

## 32 Experiencing Cultural Content

Are museums, content providers and users ready and willing to use new technologies to explore cultural heritage? In the twenty-first century, the Information Society era, does the nineteenth century's *encyclopaedic* approach to museums still apply? Do ICT tools really help content holders and/or end-users?

In the last ten years, an increasing number of projects have taken advantage of computer graphics, hypermedia and telecommunications on a large scale to document, study and/or communicate cultural heritage.

In many countries around the world, projects that use technology to preserve and communicate cultural heritage are receiving increasing levels of financial support, as it is recognised that cultural heritage is a *vital national resource*<sup>72</sup>.

*Computer graphics, hypermedia and telecommunications*

*Cultural heritage is a vital national resource*



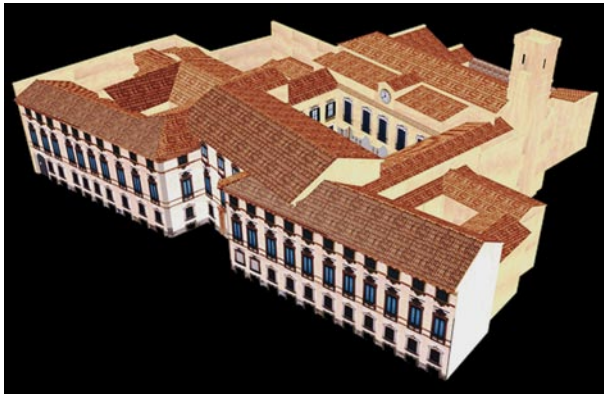
**Fig. 32.1** *The Tribuna of the Uffizi* (1772–78) by Johannes Josephus Zauffely (1733–1810)

<sup>72</sup> The key aspect in cultural heritage market evaluation is that revenues are not passed back to the major investors. Most of the revenue is shared between hotels, restaurants, travel agencies, merchandise, books, electronic media, etc. Please refer to recent studies included in the reference section.

Is cultural heritage merely an interesting field in which to apply computer graphics, multimedia and networking, or does it present unique research challenges? Are the basic tools and techniques used in cultural heritage adequately developed, or are they missing opportunities?

Technology is being used for a wide range of cultural heritage applications, including the digitisation and exploitation of museums, art galleries, architecture and other kind of works of art. Network access to museums and galleries seems to offer both easier access to cultural heritage and, potentially, additional revenues that can be directed towards its preservation and display. Many relevant players in both memory institutions and ICT have invested time and resources into creating pilot projects and applications in the field of cultural heritage, ranging from *3-D reconstruction* to *image-based rendering* to *virtual museums*.

**Fig. 32.2** Palazzo Clerici, Milano (HMG Lab, 1995)



**Fig. 32.3** Virtual restoration (HMG Lab, 1995)



Computer graphics research now includes methods and techniques for digitally reconstructing historical environments. Laser scanning technologies are used to “capture” the original artefacts.

These projects are appealing to people that work in computer graphics because of the sheer volume of results obtained. The results are used in museums and schools as a communication tool.

Restorations generated using computer graphics—so-called *virtual restoration*—have also become commonplace in television programmes about art and history. It is also possible to perform live events in virtual sets that are sometimes based on historical environments, such as Ancient Thebes in Egypt.

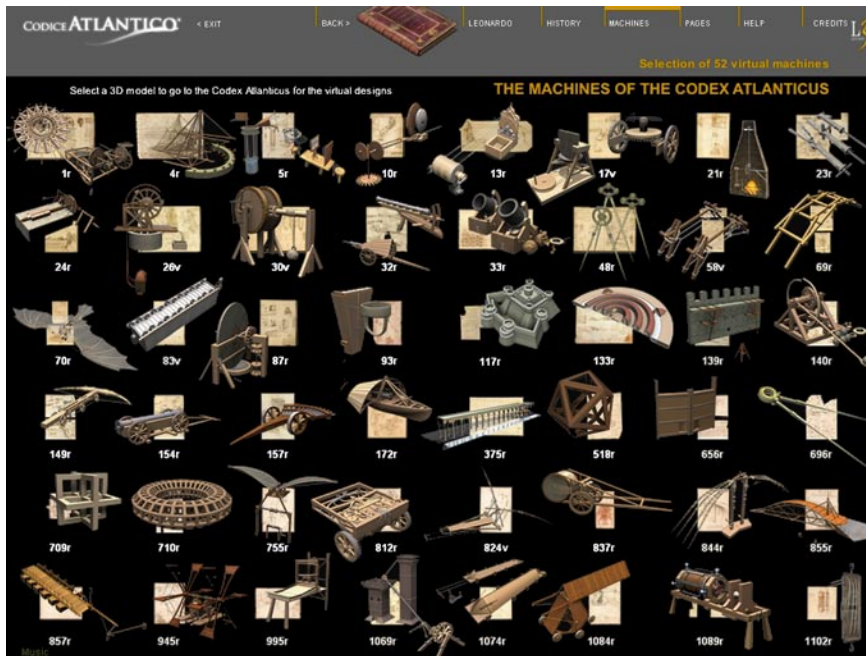
Are the techniques used to create feature films the same techniques that are needed to communicate cultural heritage?

Is this just another example of the use of computer graphics for *digital storytelling*, or are there other specific issues associated with communicating accurate reconstructions? Which types of representations and interactions are needed in these areas?

Should the application use a computer games approach to engage the audience, as in the case of *the Forbidden City*<sup>73</sup>, or do we need another model to communicate heritage?

*Virtual restoration*

*Digital storytelling*



**Fig. 32.4**  
Leonardo da Vinci:  
*Codex Atlanticus*  
(copyright Leonardo3, Italy;  
<http://www.leonardo3.net>)

<sup>73</sup> Early edutainment applications from Cryo: *Versailles*, *Forbidden City*, *Egypt* (published in the mid-1990s).

Less visible projects have investigated how graphics and multimedia technologies can be used by a variety of experts, such as historians, art historians, archaeologists, anthropologists, and architects, to study the past. Data visualisation techniques have been used to organise data collected from archaeological sites in order to yield new insights. Solid modelling software has been used for visual problem solving in order to attempt to understand how ancient structures and mechanisms were built, and how people may have used them.

The experts involved in these endeavours are very different to the engineers and technicians for which graphics tools have been designed in the past.

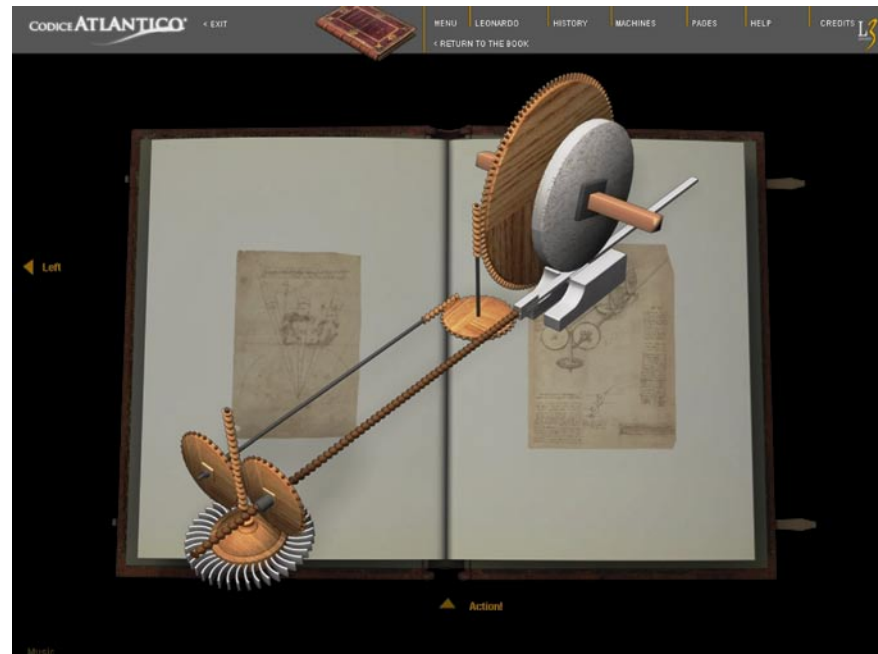
It is simply a matter of tailoring interfaces for specific applications? Or do we need fundamentally different ways of interacting with data and models? Are new devices or technologies needed?

We are now in a position to consider whether such approaches and ideas are effective; whether they really do increase and spread knowledge of the arts, sciences and history, and whether they satisfy users' requirements. Do ICT applications and virtual museums really provide added value to end-users? Are museums, content providers and users ready and willing to make use of new technologies for cultural heritage? What roles do wireless communication and mobile services have to play in cultural heritage?

**Fig. 32.5**

Leonardo da Vinci:  
*Codex Atlanticus*

(copyright Leonardo3, Italy;  
<http://www.leonardo3.net>)



Other questions, which have already been outlined in DigiCULT reports, are:

- How do new technologies affect the core business and how can they be best integrated into the current workflow?
- Which new technologies can be expected and how can cultural heritage institutions avoid jumping on the wrong technological bandwagon?
- What kind of institutional changes are needed to adopt and adapt new technologies?
- How can small institutions manage to participate in the emerging Information Society?
- What is the potential to commercially exploit cultural heritage resources, and what are the future markets?
- What is needed to make cultural heritage services sustainable?

While we cannot answer this long list of questions with exhaustive replies, some *basic principles* could help us to frame the problem. In order to evaluate the potential benefits, we must refer to the added value applications and services that are enabled by new technologies. One of the main ways of evaluating the effectiveness of a (real or virtual) visit to a museum or general exhibit is to ask for feedback about it. Do users exiting the museum believe that they know or understand more about the exhibits than they did before the visit? How do they *score* the experience?

And what about feelings and emotions? Artefacts are mainly “communication objects”, and so they must communicate with the visitors. ICT has to ease this process by breaking the barriers that sometimes disable the communication process.

The communication process associated with cultural heritage involves a reasonable degree of complexity. We can present a work of art and propose an interpretation of it, or try to offer visitors all of the elements required to evaluate the work of art autonomously. Some of the main intrinsic difficulties with the cultural heritage communication process arise from the fact that the work of art usually pertains to a different historical and cultural context from its current situation; indeed, its original location may not be accessible anymore.

*Artefacts are  
“communication objects”*

*Predefined  
or self-interpreted?*



**Fig. 32.6** Bronze fragments from the third century B.C. (photo by the author)

How many times have we seen descriptions such as “Terracotta Fragment—Second Century”, objects removed from their usual context or function, and artefacts on display without a “code” that can help us to understand their function or meaning? ICT should help to solve such problems, since it should provide context, customised information, references, virtual reconstructions and interactive applications.

*Rebuilding  
the original context*

One of the main roles of the communications manager must be to rebuild the original context of the work of art in such a way that it is possible to “communicate”<sup>74</sup> it together with all of the elements required to make an objective evaluation. Information science, specifically hypermedia and computer graphics, should offer a fertile field for developing such applications. When rebuilding the typical context of the work of art, another important aspect that is specifically linked to computer graphics and 3-D models is *space contextualisation*, which means the ability to place the digital 3-D object in the right location while preserving the full set of spatial relations between the model and all of the other objects in the scene.<sup>75</sup>

*Space contextualisation*

Of course, the implementation of these services will necessitate a different workflow, additional competencies and skills, and more exhibition space in order to host hi-tech installations.

**Fig. 32.7** Terracotta fragments from the fourth Century B.C.  
(photo by the author)



<sup>74</sup> Artefacts usually come from a different historical period to our own, and so we must re-enable communication between the artefact and the public.

<sup>75</sup> As examples simply consider the following: Michelangelo’s *Mosè* was originally created as a part of Julius II tomb in St. Peter cathedral but instead was placed in the church of San Pietro in Vincoli as a single sculpture after the Pope’s death. Michelangelo’s *Pietà Bandini* was supposed to be placed on a tall basement, because this statue was sculptured in order to compensate the specific perspective effect.

In addition, one of the possible catalysts for the application of technology to cultural heritage is education. Technology-based cultural heritage services should be used at home, at school and on-site. Indeed, there are many digital cultural data repositories, usually websites, that could potentially be linked to form an educational service<sup>76</sup>.

One of the key approaches is to employ a set of methods and tools that can be used to select a limited amount of artefacts that comprise a “learning path”.

*Educational service*



**Fig. 32.8** “3D Models” section of the CD-ROM *The Metopes of Selinunte* (V. Valzano, A. Bandiera, J.-A. Beraldin, (2006) Coordinamento SIBA University of Lecce, Italy, ISBN 8883050398)



**Fig. 32.9**  
Leonardo da Vinci:  
*The Codex of Flight*  
(copyright Leonardo3, Italy;  
<http://www.leonardo3.net>)

<sup>76</sup> See, for example, <http://www.louvre.edu>.

## 32.1 Impact of the Interface on the Enjoyment of Cultural Content

Cognitive “trails”

There is no doubt that ICT can aid the enjoyment of cultural content to some extent. Museums, for example, can offer explorative and cognitive *trails* that are created on the fly based on user profiles and the advice of communication experts and cognitive scientists.

The artistic and historical objects to be exhibited (ranging from architecture to sculptures, and from paintings to archaeological finds) could be exhibited using the most suitable technology in each case. In the case of architecture, in addition to the usual “movie maps”<sup>77</sup>, 3D *modelling* techniques such as virtual reality, animation and digital movies are utilised, sometimes together with a 3-D plot (computer-generated *maquettes*), whilst volume rendering is much more appreciated in sculpture.

3-D or 2.5-D exploration

For paintings, aside from using high-quality digital images, methods of creating strong effects such as morphing, X-ray imaging, infrared imaging, chromatic variation and variations in perspective are used because they offer new and interesting ways of exploring the work of art. The *exploration* of a classic scene through 3-D or 2.5-D representations may help us to understand or *perceive* a painting.<sup>78</sup>

None of these features are gadgets but digital tools that aid our understanding, knowledge and studies of works of art, offering the visitor the opportunity to perform an immediate analysis.

Artefacts versus  
digital clones

There is no competition between artefacts and their *digital clones*, just as there is no competition between artefacts and art books, or books and CD-ROMs.

The application of ICT solutions to cultural heritage does not imply in any way diminish what can be gained from directly experiencing the work of art, and it does not involve reducing the artistic universe to a funfair with trivial content and approaches. Instead, the aim is to create an efficient hypermedia catalogue that does not just recreate an electronic version of traditional paper filing, based on the same methods, but instead provides an irreplaceable and unique working tool for the curator, the researcher and the common user<sup>79</sup>.

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<sup>77</sup> *QuickTime VR*, *Real Vista*, *OmniView*, etc.

<sup>78</sup> Some excellent examples are: The Tretyakov Gallery CD-ROM designed by the Russian National Multimedia Center of the Ministry of Education of Russia, or the Enciclopedia del Futurismo created by the International Multimedia Titles, Milan Italy.

<sup>79</sup> Usually the tools and the methods used to access data are predefined by experts. It would be very interesting to offer a set of digital tools enabling personal analysis: the creation of links with attributes, comparison and analysis of parts of scenes in paintings, automatic validated translation from Ancient Greek and Latin or other languages, etc.

However the best way to start a revolution in this field is undoubtedly to use networks. These allow us to link *cultural heritage* to a wider range of topics and thus reach people that would not normally take much of an interest in cultural heritage, thanks to the relative ease with which websites can be created, together with the high degree of standardisation of formats and protocols.

The future of communications is undoubtedly *online*. Customised *cultural* search engines will make it possible to search through rich sources of knowledge such as museum databanks<sup>80</sup>, not just through traditional searching on general-purpose engines and through lists of keywords, but also by data mining *weak* information<sup>81</sup>, images, 3-D models, subtopics, etc. This approach will offer to researchers the ability to develop studies based on a wide range of online resources; for example, all of the paintings representing a specific subject, or all of the locations of Michelangelo's statues around the world. It will be possible to browse information on any work of art, wherever it is stored, and compare it with any similar artefacts.

"Cultural" search engines



**Fig. 32.10** Ricci Oddi Art Gallery. This early online art gallery includes the Invisi(ta)ble Gallery showcasing the content of the art gallery warehouse. (HMG Lab, 1994)

<sup>80</sup> At this point it may be necessary to underline the difference between online and offline information management and data publication systems. Information management systems include DBMSs (database management systems), while data publication systems include the Web, CD-ROMs, electronic hosts and other interactive and nonadvertising formats. In the early phase of the Web the difference between these types of system was not clear; webmasters tended to place a lot of content online without providing any tools to manage it.

<sup>81</sup> In other words poorly structured "raw" information.

However, we are yet to reach this goal. Currently, and probably in the near future too, the richness of online data and references is also causing a number of problems. One of these is the syndrome commonly termed “lost in cyberspace”, which has resulted from the uncontrolled proliferation of links, references, and unstructured websites. This problem highlights the benefits and the importance of using *information frameworks*, clear references, and customised search engines connecting objects, people, events, times, and places.

Other important aspects to consider are the *validity* and the *reliability* of the information uploaded as well as the compliance of the published data to patrimonial and moral rights<sup>82</sup>.

Lost in cyberspace

Validity and reliability  
of information

## 32.2 A Quick Overview

From one point of view, choosing the right *navigation tool* can be highly beneficial to a data processing solution, since a highly appealing or user-friendly navigation tool can greatly increase the popularity of a particular solution. However, the rapid obsolescence of interface solutions and the evolution in the abilities and tastes of users themselves also dictates that they should be interchangeable. Many different types of user *interface* have been used to represent cultural content over the years, starting from the standard textual structure with references and logic connections, and including much more recent highly graphical interfaces that are realised using *QTVR-like* or *VRML-like* environments. The classification of navigation interfaces and metaphors used for cultural heritage is rich and full of interesting entries, beginning with the first tests carried out in the field of virtual reality with the *Padiglione d’Arte Contemporanea* (*Contemporary Art Gallery*, HMG Lab. 1993) and the *Basilica Superiore di Assisi* (*Infobyte* 1993), and then moving onto the Internet and online applications such as the *unofficial Le Louvre*<sup>83</sup> and the *Galleria d’Arte Moderna Ricci-Oddi* (*Ricci-Oddi Modern Art Gallery*, HMG Lab. 1994), the *Palazzo Grassi* (*Grassi Palace Venice*), and finally mentioning relatively innovative navigation interfaces, such as *Smithsonian Without Walls—Revealing Things* (*Smithsonian* 1997), *History Wired* (*Smithsonian* 1999) as well as the *Uffizi 3D Tour* (*Uffizzi Lab. & Centrica*), *Hermitage*<sup>84</sup>, *Eternal Egypt*<sup>85</sup> and *Musei Vaticani* (*Musei Vaticani*, *All Media*, 2003–2007).

In such a context, it is evident that while search engines and associated keyword masks are very useful and absolutely necessary, they are a less desirable method of locating data than simply navigating through the data structure by

<sup>82</sup> Please refer to Chap. 28 on IPR for more information on this topic.

<sup>83</sup> Developed by a French student.

<sup>84</sup> See <http://www.hermitage.ru>; from IBM.

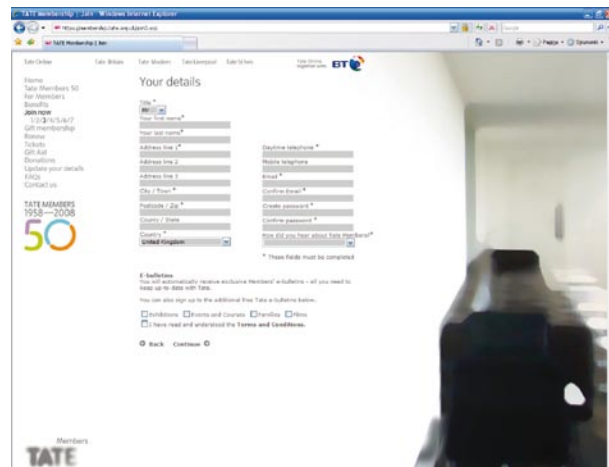
<sup>85</sup> See <http://www.eternegypt.org>; from the Egyptian Ministry of Culture in cooperation with IBM.

browsing through its contents. Such an approach may represent the key to the success of a museum site too.

However, the free and direct access to information enabled by the World Wide Web has certainly (and almost *unintentionally*) greatly contributed to its success, since it has removed the barrier represented by the database query mask. Based on these considerations, a large number of online museum sites have adopted a “double access” approach to data searches: they allow users to search either by query or by browsing.



**Fig. 32.11**  
Tate Gallery website



**Fig. 32.12**  
Tate Gallery website  
registration form

Years ago, in 1994, during the *Virtual Museums Network* project, the concept of *user profiling* was developed in the field of culture. This involved defining several user profiles, ranging between *researcher* and just *curious*. Later on, during the *EC MOSAIC project* (in 1995) and some online training courses, some features devoted to *user tracking* and *adaptive multimedia* were added.

At that time, the main developmental path envisaged was to take advantage of structured content in order to enhance the application of user profiles that tailor both the content and the interface to the needs of the user. Most of this task would be carried out in the background, using *intelligent agents* and *user tracking* methods.

The final aim was to tailor the cultural information system output to the user's requirements, by providing the right content within the right format and interface. Based on the specific user profile, the *weights* of some of the interface components are changed in order to enhance the visibility of frequently browsed sections, and some shortcuts (hyperlinks) facilitating navigation through the Web can be established.

### Case Study: Aram Khachaturian: The Life and Works

The CD-ROM devoted to the world-famous Armenian musician Aram Khachaturian is a significant example of the balanced use of multimedia content. As stated in the official presentation of the product:

"It is always hard to add virtual dimension to music, but this project succeeds in creating that, by interactively presenting not only his music, but also sources of inspiration of this great composer, the facts of his life and surrounding musical environment, that inspired and made possible such a synthesis."

*Aram Khachaturian: The Life and Works*<sup>86</sup> succeeds in immersing the user in a captivating journey into the world of the composer. The product is dedicated to the 100th anniversary of Aram Khachaturian (1903–1978), who was the first composer to significantly combine symphony music with the musical tradition of the East.

The composer's life and works are presented through his letters, photos, a biography, an archive, his contemporaries' memories, video material, in-depth commentary, personal recollections and, most importantly, his music.

This project reveals how Khachaturian absorbed the Eastern and Western cultures that were present in his native city of Tiflis. It was this

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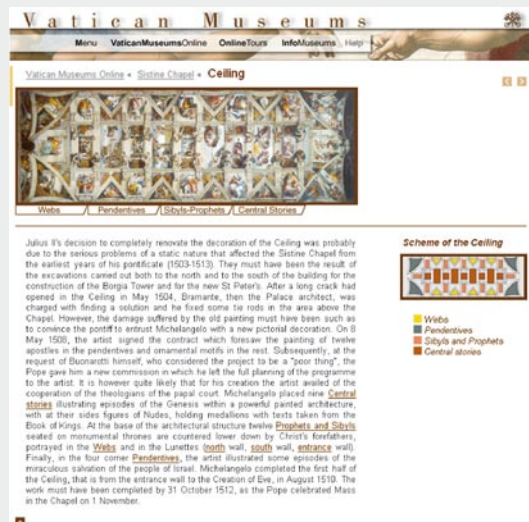
<sup>86</sup> Producer: ITE CJSC, Garegin Chugaszyan, Republic of Armenia; see <http://econtent.am/?p=77&ln=en&module=001>.

extraordinary cultural heritage that inspired him to create his unique blend of symphony music.

A time line is one of the entry points to the digital content; all the major events and milestones of Khachaturian's life are aligned along the time axis of a sheet of music. This tool helps us to clearly understand the various musical influences that provided the sources of inspiration of Aram Khachaturian. The choice of music accompanying each section gives us a clear understanding of the exceptional mix of Oriental melodic traditions with Occidental symphony techniques that make the work of Khachaturian so unique.

## Case Study: Vatican Museums Website

Here we encounter one of the most unique and rich collections of cultural heritage in the world. The Vatican Museums<sup>87</sup> host an incredible number of collections and unique artefacts, range from Etruscan relicts to geographic maps to the Sistine Chapel. These artefacts have come from all over the world and are on display for visitors from around the globe. Some of the key points about this project are: the huge amount of information to be managed and linked; the relevance of the content; the multicultural approach needed; the need to carefully consider the management and evolution of the application, at least from a mid-term perspective.



**Fig. 32.13** Vatican museums official web site—Sistine Chapel, Doom day

<sup>87</sup> Vatican Museums website: <http://www.vatican.va/>.



**Fig. 32.14** Vatican museums—Sistine Chapel

In recent years, the Vatican's visitors have been demanding an increasingly exhaustive knowledge of the collections and better assistance when viewing the collections. This requirement has become an incentive to integrate traditional communication channels with the use of the Internet. The exceptional characteristics of the Internet have helped erase barriers related to time and space, making it an extraordinarily effective way of spreading knowledge and culture. Furthermore, thanks to the Internet, the invaluable artistic heritage that has been preserved and protected in these museums for five centuries, defined by UNESCO as "humanity's artistic legacy", will be made available to all of the Web users around the world.

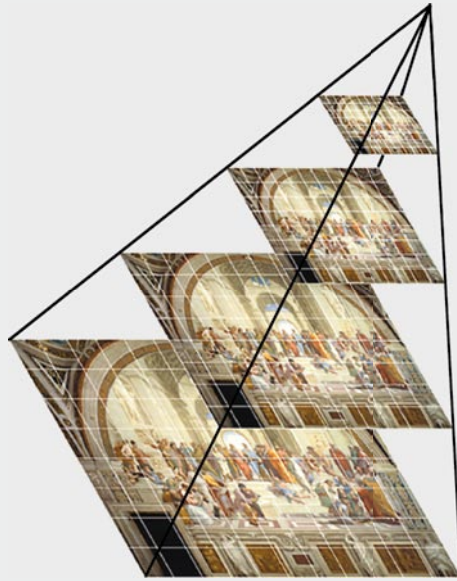
The development of the Vatican Museums website was assigned to a company called All Media<sup>88</sup> by the Direzione dei Musei Vaticani, and it took over three years to complete. The website can be explored in five languages: Italian, English, German, Spanish and French.

Due to the incredible richness of the content available, the initial phase of the project mainly involved highlighting some of the most popular collections, such as the Sistine Chapel, Raphael's Rooms and the Pinacoteca, as well as recent renewed and enriched sections, such as those of the Gregorian Egyptian and Etruscan Museums and the Ethnological Missionary Museum.

During the five-hundred-year anniversary of the establishment of the Vatican Museums (in 2006), the official website was enriched with another 4000 HTML pages (corresponding to more than 3400 conventional pages of text) written in Italian, English, German, Spanish and French, containing 215 explanatory items, 165 high-definition images and 95 medium-resolution ones. The development of the Vatican Museums website required the coordination of a group of Vatican Museum experts, who were responsible for the scientific and artistic aspects of the website, with the employees of All Media, who provided the technological and communications expertise.

The complexity of the iconographic contents of the pictorial cycles of both the Sistine Chapel and Raphael's Rooms required that a great deal of effort was expended to provide exhaustive as well as didactically accurate artistic and historical descriptions together with high-quality images and details. Some high-quality two- and three-dimensional representations of the rooms allow the viewer to rapidly scan through the pages via a considerable number of links. An additional aspect that we should emphasise here is the ability to cross-reference the biblical texts that provide the inspiration for the episodes depicted in the frescoes.

<sup>88</sup> All Media website: <http://www.allmedia.it>.



**Fig. 32.15** Vatican museums—Sistine Chapel

The Pinacoteca is approached through an introductory overview with a list of the most important paintings present in each of the 18 rooms, accompanied by a detailed analysis of the most significant works of art and related images, which can be enlarged in order to visualise the tiny details. Other museum sectors can be explored in a similar way to the Pinacoteca, with the main works exhibited in each room listed so that they can be looked at and analysed in greater depth.

Due to the technical specifications employed<sup>89</sup>, the Vatican Museums website can easily be explored on mobile platforms, both palm-sized computers and smart phones. Several applications have been developed in order to enable users to take multimedia guided tours on palm-sized computers with the Pocket PC operating system connected to WiFi access points, or GSM/GPRS/UMTS smart phones. This approach will enable access to the most important works and useful information about the Vatican Museums; soon this information will also be accessible in many areas served by public “hot spots” controlled by different operators.

The Vatican Museums website is scientifically and didactically accurate, so in terms of content quality it is comparable to those designed for other great museums. The online service is also intended to provide

<sup>89</sup> In other words the size of each webpage and the possibility of viewing the pages with any mobile device.

certified, validated and upgraded content to curators, who represent the foremost experts in their field, given that many other websites refer to the Vatican Museums' works or collections in inaccurate or incomprehensible ways.

### **Case Study: Virtual Viking Village**

One of the first forays into virtual reality in the field of archaeology was developed by Ola Odegard with the support of Telnor, the Norwegian telecom operator, in 1993.

Virtual Viking Village 1.0 can be experienced using HMDs on the SGI ONYX platform running *Performer*. Thanks to interactive virtual reality, the user can explore a Viking village just as it (probably) appeared in ancient times. The complexity of the geometrical model and the quality of texturing was limited by the technological approach of that time.

### **Case Study: Cluny Abbey**

As computer graphics and solid modelling became more popular, a number of digital reconstructions of historical buildings and monuments were created. One of the first high-quality digital reconstructions was the movie in which *Cluny Abbey* (most of which no longer exists) was recreated. IBM France provided the authors of the digital model with the equipment used to model the architectural details<sup>90</sup>.

Cluny Abbey was one of the greatest and most important churches in Christendom during the eleventh and twelfth centuries. In 1793 Cluny Abbey was demolished by French revolutionaries rebelling against the clergy; all that remains of it today is the south portion of the main transept and the octagonal bell tower.

The project was originated by a thesis written by two engineering school graduates from the province of Cluny, who had built a database of all of the architectural information on the original abbey compiled between 1928 and 1984 by Conant.

Starting from the available resources, a team of technicians rebuilt Cluny Abbey by offering a live digital experience to the public. The

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<sup>90</sup> This televirtuality application was created by a real mix of expertise, including IBM France's database muscle, Medialab's televirtuosity, France Telecom's ISDN bandwidth, and the collected notes of the late Harvard architecture professor John Kenneth Conant. The chief coordinator was the leading French VR guru Philippe Queau, a researcher at the Institut National de l'Audiovisuel.

digital movie was created in order to promote the historical monument and generate revenue for an association. The movie included a dynamic walkthrough and a detailed exploration of the original shape of the church, including animated actors like pigeons and even a nun walking over to her own burial stone at the end of the movie. The same approach was later adopted to finance the reconstruction of another relevant monument: the *Dresden Frauenkirche*.

In addition, during IMAGINA 1993 (held in Monaco), Father Di Falco exchanged his vestments for a head-mounted display, while six hundred miles away in Paris, at the other end of a pair of ISDN lines, Dominique Vingtain, a curator from the Musee d'Ochier in Cluny (in eastern France), tested the torque on her joystick. Minutes later, both Dominique and the priest were time-travelling together online; they gradually floated 860 years back down the timeline and then toured through a virtual model of the famous Cluny Abbey.

### **Case Study: From Ruins to Reality—The Dresden Frauenkirche**

A similar project was realised in 1993 by the Frauenkirche Foundation with the support of IBM Germany (Collins 1993). The basic idea was to support fundraising for the reconstruction of a church destroyed in World War II by providing a digital reconstruction of the original shape of the church and a digital movie describing the history of the Frauenkirche in different sections: its status after World War II, its reconstruction and its future shape.

The movie was an important promotion tool for the fundraising campaign.

## **32.3 Advanced Interaction Models for Cultural Content**

This section will sketch the state of the art in the field of advanced user interfaces that ensure the interoperability of heterogeneous distributed datasets and their querying interfaces, describing recent solutions and implementations and outlining future trends and approaches.

The arrival of the *networking era* after more than thirty years of stand-alone data management has highlighted the need for information interchange and interoperability between systems. This issue is most relevant in the data management sector; interoperability amongst huge databanks may unleash unpredicted benefits.

Consider, for instance, cultural heritage databanks. Such datasets hold various information types, ranging from alphanumeric data to images or computer-generated movies. Experts in cultural heritage started to define data structure and formats many years ago in order to promote standards enabling information storage and exchange.

The chance to use a *common access interface* to the whole set of cultural heritage data will enable us to easily retrieve very useful results, and it should become important components of virtual exhibitions and online cultural services that specifically reference to the European culture.

Let us consider some of the most relevant shifts in the domain of advanced interaction models:

- From alphanumeric to visual/graphic (multimedia)
- From unrelated data to related and complex data (hypertext/media)
- From standalone DBMSs to distributed heterogeneous DBMSs
- From querying to dynamic “browsing”.

#### *The tip of the iceberg*

Navigation tools, interfaces and metaphors should be considered to be just the tip of the iceberg of the information system. However, users judge the application or service that they are using starting from the interface. The weight attributed to the interface is increasing every day. The shift from textual interfaces to visual interfaces and from alphanumeric content to multimedia content has enhanced the relevance of the interface.

The use of hypertext and, later on, hypermedia has unleashed the possibility of relating and linking information while allowing all of the information to be transferred in a structured and related format, skipping the usual linear deconstruction phase.

**Fig. 32.16** Indigo Media, Mexico (<http://www.reporteindigo.com/>)



The structured information transfer offered by information technology is a powerful opportunity; the usual transfer protocol applied is *serial*, like writing and speaking.

*Structured information transfer*

The resulting web of links might *represent knowledge that connects concepts* and relevant items together into predefined “trails”.

In addition, while standalone data processing characterised the past, the explosion in Internet-based working has forced the issue of data exchange amongst heterogeneous databases to be addressed. To some extent, at least conceptually, this has unleashed incredible potential in the *info domain*.

*Info domain:  
from standalone  
to networked data*

Skipping over the complexity involved with managing these functionalities at the DBMS level, let now focus on interface issues.

Bill Hewlett used to say that one graph is much more meaningful than a thousand numbers, immediately illustrating the power of graphics.

	2004/2003	2005/2004	2006/2005	2007/2006
Austria	2.3	4.6	6.0	5.9
Belgium/Luxembourg	3.1	3.8	4.0	6.1
Denmark	3.6	4.6	4.2	3.6
Finland	3.4	4.2	4.0	4.1
France	2.9	5.3	3.4	3.9
Germany	1.8	2.8	2.6	3.0
Greece	2.9	4.7	5.3	6.2
Iceland	5.4	5.7	8.1	5.4
Italy	1.2	2.3	1.7	2.5
Netherlands	1.6	4.7	5.5	6.5
Portugal	2.3	5.0	2.7	4.5
Spain	3.6	7.0	5.6	5.9
Sweden	1.3	4.7	2.8	3.3
United Kingdom	4.0	5.5	4.1	4.2
Czech Republic	14.3	9.9	10.1	9.6
Estonia	24.2	11.3	6.0	8.2
Hungary	16.9	7.0	6.9	7.5

**Table 32.1** IT market growth by country in Europe (source: EITO)

**Table 32.1 (continued)**  
IT market growth by country  
in Europe (source: EITO)

	2004/2003	2005/2004	2006/2005	2007/2006
Latvia	18.2	15.1	9.8	9.5
Lithuania	23.3	17.0	11.8	9.4
Poland	21.0	21.6	12.1	9.1
Slovakia	20.7	9.4	11.7	10.4
Slovenia	14.7	6.6	6.1	4.0
EU	3.1	4.7	3.8	4.2
Norway	4.8	5.2	4.2	3.3
Switzerland	1.1	3.5	3.7	4.7
All	2.6	4.4	3.6	4.0

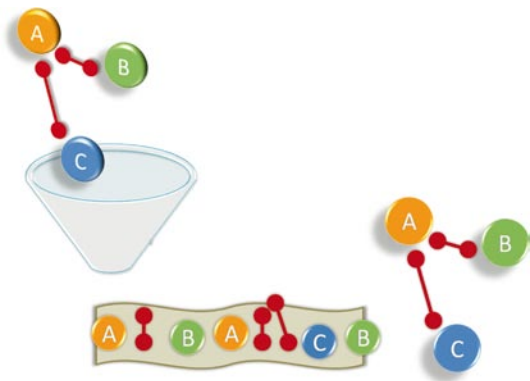
*Hypertext plus multimedia  
multiplies the results*

*VR: ultimate interface*

In addition, the use of hypermedia extensions gives us the opportunity to use the most appropriate medium for each specific information transfer, according to the rule that the use of “hypertext plus multimedia multiplies the results”, enhancing the communication.

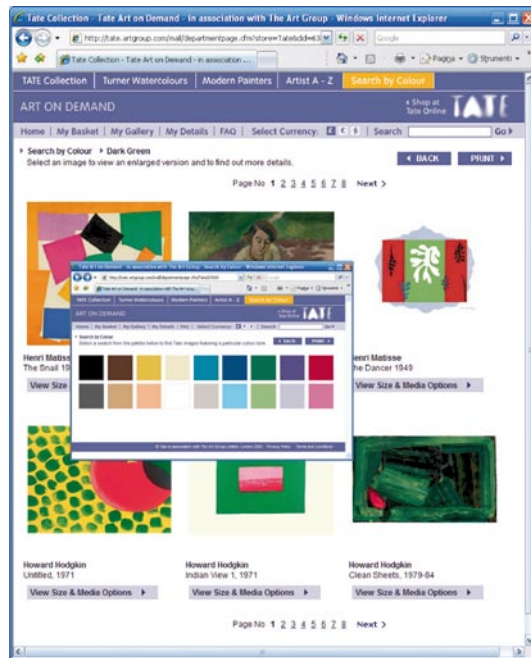
Even the use of *virtual reality*, which could be considered to be the *ultimate medium* for multimedia, provides many benefits in the field of education and training because it simplifies the information transferring process, especially when it is necessary to deal with structured complex data. In such cases the information can be transferred “as is”: with all concepts and relations included.

**Fig. 32.17** Serial communi-  
cation process: knowledge  
transfer

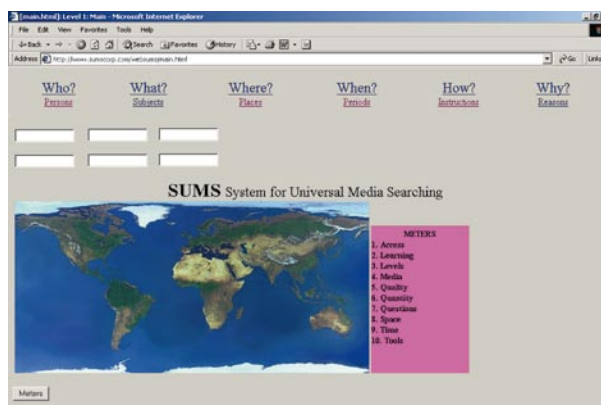


The classic way to access information within databases is to create a query using single or multiple keywords and type this into a form. This approach requires a good knowledge of both suitable keywords and the properties of the query language. Querying can be a frustrating task, because we may know that interesting data are inside the database, but we may not know the correct query to use to retrieve that data. Of course, in this case we could bypass this problem by using an appropriate interface to the database.

*Querying databases or browsing data?*



**Fig. 32.18** Tate Gallery website: search by colour



**Fig. 32.19** The original SUMS interface based on: Who, What, Where, When, How, Why (developed by Kim H. Veltman)

The “direct query” approach is suitable for experienced *infosys* users but is too complicated for general users interested in accessing cultural content.

Following relevant discussions on data structures, interoperability and data management (OODBMS, XML, CIMI, Dublin Core, CIDOC and others), websites devoted to cultural content now tend to offer a query form based on a list of selected entries, such as *Artist Name*, *Work Title*, etc.

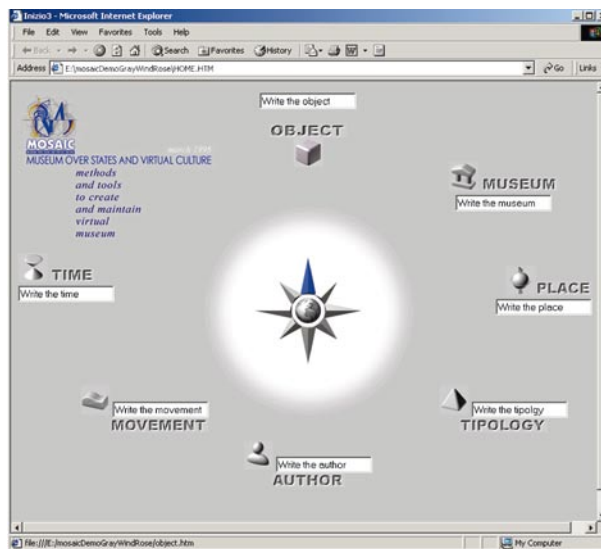
However, interactions achieved through the use of a set of interrelated *key-words* do not offer a comprehensive view of the network in terms of relations and references. It often happens that we jump from no results to hundreds of links—an *invisible* universe of data is again beyond our reach.

A common solution to this problem is to give the user hints and *cues* about this *invisible world of data*. This means dynamically updating the list of available keywords with the most relevant choices, or in a graphic environment the links and data distribution around the focus of the query can be displayed.

When dealing with cultural content it is important to outline some relations or at least make them visible. One of the most important early experiences in this field is named *SUMS*.

The *System for Universal Media Searching (SUMS<sup>91</sup>)* was chosen as one of the reference solutions for G7 Pilot Project 5: *Multimedia Access to World Cultural Heritage*.

**Fig. 32.20**  
MOSAIC query form (1995)



<sup>91</sup> In 1991 Prof. Kim H. Veltman developed the concept of SUMS at the Perspective Unit of the McLuhan Institute, Toronto, Canada, refer to [www.sumscorp.com](http://www.sumscorp.com).

*SUMS* offers interesting opportunities for advanced conceptual navigation in cyberspace. The Internet has magnificent resources, but it is chaotic because its basic tools are too primitive. There are home pages: but the notion of a page with a few *hotwords* becomes impractical in the case of a museum with thousands of paintings or a library with millions of books.

Present browsers search keywords alphabetically and usually give us an enormous amount of references we don't want. There are bookmarks that help us to remember a site that we have found, but if we do a lot of searching, the resulting pages and pages of bookmarks soon become overwhelming.

*SUMS* provides a methodology for tackling these problems. It is a systematic tool for finding, retrieving and organising material on the Internet, linking your own local collection of facts with the external electronic universe. The system is based on a primary set of references: *who, what, where, when, how, why*, etc.

A customised browser that used this approach was released during the *MOSAIC*<sup>92</sup> project. The evolution of *SUMS* and *SUMMA* projects was the "Digital Reference Room" elaborated by Prof. Kim Veltman in the 1990s.



**Fig. 32.21**  
MOSAIC concept,  
early demo (1995)

<sup>92</sup> *Museums Over States and Virtual Culture* (an EC Ten Telecom project), 1995.

## Case Study: Smithsonian Without Walls—Revealing Things

An interesting project that considered how to preserve the richness of relations and offer the opportunity to browse content by following a series of possible connections, and even change the point of view, was carried out by the *Smithsonian Institution* and presented during the *WWW7 Culture Track* in 1997.

The resulting application was named *Smithsonian Without Walls—Revealing Things*<sup>93</sup>. Users could browse the site using both a graphical representation of the structure of the data and a set of filters and keywords that could be tuned in order to encompass or filter out information.

The application screen was ideally subdivided into three main sections: navigation tools, content preview, content publication. The first section, navigation tools, was structured into three main functional areas. The first area provided an outline of the items, concepts and relations within the data via a 3-D “look and feel” graph; the second area included some *sliders* that filtered themes, eras, objects and data shading. By moving each slider the user was able to increase or decrease the *weight* of the related filter. A search field was also provided. The final navigation tool was a strip of thumbnails representing the top of the list of selected items. Users were able to click on any of the thumbnails to select the corresponding item.

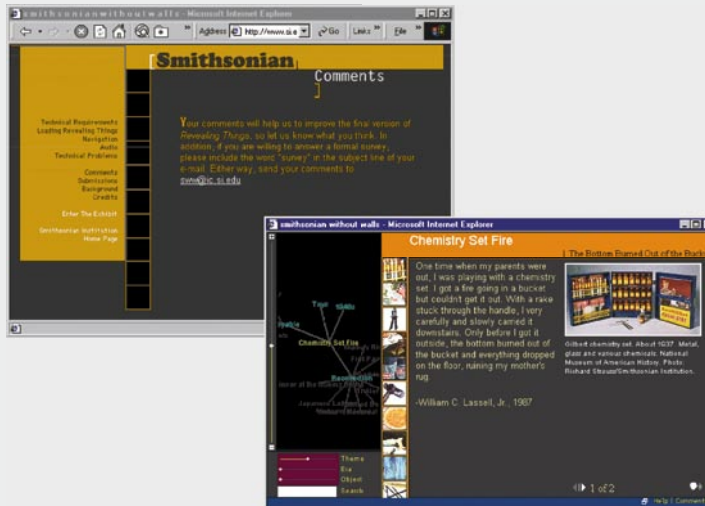
*Smithsonian Without Walls—Revealing Things*

**Fig. 32.22** Smithsonian Without Walls: *Revealing Things* (1997)

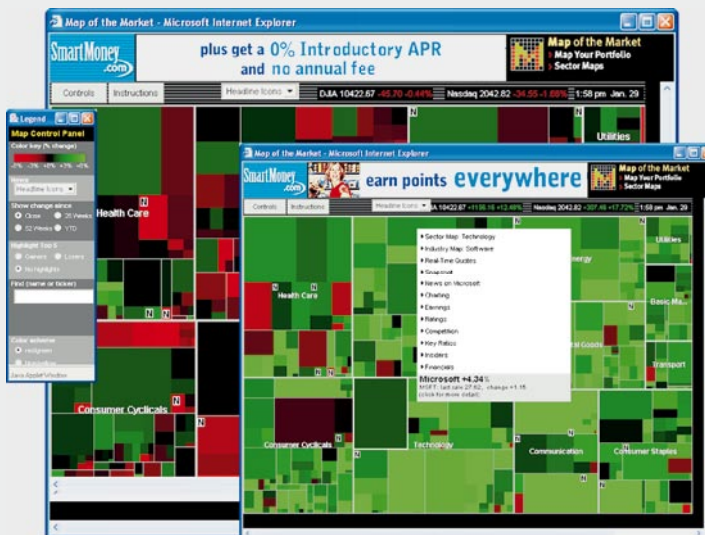


<sup>93</sup> The project was presented by Judith Gradwohl of The Smithsonian Institution (<http://www.si.edu>).

While some “basic” users encountered some difficulties with it, this application allowed enhanced interaction with a dataset. Users could move from one reference entity to another one by following a relation (e.g. from blue jeans to the 1970s before finally reaching a guitar).

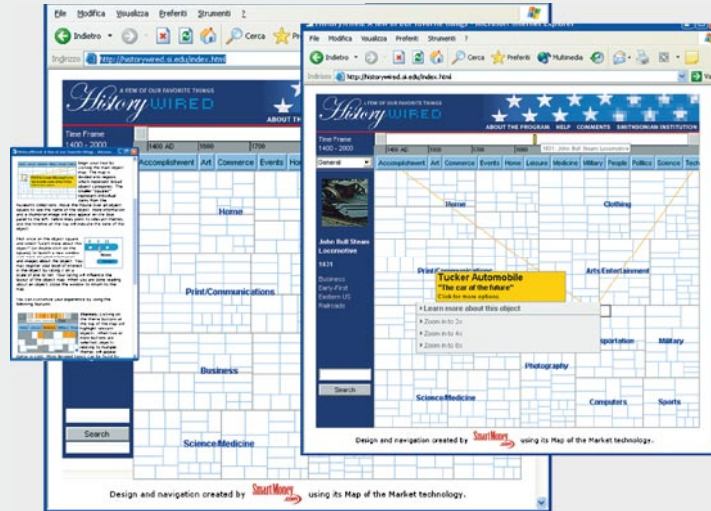


**Fig. 32.23** Smithsonian Without Walls: *Revealing Things* (1997)



**Fig. 32.24** Smart Money website: *The Map of the Market*, a tree map (1998)

**Fig. 32.25**  
Smithsonian Institution:  
*Historywired* (1999)



This approach combined the power of DBMS querying with the friendliness of browsing; visitors were able to follow their own lines of thought. Nevertheless, this approach, while a flexible one for a specific collection such as *Revealing Things*, is not easy to extend to multiple collections due to the complexity of the web of links that connect the artefacts.

A second project was also developed by The Smithsonian in order to overcome these limits. While looking for a suitable interface paradigm, they found the SmartMoney.com website and its *Map of the Market*. In this map, a patchwork of coloured rectangles represents the stock exchange market. The map is subdivided into macro areas (energy, food, ICT, etc). Each single tile represents a company and the size of the tile the value of the company. The colours range between green and red and represent stock health. Users can zoom into a specific section of the market, and when a tile is selected some more options are made available.

This interface concept is based on Benjamin Shneiderman's concept of *tree maps*. The application of this approach to multiple museum collections led to the creation by The Smithsonian of *HistoryWired*, which comprises a set of elastic links to a set of keywords pertaining to the selected collection or object.

### Case Study: Ename 974

The *Ename 974* project represents a typical example of the added value use of technology in the field of archaeological sites and monument communication, providing contextualised visual and textual information to visitors and students.

In 1997, during the MEDICI meeting on Virtual Museums, Dirk Callebaut, the project leader and senior staff member of the Institute for Archaeological Heritage of the Flemish Community of Belgium (IAP), introduced the concept of the ENAME 974 project:

At Ename, a number of extremely important and varied monuments have been preserved from both the early-medieval occupational phase and the period of the medieval and post-medieval abbey. This rich evidence of continuous occupation has enabled the Ename 974 Project to reconstruct the history of this living community and its environment over a span of more than a millennium. This story involves not only wars and kings and emperors, but also the lives of countless common people who adapted to their environment and altered the surrounding landscape to fit their changing needs.

The mission of the ENAME project is to define the basic objectives and principles of site interpretation in relation to authenticity, intellectual integrity, social responsibility, and respect for cultural significance and context. It recognises that the interpretation of cultural heritage sites can be contentious and should acknowledge conflicting perspectives.

The interpretative program of the Ename 974 Project focuses on four points of archaeological and historical importance, all situated within walking distance from each other: the archaeological site, the Saint Laurentius Church, the Ename Provincial Museum and the “Bos t’Ename”. In the present section we will mainly focus on the archaeological site and the Saint Laurentium Church.

The archaeological site of Ename (covering an area of eight hectares) has been developed as an open-air museum. It is often the case that open-air museums and archaeological sites are not, to use an ICT term, very “user friendly”.

One of the usual challenges related to archaeological sites is to make complex and poorly preserved archaeological remains comprehensible to the general public.

Archaeological remains are rarely recognisable (as churches, houses, workshops, etc.) to those working outside of the field. Fragments of walls, columns and floors do not provide enough information to allow the casual observer to figure out the original shape and sometimes even the type of building that the fragments refer to.

In the case of Ename, visitors see a labyrinth of partially preserved walls and courtyards. These are the foundations of the Benedictine abbey that dominated life in Ename from 1063 to 1795. The remains of the early-medieval trade settlement (975–1050) are not visible, since they consisted largely of soil layers and traces of decomposed wood that were removed in the process of excavation.<sup>94</sup>

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94 From the official description of the project.

The Ename 974 project has developed a computer-based presentation technique that allows archaeological sites to be interpreted in a variety of ways, by different audiences, without damaging or performing dubious physical reconstructions of the archaeological remains. As the official description of the project explains:

The first prototype of this non-intrusive interpretation system, called *TimeScope*, was installed at the Ename site in September 1997, using the foundations of the abbey church as the basis for virtual reconstruction. The initial concept, called *TimeFrame*, by John Sunderland and André De Clercq (Barco), was technically developed by IBM and further refined by Daniel Pletinckx of the Ename 974 team. The project was commissioned by the government of the Province of East-Flanders. The Institute for Archaeological Heritage of the Flemish Community of Belgium (IAP) was responsible for providing the archaeological data used in the computer reconstructions.

The current TimeFrame on the site was the first of its kind worldwide. In the beginning the visitors were asked to evaluate the system and assess the concept. The reactions were enthusiastic and are best summarized with the words of a visitor: “*I have been to the site many times before, but this is the first time I really understand what is actually shown here.*”<sup>95</sup>

TimeScope shows a semi-solid 3-D plan of the Saint Salvator church precisely superimposed on a real-time video image of the archaeological foundations visible at the site. This composite image is observed by visitors standing in a kiosk at the same vantage point implied by the video image. Together with narration, images and other architectural reconstructions, the TimeScope presentation offers a clear and vivid interpretation of the evolution of the archaeological site over the last thousand years.

As the site is developed further, new additional TimeFrames will be installed all around the excavations to give the visitors a comprehensive idea of the history of the site.

### **TimeScope 1: The Concept**

The *TimeScope I* system consists of a video camera, a computer system, two monitors, and a touch screen. A specially designed on-site kiosk houses the system and protects visitors from the elements. The video camera is directed toward a particular section of the archaeological remains (for instance the visible foundations of the Saint Salvator church) and it

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95 From the official description of the project.

transmits real-time video images of those remains to the monitor screens in the kiosk.

Through the use of a series of touch screen icons on the main monitor screen, visitors can view computer reconstructions of the structures that have successively stood on that spot, superimposed precisely on their excavated foundations.

In this way, the TimeScope 1 system helps visitors to understand the labyrinth of the archaeological remains at a site and to visualise how the original structures might have appeared when standing.

By using real-time images of the archaeological remains as a background for the reconstructions and multimedia presentations, the TimeScope 1 system offers visitors a sense of immediacy and realism in which the actual weather, sky conditions, and angle of sunlight at the time of their visit serve as a background for the virtual reconstructions.

The touch screen also allows visitors to select programmes that deal with various historical subjects and offer other perspectives on the virtual reconstruction. For example, when a structure from a certain period has been “built” over its visible foundations, viewers can explore its interior rooms and furnishings. In this way, a multimedia presentation with photos, plans, drawings and animated virtual images describing the evolution of the site and its buildings is shown on the same screen.

In the *TimeLine*, interactive virtual reality is used to place various excavated objects in their historical context and thereby help the visitor to gain an understanding of the living world of Ename over the last thousand years. A traditional, chronologically arranged display of excavated archaeological artefacts is juxtaposed with a virtual reality application. On one side of the exhibit room, the artefacts are presented in small exhibit cases. On the other, a computer application places each of these objects in its original spatial and chronological context (where was it discovered? What culture or activity did it belong to?). Through these virtual images the object can be placed in the historical milieu in which it was used.

This system offers an effective means of archaeological presentation: it can be continuously updated and expanded as additional discoveries are made. An additional program is currently available at the museum in which the excavations and restoration work at the nearby Saint Laurentius church are shown and regularly updated.

### **TimeFrame III**

A new TimeFrame was set up in the west choir of the Saint Laurentius church that allows individual visitors as well as guided groups to explore the history of the church in an interactive way. Guided by their own interests, the visitor actually puts the story together and is shown an optimal

presentation not only of the monument, its history and its significance, but also of the restoration and the excavations.

The TimeFrame technology also takes into consideration the fact that the monument is used as a church. The visitors use audio guides so that the noise of the presentation does not disturb the character of the church as a place for prayer. The TimeFrame also gives a good idea of the church before the restoration. Thus the technology ensures that the architectural evolution of the building up to its present state is not wiped out.

In this way, experience and expertise has been gained in applying virtual reconstruction methods, creating user interfaces for exploring virtual reconstructed worlds in time and space, in the use of the Internet for heritage presentation and in on-site outdoor interpretation systems. Applied technologies include:

- Websites
- Timescopes
- Character-based interpretation
- Audio interpretation
- CDs and DVDs
- 3-D
- Graphical panels.

During the MEDICI meeting, some future developments of the TimeFrame concept were outlined. An interesting “movable window” showing the past and created by combining the technology developed by ART+COM in Berlin (for *Virtual Vehicle*<sup>96</sup>) with the TimeFrame concept was outlined. The user explores the scene via a movable window (plasma screen) that presents selectable *layers* of the past superimposed onto the actual view. Such an application can be used to offer a complete recontextualisation of scattered objects or to integrate different relicts within their original environment.

### **Case Study: CREATE (Constructivist Mixed Reality for Design, Education, and Cultural Heritage)**

This project represents an excellent case study in the field of interactive virtual reality. It enables full interactive navigation in complex scenarios enriched with both autonomous actors and multisource audio feedback.

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96 The *Virtual Vehicle* (1997) developed for Daimler Chrysler is an interactive presentation system for viewing and configuring the entire model range of a given vehicle. It was designed for use in showrooms and at trade fairs. See <http://www.artcom.de>.

The virtual environment enables re-lighting, photorealistic rendering, population and sound so that it can provide a highly realistic experience while supporting interactive use.

In addition, an ad hoc haptic interface enables physical interaction with the model. Thanks to force feedback the user can actually “grab” objects in the scene and replace them. A typical use for this is in anastylosis<sup>97</sup>, where archaeological ruins are reconstructed from the original material. Of course, this feature can also be used for didactical purposes, enabling a kind of assembly box for classical temples to be created.

*CREATE*<sup>98</sup> (Constructivist Mixed Reality for Design, Education, and Cultural Heritage) aims to develop a mixed-reality framework enabling highly interactive real-time construction and manipulation of realistic virtual worlds based on real sources. This framework has been tested and applied to two prototypes: a cultural heritage/education application with a haptic interface, for students and the general public, and an architectural/urban planning design review application incorporating an autonomous crowd of people and multiple sources of sound, for use by decision makers and the general public.

To develop these applications, the project follows a “constructivist” approach, combining innovative work in VR, simulation, data capture, visualisation graphics, and interface design to provide highly realistic yet interactive experiences where users actively participate in the construction of environments. Development will be driven by actual user requirements, through careful analysis of each case, and evaluated for its effectiveness.

## Case Study: The Foundation for the Hellenic World

*The Foundation for the Hellenic World (FHW)* is an interesting initiative that illustrates the active role of private foundations in the field of culture. The Foundation of the Hellenic World was envisioned, founded and funded by the family of Lazaros Efraimoglou, and is a privately funded not-for-profit cultural institution based in Athens. Its foundation was ratified in 1993 by a unanimous vote of the Hellenic Parliament.

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97 Anastylosis from the Ancient Greek: αναστηλωσις, -εως; ανα, ana = “again”, and στηλώω = “to erect (a stela or building)”. Archaeological term referring to a reconstruction technique where a ruined monument is restored.

98 Consortium partners: Centre Scientifique et Technique du Batiment (CSTB; France), Realviz (France), University of Cyprus (Cyprus), Scuola Superiore di Studi Universitari e di Perfezionamento Sant’Anna (Italy), Institut National de Recherche en Informatique et en Automatique (INRIA; France), Foundation of The Hellenic World (Greece).

The official mission of the FHW is the preservation of Hellenic history and tradition, the creation of an awareness of the universal dimension of Hellenism and the promotion of its contribution to cultural evolution. Its aim is to provide an understanding of the past as a point of reference for the formation of the present and future, such that contemporary thought may once again be inspired by the Hellenic spirit. The dissemination of Hellenic history in any way possible is the principal objective through which the aim of the Foundation will be achieved.

The Foundation is located in Athens on the way to Piraeus; the building hosts several different installations and services, ranging from multimedia desks to virtual theatres and a CAVE.

### **Case Study: Eternal Egypt**

*Eternal Egypt*<sup>99</sup> is a multilingual website (provided in English, French and Arabic) that uses a number of interactive technologies to offer users from around the world the experience of learning about ancient Egypt. High-resolution imagery, animations, virtual environments, remote web cameras and three-dimensional models all combine to provide a rewarding interactive learning experience.

The user can explore the site by taking a guided tour and selecting the highlights of Egyptian civilization in addition to a number of valuable search possibilities.

Eternal Egypt brings to light over five thousand years of Egyptian civilization. It is a living record of a land rich in art and history, people and places, myths and religions. It is not an easy task to provide intuitive and consistent access to this rich content spread over a time span of five thousand years and thousands of square kilometres of territory along the River Nile.

There are many ways to begin your journey through Eternal Egypt. The guided tour is a quick way to experience the best that the site has to offer. You can also begin with one of the cultural highlights, like specific objects or places, or make your own discoveries using one of the many other ways to explore. Choosing the last option, the basic ways to explore Egyptian History are across time or space.

An interactive timeline provides one of the key routes to accessing the web content. The *Timeline of Egyptian History* allows users to place the stories, artefacts, characters, and places of Egyptian culture in their

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<sup>99</sup> Company: CULTNAT Fathi Saleh in partnership with Editions du patrimoine Commission du Vieux Paris, Arab Republic of Egypt; see <http://www.eternalegypt.org>.

On the occasion of the Tunis phase of the World Summit on the Information Society, an innovative application devoted to the exploration of ancient papyri was shown for the first time. The application is based on an in-depth interactive multimedia presentation of papyri content presented on a panoramic 180-degree screen.





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