faculty af Architecture and History of Art.

[6] *London Charter for the computer-based visualization of cultural heritage*: <http://www.londoncharter.org/downloads.html> (accessed 2018, March 21).

[7] *Charter on the Preservation of Digital Heritage* (UNESCO, 2003): <http://portal.unesco.org/en/ev.php-URL_ID=17721&URL_DO=DO_TOPIC&URL_SECTION=201.html> (accessed on March 21, 2018).

[8] Definition from the Treccani online encyclopedia: <http://www.treccani.it/vocabolario/dizionario/> (accessed 2018, March 21).

[9] "The reputation of some, distinguished though their work may be, has been obscured by the number of artists engaged with them on a single task, because no individual monopolizes the credit nor again can several of them be named on equal terms. This is the case with the Laocoon in the palace of the emperor Titus, a work superior to any painting and any bronze. Laocoon, his children and the wonderful clasping coils of the snakes were caned from a single block in accordance with an agreed plan by those eminent craftsmen Hagesander, Polydorus and Athenodorus, all of Rhodes", Pliny's *Naturalis History*, XXXVI, 37, translated by D.E. Eichholz (vol. 10) published by Harvard University Press, Massachusetts and William Heinemann, London; 1949-54.

[10] <http://smartheritage.com/seville-principles/seville-principles> (accessed 2018, March 21).

Author

Mario Centofanti, Department of Civil, Architectural and Environmental Engineering, University of L'Aquila, mario.centofanti@univaq.it

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