

Virtual Reconstructions, Knowledge Organization and Creativity

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Abstract: Plans for architecture go back to Antiquity. Attempts to create idealized views of ancient cities go back to the 16th century, when architects reconstructed Roman cities. From the 17th through the 19th centuries such reconstructions became linked with archaeology and history. Since 1990, especially in Italy, Germany and Japan, there have been trends to reconstruct buildings, sites and cities in digital form, partly for conservation purposes, partly to understand historical contexts. Recent trends are to link these with Geographical Information Systems (GIS) and with reconstructions of events such as the eruption of Vesuvius. Seven applications of such virtual reconstructions have evolved in parallel, namely, restoration, tourism, architecture, history, entertainment, education and games. Three waves of convergence with trends towards Universal Convergence Technologies (UCT), are bringing new synergies among these applications. They also point to a potential integration of mapping, reconstructing, recognition and embedding. Herein, lie new possibilities for new knowledge organization in the form of systematic scales and worlds of knowledge. Virtual and digital reconstructions therefore represent much more than electronic versions of the physical world. They help us to understand, why there has been an increasing interplay between software for architecture and entertainment. They open new possibilities, whereby methods of film and television such as blue rooms, can be used for education and research. They offer new strategies for organizing the knowledge of memory institutions, which in turn can serve as a renewed source of creativity.

Key-Words: Reconstruction of Ancient Cities; Virtual and Digital Reconstruction of Art; Virtual Reconstruction for Education and Tourism.

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1. Introduction

Planned cities using a grid-system go back at least to the time of Hippodamus of Miletus. During the Middle Ages, Saint Augustine explored the idea of an earthly city of man and a heavenly city of God, thus shifting idealized cities explicitly to the divine world beyond the experience of everyday life. The Renaissance introduced a new chapter in this story which brought the idealized city back to earth. The Baltimore, Berlin and Urbino panels represented idealized cities as if they were local places. Meanwhile, physical sites of piazzas in Venice, Ferrara, Florence, Pisa and Rome became sources for idealized spaces in stage scenery. Architects such as Filarete, Leonardo da Vinci, Bramante and Serlio offered visions of idealized sacred and secular architecture.

In the 15th and early 16th centuries, the sojourns of Brunelleschi, Donatello, Raphael, Baldassare Peruzzi and others among the ruins in Rome heralded a next important step. Their detailed studies of individual capitals, columns, and other architectural features prepared the way for what would later become classical archaeology. At the same time, their drawings introduced various idealized images, which were both reconstructions of possible past buildings and scenarios for possible future constructions. By the 1530s, Sebastiano Serlio, who inherited much of the corpus of Peruzzi, began publishing these studies. In the decades that followed, a wave of Northern artists and engravers, notably Thiry, Du Cerceau, Cock and Vredeman de Vries, began a more systematic publication of Roman ruins. These ruins were much more extensive, consciously more playful and introduced a tradition of fanciful and creative combinations to produce caprices and capriccios. What began as a recording and copying of the past, was thus transformed into a new source of creativity. This tradition of Roman ruins was most active in the second half of the 16th century and continued until the mid- 17th century.

The 17th, 18th and 19th centuries saw a significant expansion of horizons as explorers and archaeologists looked beyond Rome to other Roman sites (Pompeii, Herculaneum, Paestum) and then to the Near, Middle and later the Far East. High costs of printing images meant that early descriptions of sites were frequently only verbal. Only gradually were reconstructions in the form of engravings available. Some of these,

such as Robert Wood's *Ruins of Palmyra* (1753), became luxurious classics, which fired the imagination of both active and armchair explorers. Parallel with these developments was the rise of archaeology, which entailed reconstructions, often highly idealized, of major sites in Rome, Greece, Egypt and Babylonia. While very impressive, most of these virtual reconstructions lacked specific measurements and explicit methods and were thus not reversible: one could not go from such a reconstruction to rebuild accurately an original building or monument.

By the 19th century these images were sometimes coloured. For instance, Owen Jones' *Grammar of Ornament* (1856) provided a catalogue of ornamental details from cultures around the world. While purportedly a catalogue of existing motifs, it effectively became a starting point for novel, creative expressions. By the late 19th century, attempts to record details and sites in the form of drawings, and engravings, were complemented by black and white photographs. In the 20th century, these were slowly replaced by coloured photographs and techniques from photogrammetry.

Parallel with these trends towards ever more accurate documentation of archaeological remains, were more fanciful reconstructions by artists such as Eugene Delacroix in his visit to Spain and North Africa (1832) and David Roberts' *Sketches in the Holy Land and Syria* (1842-1849). These shifted the fascination with Greco-Roman traditions to include more exotic vistas of the Near and Middle East in what is now called Orientalism. While very attractive, these images often belonged to what would today be called artists' impressions. They combined records of physical buildings and ruins with imaginary views of how these might once have looked. They also frequently used an Eastern backdrop to explore possibilities, romantic visions or make explore political and or moral critiques of society at home (cf. Voltaire and Montesquieu). What were supposedly the equivalents of reporters accounts from abroad, thus became also reports of journeys into the worlds of imagination and fantasy, glimpses into the possible worlds and utopias.

Meanwhile, the relationship of regular architects to their constructions changed also. For instance, the French architect, Ledoux, constructed buildings; then published idealized versions of these existing buildings in his books, which frequently simplified the contours of the physical monument. Plans to build did not necessarily mean that buildings were completed.

In the 20th century, even famous architects such as Corbusier and Frank Lloyd Wright produced various plans that remained visual ideas rather than finished physical structures. Examples such as Gaudi's *Sagrada Família* continued the tradition of mediaeval cathedrals, whereby plans for a building continued to evolve beyond the lifetime of a given builder. In the 1930s, the Bauhaus School explored motifs in nature as modules and building blocks that could serve as design elements in architecture. At its worst this led to massive apartment flats and suburbs that resembled the mass/production of factories. At its best this led to new creative methods and forms, which are being taken up anew in electronic form by Oliver Bimber and others.

One might expect that the rise of commercial computers in the second half of the 20th century would mean that traditional analogue activities were gradually translated into digital form. To some extent this is the case. But the possibilities of cross-media and potentially cross-sensory translation in a digital context, mean that the advent of digital techniques is having more far reaching effects. We begin with a short survey of changes in visualization software, examine the role of previsualization; consider seven domains where visual and augmented reconstructions are becoming important; then outline four developments with a trend towards Universal Convergence Technologies and show how this has implications for new approaches to knowledge organization, which can also stimulate future creativity.

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2. Virtual and Augmented Reality

Technology has long played a role in restoration through techniques such as X-Radiography (x-rays) and dendrochronology. More recently these have been complemented by Infra-Red (IR) Reflectography, Infra-Red (IR) Photography in Pseudo Colours, Ultra Violet (UV) Fluorescence and High Definition Images in Visible Light.

The past decades have seen an extension of technology, whereby digital facsimiles in 2D and 3D are used to explore virtual interventions in an historical artefact. The restoration of the frescoes by Piero della Francesca in Arezzo, with the technical aid of Massimo Chimenti and Luca Menci, was one of the earliest examples of this principle applied to a major work of art. The restoration of the *Last Supper* by Pinin Brambilla Barcillon took these methods further. Methodologically, this is of the greatest

importance because it means conservators and restorers can explore potential effects of alternative interventions in a virtual environment before introducing irreversible effects on the original. The Japanese firm, Hitachi has used similar principles in exploring values for the original colours of Hokusai's woodcuts and in restoring one of the famous ceilings of Kyosai. The past 50 years have seen the beginnings of Conservation Networks (CCI, Getty, C2RMF). Needed are global networks in this domain, whereby some of the interventions on individual works become a layer of knowledge accessed via memory institutions.

3. Tourism

In the past decades, there has been an enormous rise in virtual reconstructions of archaeological and historical sites. Some critics remain very sceptical as to the value of such reconstructions arguing that they can never replace the original. This scepticism is understandable. On the other hand, it is worth recalling that in earlier times potential explorers and visitors had only oral accounts. From the 16th through the 18th centuries explorers, visitors and proto-tourists, were limited to woodcuts, engravings, and lithographs. The 19th century brought black and white photographs. The 20th century brought colour photographs, videos, which are now being complemented by virtual and augmented reality. Once we accept that these reconstructions are effectively a new kind of travel brochure on steroids, their contribution is clear. As orientations in helping to prepare us for what we will see in situ, these new tools offer a significant stage forward.

The deeper value of virtual reconstructions lies elsewhere. Many sites are so delicate that they are closed to the public and even to most researchers. The famous caves at Lascaux are one obvious example. One alternative is to build replicas as 1:1 scale models. There is one such replica in the Dordogne near the original caves and another in Saint-Germain-en-Laye, near Paris at the Musée d'archéologie nationale. While very useful, such replicas constrain visitors to go to these specific sites for the experience. Virtual reality reconstructions, such as that of Benjamin J. Britton, allow potential visitors to have this experience anywhere in the world where there is the appropriate equipment.

It may not be "the real thing", but it is far superior to the prospect of never seeing the original.

This principle extends to many other important sites such as the Tomb of Nefertari and the Palazzo Sciarro reconstructed by Infobyte. This principle extends also to many cases where the original is theoretically open for view. There are thousands of aboriginal caves in Australia. There are over 30,000 painted caves in Africa. Even a professional fully dedicated to cave markings, drawings and paintings, would have difficulty visiting all these caves in a lifetime. If there were reconstructions of all these caves and efficient search tools, then scholars, amateurs and the general public alike could have a chance to explore many parts of the world beyond their travel budgets and time constraints. Meanwhile, an estimated 50-95% of museums and collections are not on display and carefully stored in museum vaults and storehouses. If these materials were scanned, these too could be made available virtually for study and leisure. Hence, while virtual reconstructions ultimately cannot replace the full experience of seeing the original; they can make fundamental contributions in increasing the sample of materials on which we base our studies.

The earliest reconstructions focused simply on a physical object, cave, monument or building. They were effectively static facsimiles. In the 1990s, further elements were added. The pioneering work of Marilyn Aronberg Lavin, linked reconstructions with their narrative sequences. The reconstruction of the Tomb of Nefertari (1995) by Infobyte contained translations of the hieroglyphs on the wall of the tomb, which could be read out loud by an actor or silently by a user. The reconstruction of the Cappella degli Scrovegni (2002) went considerably further adding other interactive possibilities such as focussing on individual scenes, following their narrative sequence. A reconstruction of the Interior of the Winter Counsel Chamber Earthlodge at the Ocmulgee National Monument, Macon, Georgia (1998), allows us to imagine what Indian ceremonies that are no longer extant may have been like. A project by Antonella Guidazzoli (CINECA) has reconstructed the Cathedral of Parma (2007) and uses this reconstruction as a context for re-enacting mediaeval processions and other sacred events. A project by Malvina Borgherini (Venice) is linking the cycle of frescoes in the Palazzo della Ragione (Padua), with astronomical and astrological cycles and mediaeval clock-making, thus allowing us to understand connections, which we could not see simply by looking at the originals in situ. Such examples are of interest to tourists and researchers alike.

Visiting endangered, remote and non-extant sites is probably the most obvious set of applications of virtual and augmented reality for tourism. A second set of applications entails the domain of contextualization. Complex works of art are often made in one location and then become dispersed in separate collections. If we go the Louvre, for instance, we find a predella by Gentile da Fabriano showing the *Presentation in the Temple* (1423). This was originally part of an altar now in the Uffizi showing *the Adoration of the Magi*. The Louvre is not likely to give their predella back. Reconstructions can show their connections. Carpaccio's *Two Court Ladies* (Venice, Museo Correr, c.1490) is well known. Less well known is Carpaccio's *Hunting on the Lagoon* (Los Angeles, Getty Museum). Scholars have suggested that they were originally one painting. In such cases, a virtual reconstruction available at both locations can help viewers understand the original work. More detailed reconstructions can also explain the points of controversy in different interpretations concerning the same work.

This quest for contextualization goes beyond re-assembling complex works of art, pieces of which have landed in various galleries. It applies also to understanding the sources, related paintings and drawings of a given work. A tourist visiting the beach at Etretat in Normandie might well be unaware that this was a recurrent scene in Monet's paintings. How many visitors to the museum in North Carolina who look at Monet's *Sunset at Etretat* realize that there are similar paintings in Cleveland and Nancy? Needed are contextualizers that show us these connections.

The extent to which this approach might be useful is seen if we turn to another Monet painting, which almost every art student has encountered: the *Japanese Bridge at Giverny*. Monet lived at Giverny, West of Paris, from 1883 until his death in 1926. In 1890 he bought the property, built extensive gardens including a Japanese bridge, which crossed an adjacent pond. By 1895, he had begun painting this pond and bridge. The titles varied: *The Water Lily Pond*; *Le pont dans le jardin de Monet*; *Le Bassin aux nymphéas*; *Japanese Bridge at Giverny*, but the basic theme remained the same. In the course of 31 years he painted at least 26 versions of this theme. Over seventy books have been written on Monet. Many contain some examples. Strikingly, as of 2000, not one of the major monographs of Monet contained the entire series. This is all the more significant, because it is only when we see them in context that we realize how Monet's impressionist version of realism gradually transformed into an almost abstract modern

art. Contrary to what we read in general histories of art, this case shows that one important source for the rise of modern art lay in a profounder study of nature rather than a simple rejection of naturalism.

A third application pertains to recreating the spaces of paintings. Art historians (e.g. Carter, 1953) explored this principle in their efforts to reconstruct the perspectival space of paintings such as the Piero della Francesca's *Flagellation* (Urbino, Galleria Delle Marche). This idea was taken up by Andrei Tarkovsky, in his film, *Solaris* (1972), where the protagonist at one point floats in front Brueghel's *Hunters in the Snow* (Kunsthistorisches Museum, Venice, 1585), and then floats into the space of the painting itself. In 1994, Infobyte used this technique in the virtual reality reconstruction of the Basilica of San Francesco in Assisi, to show how one could fly through Giotto's depicted spaces. They used the same technique in their reconstruction of the *Stanze* (1995) of Raphael in the Vatican to show how one could enter the depicted spaces of the *Incendio nel Borgo* and the *School of Athens* and interact with avatars of the painted figures. DePinxi developed this approach in their *World of Rousseau* (2004) shown at Laval Virtual, wherein a series of Rousseau's painted spaces were combined in a virtual interactive game. These potentials have also led to playful applications, whereby contemporary individuals are inserted into seventeenth century paintings by Jan Steen.

A fourth application of virtual reconstructions is unexpected: providing public access to images, which are forbidden and censored because they reflect politically incorrect or politically unpopular themes. A case in point is a group of modern artists in Uruguay who were banned from physical museums, because they did not reflect the tastes of the ruling political party. After a number of years attempting to find acceptance, the artists constructed a *Museo Virtual de Artes El Pais* (MUVA), which has brought their work to the attention of viewers worldwide. Such "reconstructions" are so convincing that they pose new problems of method. Unless we develop very clear rules for presentation of such non-physical museums, there will be no way of knowing at a future date, which museums were born-virtual and which were virtual surrogates of physical originals – which will pose major difficulties for future historians. The early practitioners were so intent on creating images that could pass for real, that we have not really thought enough about the need to be able to distinguish between born-physical and born-virtual.

4. History

All this is fine and well if the extant remains are sufficiently intact and/or if historical documentation is available. In some cases, both are lacking or the evidence is such that it is open to multiple interpretations. This applies to reconstructions ranging from single churches, through sites to cities.

Churches

One of the earliest objects of detailed study in this field was the Abbey at Cluny. In the decade from 1991-2000 there were at least six significant reconstructions. These varied tremendously in their interpretations. It is striking that three are no longer available at their original addresses. Lacking thus far is a detailed documentation of sources used, assumptions made and methods used, which will enable future students to weigh the relative value of these reconstructions. This desideratum applies to the hundreds of reconstructions of churches now online. Not surprisingly in a new field, there is a flurry of initial enthusiasm, which is only gradually tampered by clear rules of method. In the next decades, there is a need to define a basic set of rules and methods for the emerging field of digital reconstructions. As in the case of restorations, reconstructions need to become a layer in our access to knowledge in memory institutions.

In the case of major sites such as Pompeii, there is long tradition of reconstructions going back to famous examples such as Rochette (1825). These reconstructions range from the efforts of individuals such as Victoria I (1993), to university projects; commercial products; to formal sponsored by the Soprintendenza dei Beni Culturali. Each of these parties typically refers to their own work. Lacking thus far is a systematic survey of work done by different parties and a set of criteria to weigh their relative contributions. Meanwhile, some of the most impressive reconstructions of ancient cities are being produced outside Europe, namely, of the city of Kyoto in Japan and the Forbidden City in Beijing. Organizations such as the Virtual Heritage Network are bringing together some of the major contributions worldwide.

One significant development of the last years has been an extension of concerns beyond simple archaeological reconstruction. Researchers at CINECA in an EU project

have simulated the eruption of Vesuvius in the context of larger concerns about natural disasters and emergencies. As a result geo-physicists, seismic experts, computer scientists, archaeologists and historians are now working together. Study of an event long past thus becomes much more than an historical curiosity: it prepares us for future volcanic eruptions around the world. Some researchers believe that virtual reconstructions can be used to test hypotheses regarding social and economic life in Antiquity.

Cities

These developments are found also in the case of digital cities such as Rome. Again there are research efforts (CNR); university efforts such as those of the Centre Interdisciplinaire de réalité virtuelle (CIREVE, Caen) or the Cultural Virtual Reality Lab (UCLA). There have also been commercial efforts, such as the reconstruction of Rome by the Taisei Corporation (1995). In the case of Rome, certain key sites such as the Forum of Trajan and especially the Basilica Ulpia have been a source of numerous interpretations. While European, notably Italian versions, tend to downplay dramatic effects, American and also Japanese reconstructions often have a Hollywood-like effect of being almost too perfect in their sparking colours and bright skies.

5. Conclusions

The thrust of this paper has focussed on virtual and digital reconstructions, outlining key moments in their development during the past 50 years. We explored seven application areas, namely, restoration, tourism, architecture, history, entertainment, education and games. These developments have come together through two waves of convergence. A first wave brought Multi-Sensory Media or Multimedia. A second wave brought networked Information and Communication Technologies (ICT). In the past decade, there is evidence of a third wave towards Universal Convergence Technologies (UCT), whereby Mapping, Reconstructing, Recognition, and Embedding are also becoming interconnected. One important feature of this latest convergence is that the physical world, which was once seen as a passive object of study, now potentially becomes an interface to link with knowledge in memory institutions. In the

past, we went to memory institutions such as libraries to study the world. In future, we can also use the world to study the contents of memory institutions.

Central to the human condition is the notion of relations which are the basis of taxonomy, classification systems, thesauri, which are now typically called ontologies. Using matrices which combine worlds and basic questions (Appendices 2-4) we can arrive at new insights into the differences in goals of art and science as a starting point for a new organization of knowledge. In this quest, we need to maintain a multilingual approach, which also reflects multiple ways of knowing. Science attempts to define concepts (cubbyholes) of knowing. Language, literature and art insist on suggesting, implying and inviting metaphorical relations that allow us to jump between and among such concepts, categories and cubbyholes. In so doing, they constantly remind us that beyond everything that exists, there are many other things that could be. Artists call this the spark of inspiration. Others call this the essence of creativity. This is why the creation of virtual and digital reconstructions is much more than an immaterial copying of the physical buildings. It points beyond the five worlds (metaphysical, mental, physical, man-made and social) to a sixth world, a world of dreams, of the possible, of the one the one thing Pandora's box could not disturb: hope. Some call it the world of creativity which among the highest expressions of the human condition.

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