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EPOCH

Excellence in Processing Open Cultural Heritage

Network of Excellence

Information Society Technologies

D.2. 2.1: Vertical Integration

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'Everything the human mind can imagine,

will be reality one day.'

Jules Vernes

Executive Summary

The goal of the EPOCH network is to develop and provide proper ICT tools for the cultural heritage community and to improve the use and uptake existing and new cultural heritage IT tools.

Work package 2.2 concentrates on the issue of Vertical Integration, mainly the use of IT tools and methods throughout the entire cultural heritage domain. The main tasks are:

- Mapping all technologies currently used in the CH domain (inventory)
- Identifying the success, failures and technology gaps
- Compiling a CH integration roadmap

This report includes:

- The collection of data from multiple published and electronic sources
- Selected responses from EPOCH partners regarding their use of technology in CH projects
- Results of standardised questionnaire distributed to selected museums and cultural organisations
- Information and observations gathered in onsite visits and interviews at selected museums and archaeological sites
- Analysis of feedback regarding preliminary surveys received from EPOCH partners at VAST2004
- Preliminary evaluation of success/failure factors and technology gaps as a guide to future research
- Evaluation of methodology and recommendations for continuation of vertical integration study

Preceding the description of the methodology and results of the research activities, evaluation benchmarks for Vertical Integration are pointed out. From a seminar, held in 2004, five pre-defined themes were chosen as benchmarks and examined:

- Motivation for the use of technology
- Action plan/definition of the concept
- Method of Realisation
- Content
- Evaluation

Each of the research activities is then highlighted. Based extensive secondary data research museums and archaeological sites using technologies are listed and inventoried in a target area. The initial internet research permitted a selection of museums and archaeological sites within a target area that could be used as case studies.

The inventory identified what types of technologies are being used in museums and archaeological sites, but it did not explain the processes involved. In order to collect this additional information direct contact was made with museums and sites and a questionnaire was devised to serve as a guideline for site visits and interviews.

The questionnaire was based on the pipeline model and the benchmarks described above. Keeping this in mind, the following issues and information were highlighted in the questionnaire:

- General information
- Description of technology
- Formulation of the concept
- Process workflow
- Realisation
- Maintenance

- Lifecycle
- Use
- Future developments

The preliminary results of the case studies are then explained.

After the description of the questionnaire, the following section focuses on a specific technology, namely Virtual Realty. In this methodological experiment, VR serves as a pilot analysis to elaborate an evaluation method. Different aspects of VR are discussed and illustrated with examples.

The highlighted technology is followed by the presentation of the developed structure of a database of technology in CH, which is the last stage of the methodological chapter of the research activities. The next chapter deals with the preliminary research activities results. First, the success/failure factors and technology gaps are identified, using the outlined benchmarks. These are based on the results of the questionnaire. The success/failure and technology gaps analysis serves as a basis for determining preliminary integration guidelines, which can be seen as a first step towards the formulation of an integration roadmap.

The report concludes with preliminary conclusions for each research activity as well as methodological observations on which future research directions of the Vertical Integration activity will be based.

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I Introduction

1.1 Objectives of WP 2.2 Vertical Integration

The goal of the EPOCH network is to develop and provide proper ICT tools for the cultural heritage community and to improve the use and uptake of existing and new cultural heritage IT tools. The present state of technology integration in the cultural heritage field is therefore an important subject for analysis and recommendations to achieve the goals of the network.

Work package 2.2 will therefore concentrate on the issue of Vertical Integration, mainly the use of IT tools and methods throughout the entire cultural heritage domain extending over the entire information pipeline from initial data collection to final scientific reporting, public presentation, and education.

The Vertical Integration study undertaken by this work package consists of mapping all technologies currently used in the CH domain. The final aim is to obtain a detailed inventory through multiple input channels (such as internet research, existing reports, studies and websites, CH related projects, conferences, publications, network members, CH and related companies).

In addition to the inventory, success/failure factors and technology gaps will be identified through questionnaires and interviews at existing installations. Additional evidence will be collected through the members of the Network of Excellence.

From the inventory of technologies and analyses of success/failure and technology gaps, a CH integration roadmap will be compiled. Together with WP 2.1 and 2.3 the vertical integration study will supply basic data for the formulation of the common research agenda (2.5). Moreover, the general acceptance by network members of the CH integration roadmap, guidelines and best practices will serve as a qualitative measure of the common view of the Network of Excellence.

1.2 Network partners involved in WP 2.2

- The Ename Center for Public Archaeology and Heritage Presentation, Activity Leader (Partner 3)
- University of Surrey: School of management (Partner 58)

1.3 Methodology

This report includes:

- The collection of data from multiple published and electronic sources, including existing reports, studies, websites, other CH related European projects and conference proceedings
- Selected responses from EPOCH partners regarding their use of technology in Cultural Heritage projects

- Results of standardised questionnaire distributed to selected museums and cultural organisations
- Information and observations gathered in onsite visits and interviews at selected museums and archaeological sites
- Analysis of feedback regarding preliminary surveys received from EPOCH partners at VAST2004
- Preliminary evaluation of success/failure factors and technology gaps as a guide to future research
- Evaluation of methodology and recommendations for continuation of vertical integration study

Since information concerning technology in CH is widely dispersed geographically and encompasses many themes. It was decided at the beginning of the activities of this work package to concentrate on a selected segment of the pipeline and a selected target area in order to refine surveying techniques and methodologies.

The selected segment of the pipeline was of public presentation and interpretation since this includes a wide range of technologies. The initial observations of integration in this segment will assist in the continuation of the study to cover all elements of the CH pipeline including data collection and analysis.

The selected target area included both the Flemish and Wallonian regions of Belgium offering both linguistic variety and different approaches to heritage technologies within a compact geographical territory. This target area was selected because of its relatively advanced adoption of technology. It is understood however that in expanding the vertical integration survey to other areas adjustments must be made to take different levels of technology use into consideration.

Within these thematic and geographical parameters an overall survey was made of technology employed by public archaeological sites and museums that deal with archaeological material. From the general use of technology new applications and/or methodologies were selected for further evaluation and analysis.

A questionnaire was prepared for submission to selected cultural heritage sites employing new technologies or methodologies and follow up interviews were conducted at these sites. An interim report was compiled on the information collected in this initial stage. As a result of this report and continuing consultation with EPOCH partners it was decided that the thematic range and geographical scope of this survey could best be expanded through the construction of a comprehensive database.

1.4 Evaluation benchmarks for Vertical Integration

Criteria for evaluating Vertical Integration were based on a number of previous studies. One of these reports (Adriaenssens 2004) is the result of a seminar that that was held on 19th of February 2004. This seminar examined the potentialities and limitations of multimedia use in museums through 5 pre-defined themes. The seminar was structured along the following themes:

- Motivation for the use of technology
- Action plan/definition of the concept

- Method of Realisation
- Content
- Evaluation

1.4.1 Motivation for the use of technology

Multimedia function as an instrument to tell the story of a museum; it is not a purpose/objective on its own. Consequently the content of the museum must determine the use of technology, not the other way around. However, practice sometimes shows something different.

Several factors stipulate the choice for the use of technology. The most important one is the content. For some museum collections the need of multimedia is more present because they need an additional instrument to make their message clear to the public. Some do not agree about the substantial task of a museum (to gather, manage and study a collection or to inform the public). But this factor has also a strong influence on the used presentation techniques, so on the use of technology. Some museums are afraid that multimedia would turn their museum into an amusement park. The vision of a museum and the choice of technology are inextricably bound with each other.

Multimedia has several advantages:

- The information can be provided in a smaller space en within a shorter period.
- Technology can make the content flexible to the public.
- Easy to present in more than one language.
- Creates atmosphere and emotions.
- Offers an additional and a partly collection replacing role for museums with difficult content and small collections.
- It's easier to attract some target groups like children and young adults, because the story can be told in a playful and interactive manner
- It can bring people together, it has a social character.
- The museum can easily update the information.

1.4.2 Action plan/definition of the concept

The basic principle 'content first, technology later' is of great importance, but practice shows that it is rather a matter of interaction between the two. Often the content is preceded by the selection of the technological installations. It is striking that a lot of museums give their contractors 'carte blanche' for the story and scenario as well as for the choice of technology, of course within an in advance stipulated budget and with regular feedback. Another possibility is that the museum delivers a brief story that will be elaborated by specialists within the possibilities of the technological instruments.

Timing is also a significant factor when you are working with multimedia. The capacity of a museum sets natural limitations on the duration of a visit. This has consequences for the technology use, for example the duration of a film, the time needed for reading a text, etc ... and this influences the content.

Following demands are always coming back in the concept definition:

- An accessible concept (technical and with respect to the content) with a high level of usability.

- Technology has to be in proportion with the other exhibition media, it is only an additional instrument.
- The museum must stay perfectly accessible when the technology fails. For that reason multimedia often gets a second-line function. However this division of function may not mean that technology comes apart from the traditional presentation techniques.
- Nothing may go wrong. This demand looks very strange because mechanical defects can never be locked out. Consequently the museum chooses for a simple and reliable system without technological tour the forces.
- The technology has not only to be user friendly for the visitor but also for the personnel of the museum. Usability and reliability are as important for the staff as for the public. It must be feasible for the museum to do the maintenance and small repairs by itself.
- The museum aims for durability and safety when it comes for the choice of their technological instruments.

1.4.3 Method of Realisation

Museums who want their installation to be a high-quality product rely on the services of specialised firms for their multimedia presentations. However, a lot of museums depend on a local or higher government and are therefore bound in their actions to a public tender. Usually this means that the firm with the lowest tender gets the job, unfortunately this can have pernicious consequences for the realisation.

In the definition of the concept one must take the realisation in consideration, therefore only a few notes are given:

- Not only training for the museum staff is necessary, but also to have an IT specialist who knows the technology that is used.
- Regular feedback and consultation is necessary. This is easier when the museum chooses to have only one contractor.
- The involvement of the museum staff in the consultation is also from great importance for the working of the museum later on. There has to be a motivated cooperation between the staff and the firm(s).
- The time spend on the realisation has to be in relation with the concept definition.
- Insert a testing period before the opening of a museum.

1.4.4 Content

The choice of the medium in relation to the information that has to be given is of great importance. One has to consider that technology is not always the best or only option for the presentation of a one particular content in a museum. The technology has to be in proportion to the information.

While in some museums the collection of objects can already tell the main lines of the story, other ones need technology to make the visitor understand their message.

The use of technology can make the accessibility of the content easier for some target groups and at the same time more difficult for others. That is the reason why content as well as technology have to be approachable.

One installation can tell the story at different levels, so it is accessible for different ages. The visitor also can adjust the story on his own interests, so the visitor will only get the

information he is interested in. It is also easy to put several languages into the application.

1.4.5 Evaluation

Already most of the museums are supporter of the use of technology, and also visitors are very satisfied. Technology makes people come back because more information is given than they can handle in one visit.

For the museum staff the use of technology means a more intensive work environment. There has to be a constant technological control. For attendants who has to be in the same space for a considerable time the light and sound effects are sometimes physically demanding. This can be solved with a change of attendants. This gives an example of the importance of the involvement of the staff in the concept definition and realisation.

The cooperation between the museums and the firms are in general satisfying. However a good coordination and supervision is required. This brings a new business culture in museums that has his reflections on the museum staff that has to be motivated and coached.

The acquisition of the technology is expensive and for some museums not purchasable. The electricity and maintenance costs are higher, but this can be perfectly budgeted.

In the following sections the various stages of year 1 activities will be presented with examples of the types of vertical integration information collected.

II Research activities

2.1 Secondary data research

A preliminary search for secondary data sources involved examining existing reports, studies, websites and technology and multimedia in museums, sites and monuments.

Several existing reports and studies on multimedia use in museums, cultural participation (how and why visitors visit a museum) and websites were consulted, diverse museums portal sites were examined and potential partners working on other CH European projects were contacted.

With a view to carefully defining our work area, we limited our internet research to Belgium with some coverage in the Netherlands and Germany. Of particular importance were CH related websites, such as portal sites of museums, research centres (Culturele Biografie Vlaanderen en Steunpunt Recreatief Vlaanderen), other European projects and Networks (INCCA, MARS), conferences (Digitaal Erfgoed Nederland) and information markets. The intention is to broaden our research to the rest of Europe.

It is important to note that such an internet search has its limitations for efficient analysis. To begin with, not all the museums have their own website; many more have not yet even found the way to the internet. Consequently, this research does not include these establishments, even though they might potentially be interesting case studies. However, it is assumed that museums who do not have a website will also not be strong users of technology.

Secondly, portal sites sometimes contained broken links to museum websites, which raises questions about how up-to-date these sites are.

Thirdly, museum websites contain mainly practical information about the museum visit and -content. Although sometimes mention was made about the use of technology, often it was not explain what those technologies were.

Nevertheless, despite these observed limitations the initial internet research permitted a selection of museums and archaeological sites within the target area that could be used as case studies.

2.2 Analysis of operational technologies in target area

The initial Internet search identified many museums and archaeological sites in the target area that are using technology. These museums and archaeological sites were classified in a spreadsheet identifying the various kinds of technologies used. This initial categorization offered a useful overview of the current adoption of technology in the Cultural Heritage field in the target area (see figure 1).

This research identified what types of technologies are being used in museums and archaeological sites, but it did not explain the processes involved. In other words it did not describe the why's and how's of the technological choices.

In order to collect this additional information direct contact with the museums and archaeological sites had to be made. In order to maximise the efficiency of data collection at these sites a research instrument had to be established that would reflect the objectives of this work package. A questionnaire was therefore devised to serve as a guideline for site visits and interviews.

2.3 The approach of the questionnaire in detail

The questionnaire was based on the pipeline model and the themes highlighted by Adriaenssens 2004. It focussed on the process of technology integration, rather than describe the technology itself. In other words, the objective was to find out whether the technologies that are used in the CH domain fit the need of the users as described in the stakeholder needs (heritage policy, local authorities, cultural heritage sites and organisations, associated communities, tourism, education and technology) and whether the conclusions from that work package correspond to our findings on the field.

By bearing in mind the above mentioned themes (see section 4.1 Evaluation benchmarks for Vertical Integration), the questionnaire contains the following parts:

- General information
- Description of technology
- Formulation of the concept
- Process workflow
- Realisation
- Maintenance

- Lifecycle
- Use
- Future developments

1. General information	
1.1. What (museum, monument, site…)	
1.2. Contact details	
1.3. When visited	
1.4. Kind of museum (state, regional, municipal, private…)	
1.5. Content (archaeology, art, nature, industry, history…)	
1.6. Recent museum or already existing	
1.6.1. Since when?	
1.7. Permanent exposition	
1.7.1. Since when	
1.7.2. Replacement foreseen	
1.7.3. If so, in which respect (concerning content, concept, contracted, financial arrangements…)	
1.8. Temporary expositions	
1.8.1. How long	
1.8.2. Frequency	
1.8.3. Financing	
1.8.4. Room facilities	
1.8.5. Contracting or internal	
1.9. Contacted person	
1.9.1. Position	
1.9.2. In service since	
1.9.3. Number of employees (positions, number, specific recruitments…)	
2. Description of technology	
2.1. Which technologies are being used	
2.2. In general: panels, sound, kiosks ...	
2.3. Content of these media	
2.4. In detail: kind of device, brand, type	
2.4.1. Audio	
2.4.2. Video	
2.4.3. Picture	
2.4.4. Other	
3. Formulation of the concept	
3.1. Why this choice (content museum, financial, space, attraction, simplicity, …)	
3.2. Who took the initiative for the museum	
3.3. Who made the decision of the technologies	
3.4. Conservator	
3.5. Committee/ Study group	
3.5.1. Participants (internal – external, profile…)	
3.5.2. Involvement of the employees in the choice of technology	

3.6. Supplier	
3.7. Choice of executor	
3.7.1. Who	
3.7.2. How (motivation of choice)	
4. Process workflow	
4.1. Contract or direct	
4.1.1. Reason for the choice (motivation procedure)	
4.2. One main contracting party?	
4.2.1. Which elements influenced choice of contracting party (price, experience, …)	
4.3. Who made the design (museum, third party, combination…)	
4.3.1. How was it decided?	
4.4. Time needed for writing specification list	
5. Realisation	
5.1. By the contracting party	
5.2. Local enterprises	
5.3. Own staff	
5.4. Duration of realisation	
5.5. Duration of the test phase	
5.6. Collaboration between museum and contracting party	
5.7. Involvement of the staff, externals in the realisation	
6. Maintenance	
6.1. Own maintenance service	
6.2. Own IT department	
6.3. Subcontracting	
6.3.1. In general	
6.3.2. Supplier does it	
6.3.2.1. Dependence supplier	
6.3.2.2. Cost	
6.3.2.3. Maintenance contract	
6.4. What determined the choice between own service and contracting	
6.5. Training staff (by supplier, additional training…)	
6.6. Frequency of maintenance	
6.7. Complexity	
6.8. Preventive maintenance	
6.9. Replacement or repair	
6.10. Is hardware replaceable	
7. Lifecycle	
7.1. Is replacement of the exposition foreseen	
7.2. Problems with obsolete technology	
7.2.1. Not existing anymore	
7.2.2. Other OS of PC	
8. Use	
8.1. Interaction between guides and multimedia	

8.2. Comments of visitor concerning multimedia	
8.2.1. How are comments used	
8.2.2. Is multimedia (content) changeable	
8.3. ROI for the museum (satisfaction, increasing number of visitors…)	
8.4. ROI for the visitor (extra educational value, playful, impressiveness…)	
9. Future developments	
9.1. Are the investments worthwhile?	
9.2. If you should restart the same investment, would you apply a similar approach	
10.Comment	
Is the technology used in a correct and optimal way to present the content? Is the used multimedia appropriate to clarify the content or are there other possibilities	

This questionnaire served as a starting point for a discussion with mangers and/or staff of the selected museums and archaeological sites. It was designed to provide background for more detail investigation in onsite visits and interviews. It was distributed to selected sites well before the actual visit so that the site managers had time to gather the appropriate information.

It was decided to focus the research on the process of technology integration, rather than describe the technology itself. Central questions were why some applications were chosen and on how the choices were made. As installations were either very recent or on the contrary a few years old, we were also able to ask questions about the reliability and the maintenance of the systems. All these elements proved to be central to the process of technology integration in the CH field.

As discussed in the methodological part the research was focussed on Belgium. The following museum and/or exhibitions were visited (further information: see appendix 1)

- Kunsthal Sint-Pietersabdij (Ghent): "Alison, the secret of the fallen angels (PDA)
- Diamantmuseum (Diamond museum) (Antwerp)
- Mu-zee-um: temporary exposition "De val van het nieuwe Troje" (Ostend) (PDA)
- Ter Duinen 1138 (Koksijde)
- Hidrodoe (Herentals)
- Archéoscope de Liège
- In Flanders Fields, Ieper
- PAM Ename: timescope technology

In the following paragraphs the preliminary results of the case studies are explained, using the different themes of the questionnaire.

2.3.1 General information

The general information gathered about the museums, sites and monuments provided some general insights. However, the cultural heritage sector is extremely diverse and the specific types of museums (state, region, province, city, and private) strongly affected the character of technology integration in all its phases (concept, execution, choice of technology, etc).

Questions were asked about the number of staff and whether the museum hires new personnel specifically connected with the integration of new technologies. In most cases no additional staff is recruited, and in the cases where new staff is taken on it is almost never IT-specialists. Usually museums utilizing technology have a jack-of-all-trades service person, who can provide preventive maintenance and first line help. Nevertheless the museums are aware of the need of an IT specialist. Some would prefer to subcontract this function to private firms while others anticipate the need to include an IT specialist on their permanent staff in the future.

2.3.2 Description of technology

This part of the questionnaire aims to gain insight in which technologies are currently being used in museums, sites and monuments. It became apparent that some technologies are frequently used in investigated museums: touch screens, flat screens, audio guides, video, audio, image (projection), lighting effects and interactivity.

These technologies are always used as an addition to the traditional exhibitions, such as text panels, mechanical devices, and standard exhibition vitrines.

2.3.3 Formulation of the concept

Concerning the formulation of the concept the interviews revealed that in most cases a clearly defined exhibition idea preceded the decision to integrate technology.

However, it appeared that the packaging of the content within IT application was of less importance to its successful integration than the quality of content concept and, even more important, the compatibility of the concept with the selected technology. In some cases, it seemed that a particular technology was chosen before the content was fully defined, so that the final exhibition story was forced to fit (somewhat uneasily) within that particular medium. Some museum staff agreed that the chosen technology proved to be less compatible than expected for their particular content, offering a somewhat less effective presentation.

2.3.4 Process workflow

The concept was sometimes developed and executed wholly or partly by the museum (conservator, scientific collaborator(s), working group, etc.). In many cases though, specialized firms were responsible either for the concept definition or for the coordination of the whole project, including scenography, hardware installation and creation of multimedia contents. In the latter case, these specialised firms then take a leading part. The museum’s function was that of information provider and scientific (historical, archaeological, art...) consultant.

When considering the technological choices, different reasons for using technology were distinguished by the respondents:

- Technology is assumed by many to be a very effective way to attract more visitors and certain target groups (children, young people, etc)
- Technology is also believed to make a museum look more modern and up to date.
- Museums see it as their mission to make visitors aware, to set them thinking about their content (archaeology, art, etc.), work on their feelings, etc. and technology appears to be an ideal medium to attain that goal. However, the general attitude is that technology is to be seen as a medium, not as an end in itself.

2.3.5 Realisation

The visited museums are mostly non-profit, bound by different rules and are subject to public and governmental administration. Therefore the museums are often restricted in the formulation of the concept. Frequently they have to follow a certain procedure in their decision making process. For instance the choice of a company for the realisation of an exhibition can for some museums only be made through a formal process of public tendering.

Museums can decide to subcontract the whole project to only one contracting party or to divide it amongst different parties. The experience of the museum is quite different according to the alternative chosen. With one contracting party there usually is a good and close collaboration, but sometimes the museum loses control of the creative process. When working with different contracting parties – where the project is produced by different people at different times – the communication is more complex and sometimes missing altogether. As graphics people and content builders also have their own style, a good internal coordinator (who is always available and capable of handling the different disciplines) is required.

In some cases, the museum conservator was not at all involved in the decision making process; sometimes he or she inherited a range of applications, being appointed only after the scenography had been put in place.

2.3.6 Maintenance

Most of the visited museums do not have their own maintenance department. Although they are aware of the need of such a service, the financial support is often lacking to support it.

However some of the museums prefer to outsource the maintenance. Different reasons for doing this can be distinguished:

- Museums are often totally dependant on the companies who undertook the execution of the project, as they are the only ones who really know how to maintain the technologies that were used.
- Personal experience and close collaboration with the companies who carry out the maintenance.
- As the museums do not have the financial resources to have an IT-specialist on their payroll, they have no other choice than outsourcing.
- In some cases the technology is used on a temporary project, so that it is easier and more obvious to outsource the maintenance.

Public museums often work with officially appointed enterprises so as to avoid reinitiate tendering procedures – as is often the case with public services – time after time. However, collaboration with the companies who carry out the maintenance is usually good.

As already mentioned museums often have someone amongst the staff who can provide some sort of IT first aid. Because of the limitations of this type of service, some of them plan to hire an IT-specialist in the (near) future or at least train their staff.

2.3.7 Lifecycle

Most of the visited museums have some sort of replacement plan for the technologies they use. Some have a real action plan, others just keep in mind that replacement is something they will have to deal with in the future.

In museums where technical installations have been around for some years there was often a problem with repairs, i.e. replacement parts were not available. The hardware technology was in some cases totally obsolete and had been replaced by another (Laserdiscs by DVD). The content had thus to be transferred to another medium, which would cause problems.

2.3.8 Use

Some of the museums tested out the new application before introducing it. The feedback they received was very useful and thorough changes were sometimes made. In many cases however there was no real test phase.

Whether or not a test phase took place, the following remarks can be formulated:

- The proposed multimedia solutions sometimes lack flexibility, for instance not adapted to be used by guides during their group tour (changing the length, contents or audio comment; not possible to interacting with it)
- Research found that installations are not always used to their full potential, for instance interactive kiosks used as an alternative to printed panels provide the user with yet more static written text instead of moving images, video or spoken word.

Depending on the type of multimedia used, the content can or cannot be modified by the museum staff. Sometimes only the company who installed the hardware is competent to make an alteration.

Integrating technologies delivered the following benefits for the museum:

- A initial increase in the number of visitors. However, that peak was unsustainable since after a while, the visits would drop slightly and then stabilize.
- Sometimes the museum was able to reach new visitor target groups.

The return for the visitor:

- An enhanced educational value of the visit

- In some cases a successful combination of technology and educational workshops
- Sometimes the visit could be a customised or personalised experience

2.3.9 Future developments

The interviewees were asked if the investments were worthwhile and if they would make a similar investment again.

Where the investment was done with a major commitment of the museum staff, i.e. a close collaboration between museum and contractor(s), there is a willingness to repeat the experience, though bearing in mind some critical remarks. Future developments imply the adoption of totally new technology.

In cases where the decision and implementation process was done without any significant involvement of the museum staff, a totally different approach would be taken with regard to future investments. Often the museum staff attempts to make up for the bad integration process of technology by shifting the emphasis into different areas, for instance by developing high quality educational services.

2.4 Highlighted technology

2.4.1 Introduction: Virtual Reality (VR)

As a methodological experiment for the continuation of the Vertical Integration study in the coming years, it was decided to highlight one specific technology, i.e. Virtual Reality (VR) as a pilot analysis to elaborate an evaluation method. This was done for several reasons.

- VR is becoming more and more integrated in museums and archaeological sites
- VR is often subject of study in CH projects
- VR is very accessible for a broad public
- VR is mostly integrated in the interpretation and presentation phase in CH, in which the success or failure factors of technology are relatively clear.

2.4.2 Definition of Virtual Reality

"Virtual Reality consists of a range of computer-based approaches to the visualisation of concepts, objects or spaces in three or more dimensions. Although the distinction is becoming increasingly blurred, these approaches tend to differ from other three-dimensional visualisations in that the experience is interactive" (Fernie & Richards, 2003).

2.4.3 Values and possibilities of Virtual Reality

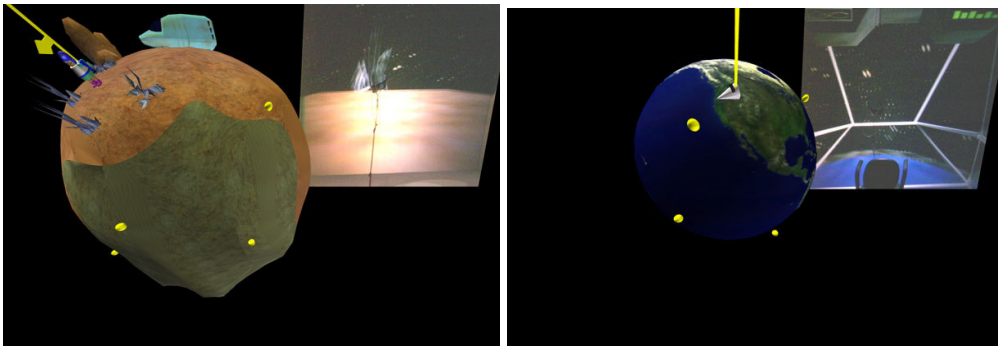
- VR makes it possible to visually construct themes, objects, etc. which are not easy to explain by words.

- VR can present realistic scenarios that otherwise would not be possible to experience
- VR can create a world, real or fantastic, and allows the user to interact
- The VR experience is accessible as for individuals, as for groups
- Multi-channel interaction and communication between different users at the same time at different places is possible, for instance between teacher and student(s), between scholars, site managers
- Virtual reality can be delivered using a variety of systems (desktop, Cave, Web application etc)
- The variety of systems implies also a variety of costs, so that the choice depends on the available budget. For instance, a web-based clients access makes the VR a relative cheap investment
- VR is an excellent medium to protect tangible heritage (offsite visiting) and still make it accessible for a broad public
- VR is not bound to one space
- VR can enhance the experience of the visitors of archaeological site and/or museum

Example of a VR project exploring the possibilities for education

The Round Earth Project is investigating how VR Technology can be used to help teach concepts that counter-intuitive to learners currently held mental model. VR can be used to provide an alternative cognitive starting point that does not carry the baggage of past experiences. In particularly this technology is comparing two strategies for using VR to teach children that the earth is round when their everyday experience tells them that it's flat.

Source: www.evl.uic.edu/roundearth/



Example of a VR technology in support of traditional teaching programs

The QuickWorlds project is motivated by the simple observation that three-dimensional models are already an important part of the educational program. A look around in classrooms reveals the presence of dioramas, geometric models, earth globes, etc. The advanced visualization technology (AVT) provides a mechanism for making additional models accessible to students without the cost of physical fabrication.

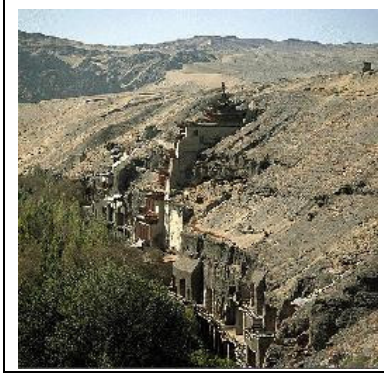
Source: www.evl.uic.edu/tile/QUICKWORLDS/

Example of how VR can save an ancient site

The Mogao Grottoes project uses Virtual Reality to explore the Mogao Grottoes, a World Heritage site in western China. Rich in Buddhist murals and painted statues and exquisite in craftsmanship, the grottoes were flooded by artists, scholars and tourists. Due to this the preservation of the site was endangered. To solve this problem was the most important objective of the project.

By creating a virtual tour among the grottoes, the site is still accessible for the public in a way that further destroying can be stopped.

Source: www.evl.uic.edu/samt/silkshrine/mogao.html



2.4.4 VR in technology projects

Several Virtual Reality projects of European, American and other national initiatives have been developed (see table 1). The aim of several of these projects is to stimulate the access to cultural and heritage information through the integration of Virtual Reality, and to make this technology approachable for a broad public. The projects explore the possibilities of this technology for the purpose of preservation, interpretation and education of Cultural Heritage.

Name (Acronym)	Region	URL
Archeoguide	Europe	archeoguide.intranet.gr/
Arco	Europe	www.arco-web.org/
Cahrisma	Europe	www.at.oersted.dtu.dk/cahrisma.htm
Charismatic	Europe	
Create	Europe	www.cs.ucl.ac.uk/research/vr/Projects/Create//
Discover Islamic Art	Europe	www.museumwnf.org
Erato	Europe	www.at.oersted.dtu.dk/~erato/
HistoryCity	Malaysia	
Hitite	Europe	
Lifeplus	Europe	www.miralab.unige.ch/subpages/lifeplus/
Mars Explorer	US	www.evl.uic.edu/cavern/seminars/limbo2/Mars/
Mogao Grottoes	China	www.evl.uic.edu/samt/silkshrine/mogao.html
Nice	US	www.evl.uic.edu/tile/NICE/
QuickWorlds	US	www.evl.uic.edu/tile/QUICKWORLDS/
Shape	Europe	www.shape-dc.org/
The Round Earth	US	www.evl.uic.edu/roundearth/
Theatron	Europe	www.theatron.org
VHp	US	www.evl.uic.edu/cavern/harlem/
ViHAP3D	Europe	www.vihap3d.org/
Virtual Ambients	US	www.evl.uic.edu/correlations/

VRCHIP	Europe	www.nnc.co.uk/vrchip
VS	Europe	www.virtualshowcases.com/Index.asp

Table 1: List of Virtual Reality Projects

A few projects are discussed more in detail as an illustration of the possibilities and different research aspects of VR.

Lifeplus (2002-2004): VR as an innovative technology

Lifeplus is a European project that proposes the innovative 3D-reconstruction of ancient frescos through the real-time revival of their fauna and flora, featuring virtual animated characters with artificial life behaviours in an immerse Augmented Reality environment.

The goal of this project is to push the limits of the current Augmented Reality technologies, exploring the process of narrative design of fictional spaces where users can experience a high degree of realistic interactive immersion.

Two case study applications on virtual heritage were developed and demonstrated. The innovation lies within the combination of real views with virtual elements. So the tourist who visits an ancient site could not only see the reconstructed place, but also catch a glimpse of the daily life of the people who lived there.

Source: www.miralab.unige.ch/subpages/lifeplus/

Shape (2001-2004): Developing and evaluating VR

This project is devoted to developing and evaluating assemblies of hybrid, mixed reality artefacts in public places. Hybrid artefacts exhibit physical and digital features and can exist in both physical and digital worlds. They combine interactive visual and sonic material with physically present manipulable devices. This project maps out different ways of linking physical objects with digital representations.

The project established an archive of empirical materials collected at a variety of public places such as museums and exploratoriums. It analysed the methods employed by visitors as they interact with exhibited artefacts and each other. On this basis a design framework for informing the development of hybrid digital-physical artefacts was produced.

Public exhibitions demonstrating technologies developed in the project were created. A couple of them are being discussed.

The augur scope is a portable mixed reality interface for outdoors use. It consists of a tripod-mounted display that can be wheeled to different locations to view a virtual environment that is aligned with the physical background.

The story tent is a mixed reality interface to support interactive storytelling experiences for children. A projection screen is shaped to form an A-frame tent. Two projectors throw synchronised images of a virtual world onto the outside of the tent, supplemented by several loud speakers. This exhibit is a form of traversable interface that allows participants to physically pass into and out of a virtual environment. It provides views of interaction to those who venture inside as well as those who remain outside.

Source: www.shape-dc.org/

Story tent

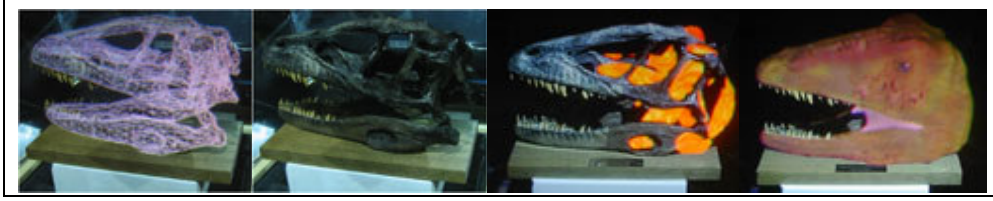
Augurscope

Virtual Showcase (VS) (2001-2004): VR to become standard equipment for CH

The Virtual Showcase project aimed at developing the knowledge and technology for Virtual Showcases to become standard equipment for museums and other public exhibitions spaces.

The Virtual Showcase combines cultural knowledge transfer with informal knowledge appropriation provided in the form of edutainment. The project will set new emphases within the area of instruction and learning.

Source: www.virtualshowcases.com/Index.asp

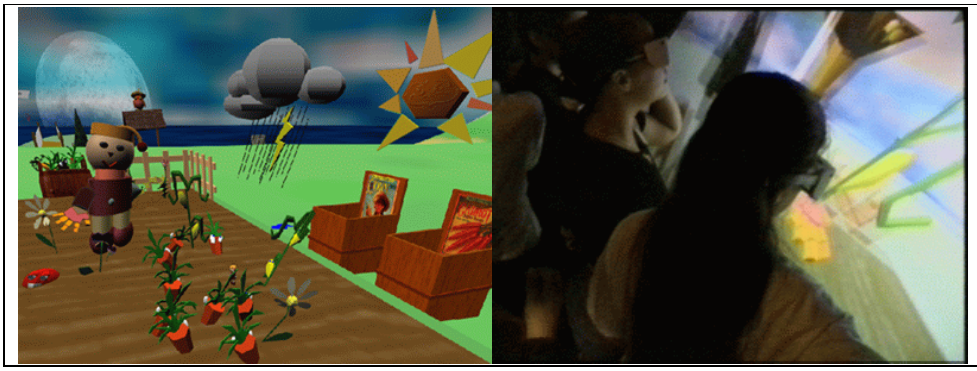


Nice: VR as learning medium

The Nice project was a tested for the exploration of virtual reality as a learning medium. An immersive learning environment for children is implemented in the cave. It provides an engaging setting where children construct and cultivate simple virtual ecosystems, collaborate via networks with other remotely-located children, and create stories from their interactions in the real and virtual world.

Nice's networking component allows clients other than virtual reality interfaces to participate. For example it's possible for web-based clients to connect and cooperate with the Virtual Reality clients. This makes it more accessible for schools, which usually cannot purchase the expensive virtual reality hardware.

Source: www.evl.uic.edu/tile/NICE/



Discover Islamic Art (2004-2007): VR with no frontiers

This is the pilot project of the 'Museum With No Frontiers' (MWNF) Virtual Museum programme. It will allow the creation of virtual doors and corridors between exhibition venues located all over Europe and the Mediterranean. Thus a Museum With No Frontiers of Islamic Art will be established, where the visitor can discover museum objects and related monuments and archaeological sites from 15 countries.

This project will offer opportunities for cooperation between museum curators and scholars, and provide a platform for discussion about the scientific interpretations.

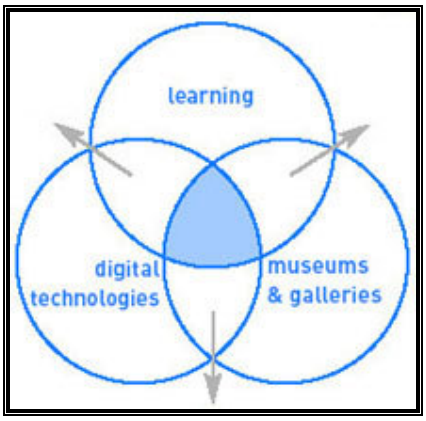
Source: www.museumwnf.org

2.4.5 VR and education

In the Nesta Futurelab series, Report 9 deals with learning with digital technologies in Museums, Science Centres and Galleries (Hawkey,n.d.). The review focuses on those aspects of learning provided in museums and galleries through the use of digital technologies and considers several points of view. Figure 1 gives a graphical view of the overlap of the three different domains: learning, digital technologies and museums and galleries.

Formal & informal learning with ICT – online, in school, home, workplace

Other formal & informal learning – exhibitions, guides, printed resources etc



Collections management, record-keeping, digital exhibitions, etc.

Figure 1: Scope of review (Source: Hawkey, n.d., p. 6)

On one hand museums can offer many learning possibilities, through digital technologies and other means. It seems that the museum is more suited to informal learning (such as lifelong learning) than formal education, due to its free-choice learning environment, emphasis on personal experience, and the engagement with exhibits as constructive dialogue (i.e. in an active process of learning from objects rather than simply learning about them).

On the other hand the features of digital technologies have much more in common with lifelong learning. Hawkey demonstrated Sharples' clear comparison of digital technology with the main modes of lifelong learning (see table 2). Here too learning with ICT is much closer to informal learning than to formal (school) learning, as the decision-making process remains largely in the control of the student.

Lifelong learning	**New technology**
individualised learner-centred situated collaborative ubiquitous lifelong	personal user-centred mobile networked ubiquitous durable

Table 2: The match of digital technology to lifelong learning (Sharples 2000, in: Hawkey, n.d., p. 20)

According to the European Union, lifelong learning can be defined as follows: "Lifelong learning encompasses learning for personal, civic and social purposes as well as for employment-related purposes. It takes place in a variety of environments in and outside the formal education and training systems" (for more information about this definition, see http://europa.eu.int/comm/education/policies/lll/lll_en.html). Keeping this definition in mind, we adapted slightly the table presented in Hawkey (Hawkey, n.d.)

Lifelong learning	**New technology**
for personal purposes learner-centred variety of environments civil, social and employment-related purposes ubiquitous	personal user-centred mobile networked ubiquitous

Table 3: Adapted match of digital technology to lifelong learning

It appeared that in the synergy between some aspects of lifelong learning and the basic nature of new technologies, museums can take advantage of ICT to more effectively achieve their educational goals. Although there are some aspects of the relationship between museums and new technology that are problematic (e.g. museums differ in their willingness and ability to adopt new approaches), digital technologies are already widely used for learning in museums, galleries and science centres. From this point of view Hawkey has illustrated a number of ways in which technologies are already being integrated (see figure 2) (Hawkey, n.d.).

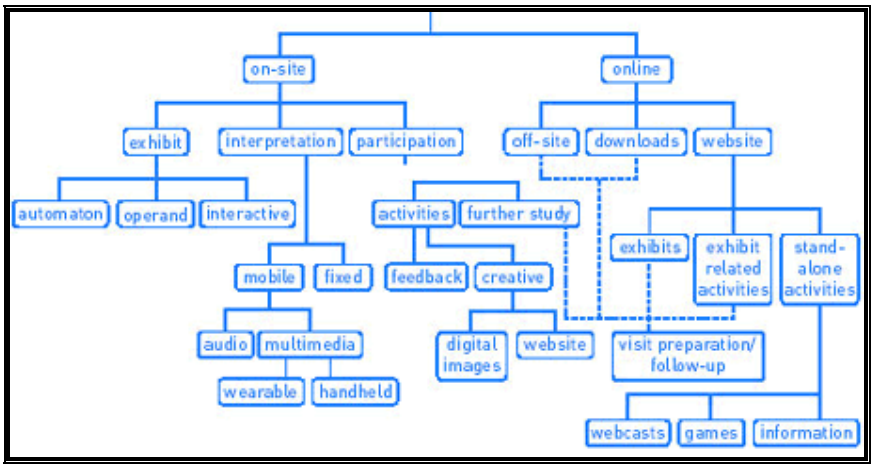


Figure 2: Taxonomy of museum learning opportunities with digital technologies (Hawkey, n.d., p; 21)

Applying the general characteristics described above to the specific case of VR, a number of conclusions can be made:

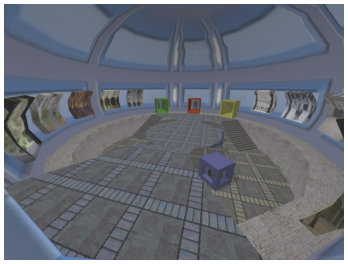
- VR is personal and user-centred: the user can explore VR in many different ways. There is the possibility of a variable degree of interaction (see below), a variety of visualisation systems and external hardware devices (such as projected on screens, headsets, desk-top and table-top) and different possible levels of immersion (fully immersive, partially immersive and augmented). Each application has its own potential for interactive learning (based the user's particular requirements: how the user will interact and what their expectations of that interaction may be) to interact with. Within the VR environment, there is a high degree of flexibility and user control.
- VR is mobile: VR is a medium for distance learning and remote collaborative learning
- VR is networked: within CVE (Collaborative Virtual Environment) the user is represented by an avatar which reflects an individual user's movement and conveys the user's communications and emotions with other users. CVE is also an environment that can be accessed by different users at different places.
- VR can have a low-level interaction and a high-level interaction. Low-level interaction is, for example, navigating and experiencing the environment; high-level interaction is for instance when users interact with the environment, for example, moving objects in a certain way.
- VR is ubiquitous: onsite (i.e. bound to opening hours of a museum) and online (24h accessible.

After recognizing the theoretical potential of VR and education, it is worthwhile to have a closer look at some specific VR projects with clear educational aspects. Virtual Reality environments designed for education fall into 3 main categories: networked text-based virtual environments, desktop virtual reality simulations, and immersive virtual environments (Johnson et al., n.d.).

Example of how a 3D environment supports real-time cooperation among distantly located learners: learning@europe
The L@E experience takes place in a 3D environment that takes the shape of a planet where users are represented by avatars. The planet hosts 5 different environments:

1. The "meeting point", on the North Pole of the planet, where students first meet
2. The cities domes, on the planet surface, where students present themselves and their homework
3. The lesson's space (in the heart of the planet), where students are given a lesson by the guide
4. A labyrinth (1st game space, on the south pole of the planet), where a treasure hunt takes place
5. A "quiz space" (2nd game space), with ability games, again on the south pole of the planet

Source: http://www.learningateurope.net



2.4.6 The use of software and hardware in VR

A variety of hardware systems is used for Virtual Reality. The virtual world can be projected inside a 'cave' within which users can move around freely. By wearing headsets and gloves the users are immersed in a virtual world which they navigate and manipulate objects. Desk-top virtual reality is the most widely used form of virtual reality in use today.
In the systems mentioned above virtual reality worlds run on users' desk-top computers and are displayed on a standard monitor and navigated using a mouse or 3D space-ball with a keyboard.

To enable interactions with virtual reality worlds a variety of visualisation systems and external hardware devices are currently being used. The level of 'immersion' within a world depends on the devices that are used, and the type of interactivity that is designed into the virtual world.

Following systems are the most common ones for viewing virtual reality worlds:

- **Projected.** The user's field of vision is effectively filled by screens displaying a projected virtual world. Projection may be onto large concave screens in front of the user or within 'caves' or 'sheds' that users walk into.

  In a cave the illusion of immersion is provided by projecting stereo images on the walls and floor of a room-sized cube. The visitors wear lightweight stereo glasses. Several persons can enter and walk freely inside the CAVE at the same time. A head tracking system continuously adjusts the stereo projection to the current position of the leading viewer.

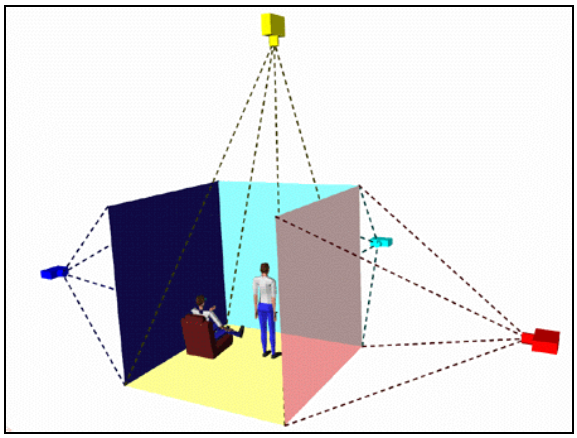


Figure 3: Example of CAVE system (Source: http://www-vrl.umich.edu/intro/index.html)

Example of CAVE: VIHAP3D project: Virtual Heritage

The VIHAP3D project strives for preserving, presenting, accessing and promoting CH by means of interactive, high-quality 3Dgraphics.

Source: www.vihap3d.org/

A virtual environment cave

A virtual environment cave simulating the user point of view

- **Headsets and gloves.** Users wear stereoscopic glasses or head-mounted displays (HMDs) which place small screens directly right in front of their eyes. HMD enhances the users' feeling of immersion/interaction within a world by excluding any glimpse of the real world and by changing the view of the virtual world as the user moves his or her head to look around. The head-mounted display was the first device to provide an immersive experience.

Figure 4: Example of a HMD (Head- mounted display;

Source: http://www-vrl.umich.edu/intro/index.html)

Another head-linked stereoscopic display device is the boom. A box with screens and optical system is attached to a multi-link arm. By looking into the box the user can see the virtual world. The viewer can guide the box to any position within the operational volume of the device. Head tracking is accomplished via sensors in the mechanical joints of the arm that holds the box.

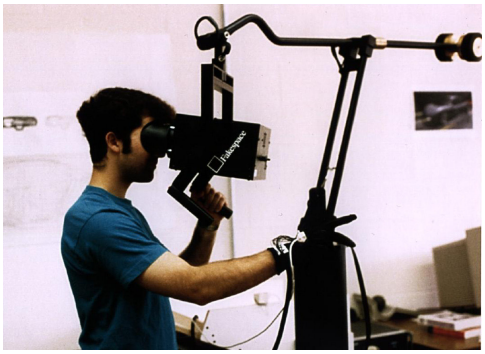


Figure 5: Example of a BOOM

(Source: http://www-vrl.umich.edu/intro/index.html)

Data gloves, joysticks, hand-held wands and other input devices also allow the user to navigate through a virtual environment and to interact with virtual objects.

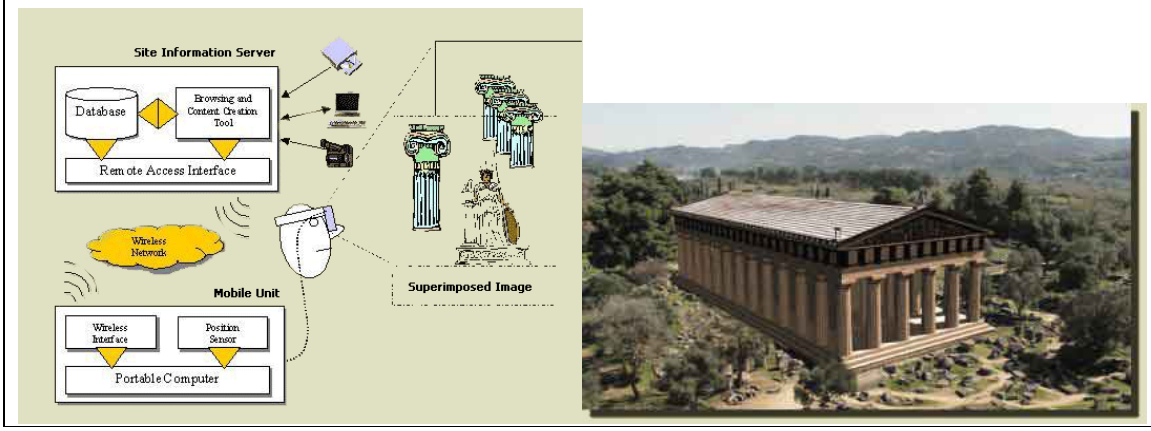
Figure 6: Example of data glove (Source:

http://www-vrl.umich.edu/intro/index.html)

Example HMD: ARCHEOGUIDE: another way to visit an archaeological site

The ARCHEOGUIDE project aims to provide new approaches for accessing information at cultural heritage sites in a compelling, user-friendly way through the development of a system based on advanced IT including augmented reality, 3D-visualization, mobile computing, and multi-modal interaction techniques.

Source: http://archeoguide.intranet.gr/

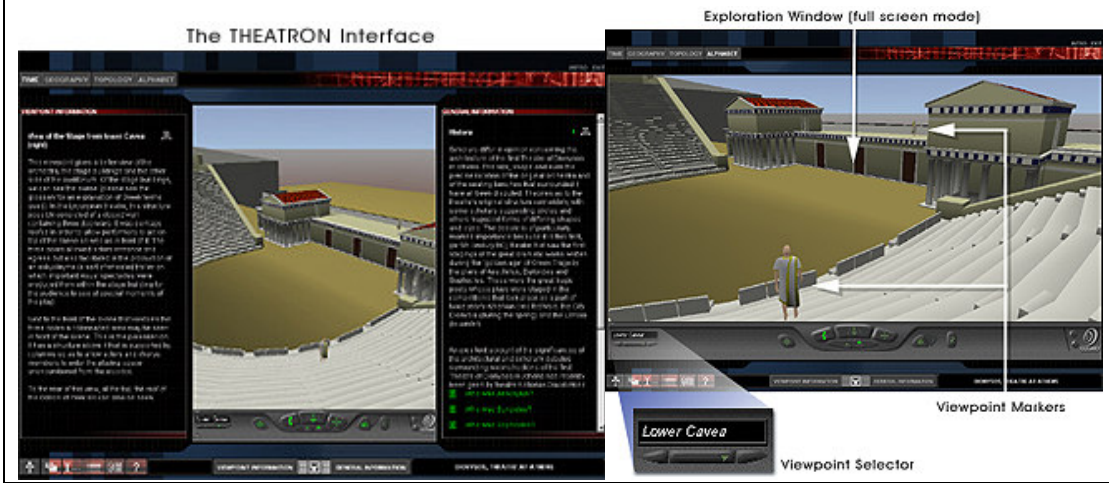


- **Desk-top.** The virtual world is projected onto the screen of a standard computer monitor. This approach relies on interactive features built into the world to provide a degree of immersion for users

Example of desk-top: THEATRON project: innovative online teaching tool

The objective of this project was to carry out a programme of work addressing the use of multi-media for teaching European theatre history. In addition to providing extensive primary factual information, the software allows students and teachers to access and study essential elements of theatre.

Source: http://www.theatron.org/



- **Table-top.** The virtual world is projected onto a horizontal table-top screen that is otherwise identical to the desk-top display. It allows interaction in circumstances where a horizontal format is appropriate.

The different levels of immersion within virtual worlds are:

- **Fully Immersive.** An array of VR specific hardware is used to translate a user's natural movements into virtual activity. It is possible to create a shared virtual reality experience with users at different locations using various devices, such as BOOM, CAVE and HMD. All users are actors within the same virtual world and they appear to each other as virtual humans in the virtual environment.

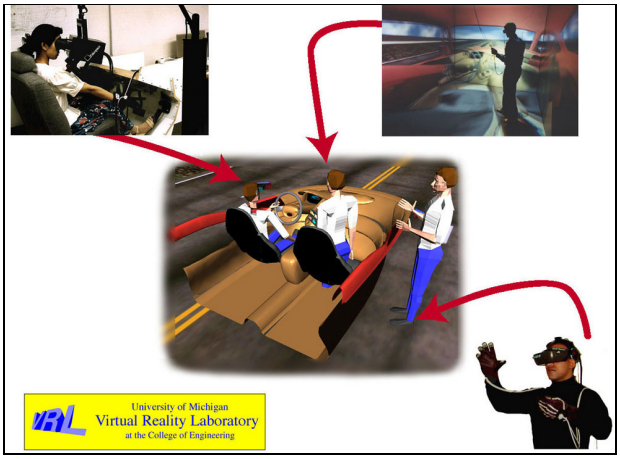


Figure 7: Shared Virtual Environments (Source: http://www-vrl.umich.edu/intro/index.html)

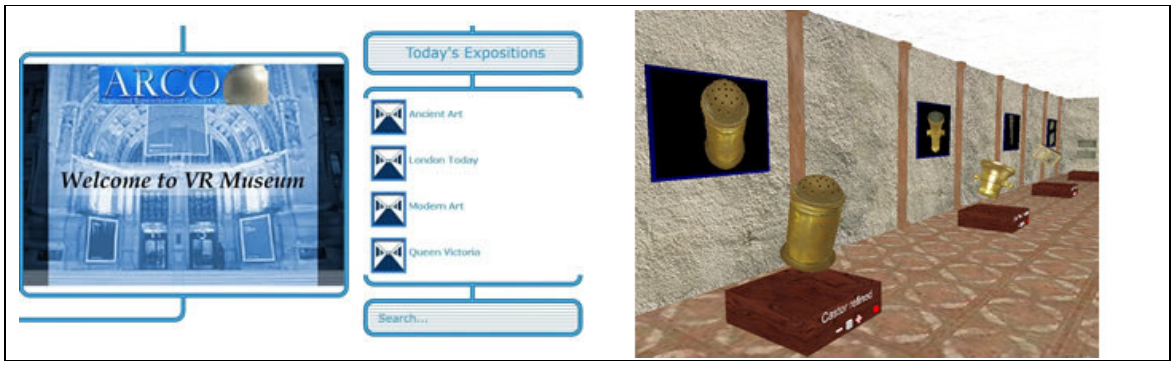
- **Partially Immersive.** The hardware utilised in these systems allows users to remain aware of their real-world surroundings rather than being fully immersed in the virtual world.

- **Augmented.** In augmented reality systems, users have access to a combination of VR and real-world attributes by superimposing graphical information over the real-world.

Example of Augmented Reality: ARCO project: a virtual reality museum

This project aimed at developing technology for museums to create 3D Virtual Exhibitions on the web. These exhibitions are created by digitising museum artefacts which are then transformed into Virtual Representations, which can be X3D OR VRML models or scenes.

Source: http://www.arco-web.org/



Due to the expansion of Virtual Reality applications, changes in the various formats of virtual reality-type software are being made. Each of the developed formats has different approaches to and varying degrees of three-dimensionality, immersion and interaction.

Until relatively recently, virtual reality systems could be operated only on very expensive graphics workstations. However, the use of virtual reality on personal computer platforms is steadily increasing.

These developments can be seen on the Internet. The Internet presence of virtual reality is currently dominated by the Virtual Reality Modelling Language (VRML) standard. VRML is both a scene description language and a file format for virtual worlds. It is used to describe the geometry and behaviour of three-dimensional scenes. This language has been developed to provide a multi-platform, universal language for interactive three-dimensional graphics across the Web. The Cosmo player is one of the most popular VRML viewers because it offers a wide range of movements.

However, VRML is not the only PC-based, web-compliant virtual reality format. Superscape, for example, created its own format (SVR) which ran efficiently and effectively, through either Netscape or Internet Explorer browsers, via its own viewer, Viscape.

The potential uses of this technology are boundless though there are essentially two approaches to current virtual reality development: modelling the real world and abstract visualisation.

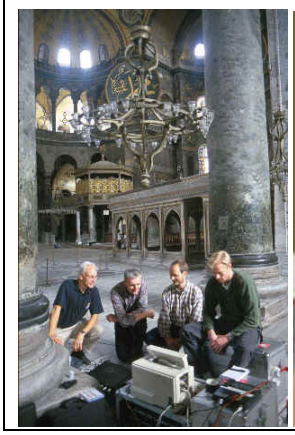
The first includes virtual reconstructions of such elements as buildings, landscapes, underwater shipwrecks, spacecraft, archaeological excavation sites, human anatomy, sculptures, crime scene reconstructions, and other space environments.

The second visually models abstract phenomena such as magnetic fields, turbulent flow structures, molecular models, mathematical systems, auditorium acoustics, stock market behaviour, population densities, information flows, and any other non-material systems including artistic and creative work of abstract nature.

Cahrisma project: conservation of the acoustical heritage

The main objective of this project is to explore and develop the concept of Hybrid Architectural Heritage. This new means of identification covers acoustical characteristics that are linked to, or additional to, visual peculiarities. The idea is that for spaces having acoustic importance, the architectural heritage concept, considered in conservation and restoration projects, should be upgraded to cover acoustical as well as visual aspects.

Source: http://www.at.oersted.dtu.dk/cahrisma.htm



2.4.7 Conclusion

The selection of VR technology as a pilot analysis in this study proved to be very useful in elaborating an analytical and evaluation method. Although published information on VR is extensive, a more focussed examination of its specific integration in the CH field provided new insights about its function in this domain, particularly its relevance for CH education.

In more general terms, the research on VR revealed that in most cases the technologies adopted in the CH field are not (totally) new. Many of the technologies have already existed for a considerable time, but were only used in films and computer gaming until now. Innovation in their application to CH lies in a creative combination of technologies and the ways in which they are used.

2.5 Creation of a database of technology in CH

The thematic evaluation that took place during the initial phase of the study highlighted the need for more systematic and comprehensive research. Due to the diffuse and highly diverse nature of applications currently used in CH, it was clear that the target area of the technology analysis had to be expanded and the focus had to be placed on every segment of the production pipeline (i.e. data collection, visualisation, interpretation and analysis- in addition to public presentation, which was the initial concern).

A survey of the large quantity of available information and the feedback from the EPOCH partners, made it clear that a more comprehensive and geographical balanced analysis of the use of technology in CH could be achieved. In order to achieve this objective, the construction of a detailed database inventory of European projects dealing with technology and cultural heritage was begun.

The following principles underlie the structure of the database:

- The difficulty of dealing with a large quantity of gathered information requires a systematic and efficient processing approach.
- The need for a more even geographical coverage of CH technology in the European research area.

- The need to establish a link with other EPOCH Work packages: Stakeholder Needs (WP2.1), Horizontal Integration (WP2.3) and Common infrastructure (WP3.3).
- The creation a user-friendly input system for collection of data.
- The need to have a clear and simple retrieval system.
- The ability to select and search different categories of information such as technology types, project description and contact details.

With these principles in mind the following database structure was established (using MS Access software), in which data can be input in four main categories:

1. Project: general information on the project
2. Technology: general information on the present and potential function of a specific technology in CH domain
3. Contact person: all contact information for key personnel involved in projects or technology development
4. Information: information on the technology and the project

Each of these themes is briefly explained below:

Figure 8: 4 main themes of the database

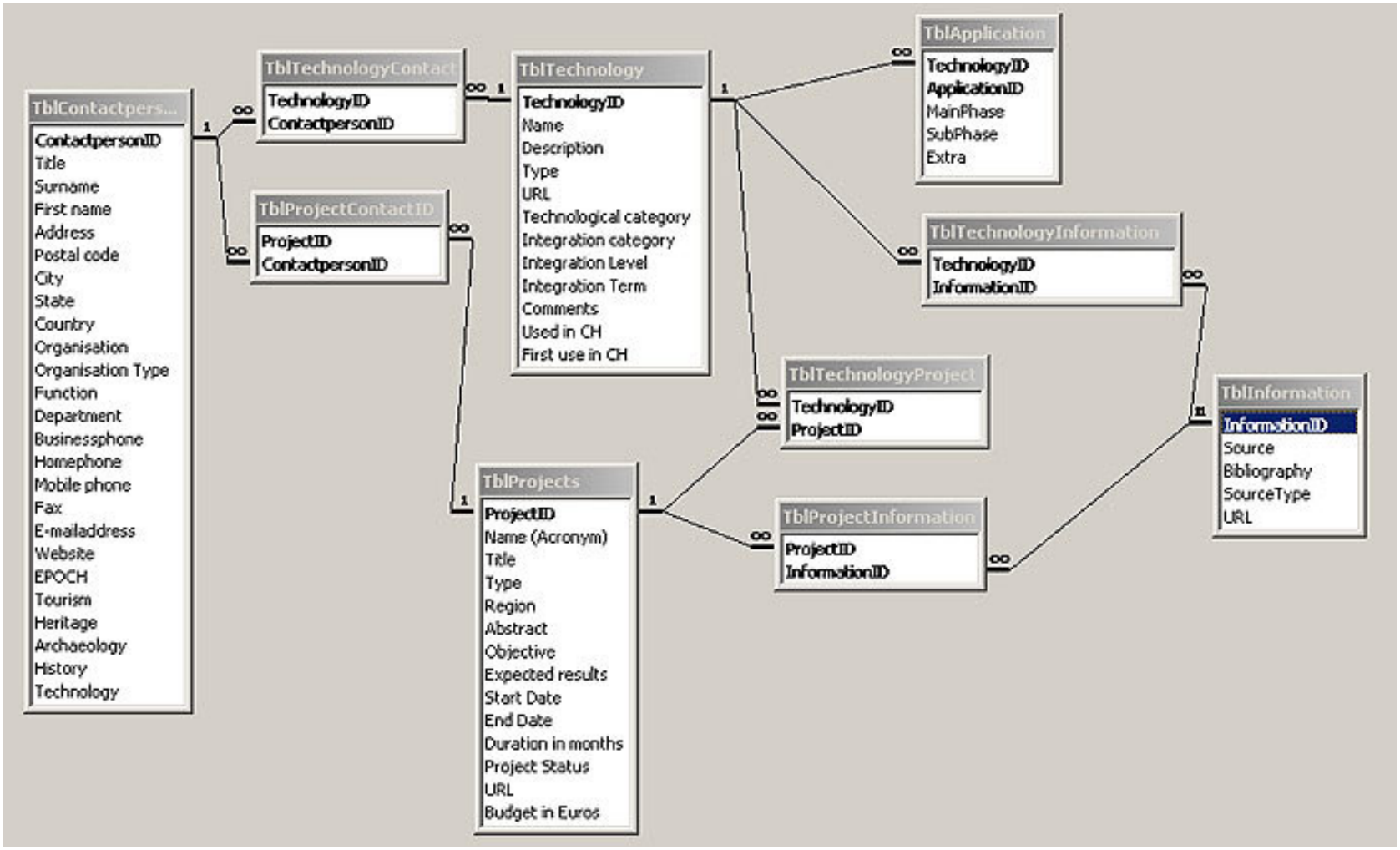


Figure 9: Relational database structure

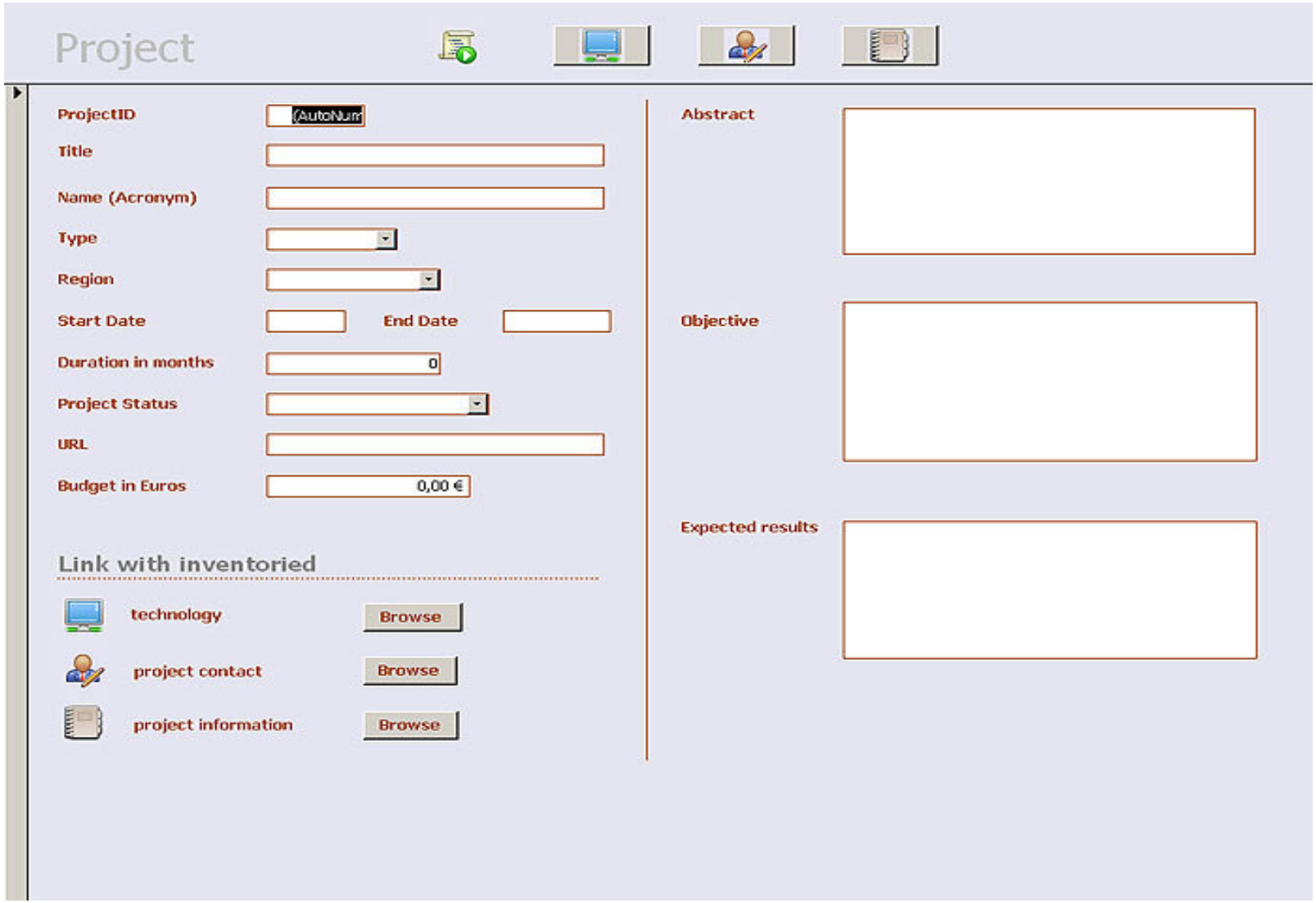


Figure 10: The project form

The structure of the project form is based on the classification system used by the database of European projects on the EPOCH website; see www.epoch-net.org/exist/projects/index.html (developed by PIN, University of Firenze). This form contains general information about each project.

In addition, the option has been added to classify projects by geographical location. Thus under "region" one can choose for example, "European", "Belgian", "American."

"Type" is understood to mean the basic programme framework of the project, for instance IST, Council of Europe, Culture 2000.

"Project status" indicates whether the project is in preparation, running or completed.

At the left bottom of the project form are links to the other input categories and overall themes. Clicking on the browse button brings up a pop-up menu from which links to the other themes can be selected.

It is possible to enter a project into the database that is related with one or more technologies. It should be noted that projects that do not use any technology can be also be added, as they may be of relevance to other EPOCH work packages.

The technology form summarizes all collected information about a specific technology. Four categories are provided on this form: general information, integration, application and the link with inventoried.

General information provides space for the name of the technology and a short text describing it. "Type" makes the distinction of hardware from software. The use of keywords such as mobile phone or virtual reality further classifies the technology in the field "technological category".

In addition, it is possible to indicate whether or not the technology is currently used in CH or whether this is its first use in CH. At this point we fulfil the principle of connecting our database with other work packages. This provides a potential link with other EPOCH work packages (for example WP 2.3 in which technologies not currently used in CH are examined).

Integration provides a link with "Common infrastructure" (WP 3.3) through the field "Integration category". The predefined selection list provides the different categories as outlined in WP 3.3.

Two other categories, Integration level (good – medium – bad) and Integration term (short – mid – long) as to comply with the objectives of WP 2.3 (see deliverable for WP2.3). Because these identification categories are in many cases based on subjective evaluation, another field is added for further explanation or comment.

"Application" refers to the relationship between the inventoried technology and its functional use within cultural heritage, thus connecting WP 2.2 with 2.1. Under main phase are the sub-fields described in WP 2.1 stakeholder need report. The sub phase field is included to make a subsequent division possible in future analyses of stakeholder needs. Related areas of use within CH can be record in the field titled "Extra" (such as tourism, heritage policy, etc.)

Due to this flexible system of relations we can link one or more technologies to a certain project, information and/or contact person. Technologies can even be filled in apart from a project. So the database is particularly useful for the inventory of technologies currently not used in CH (WP 2.3).

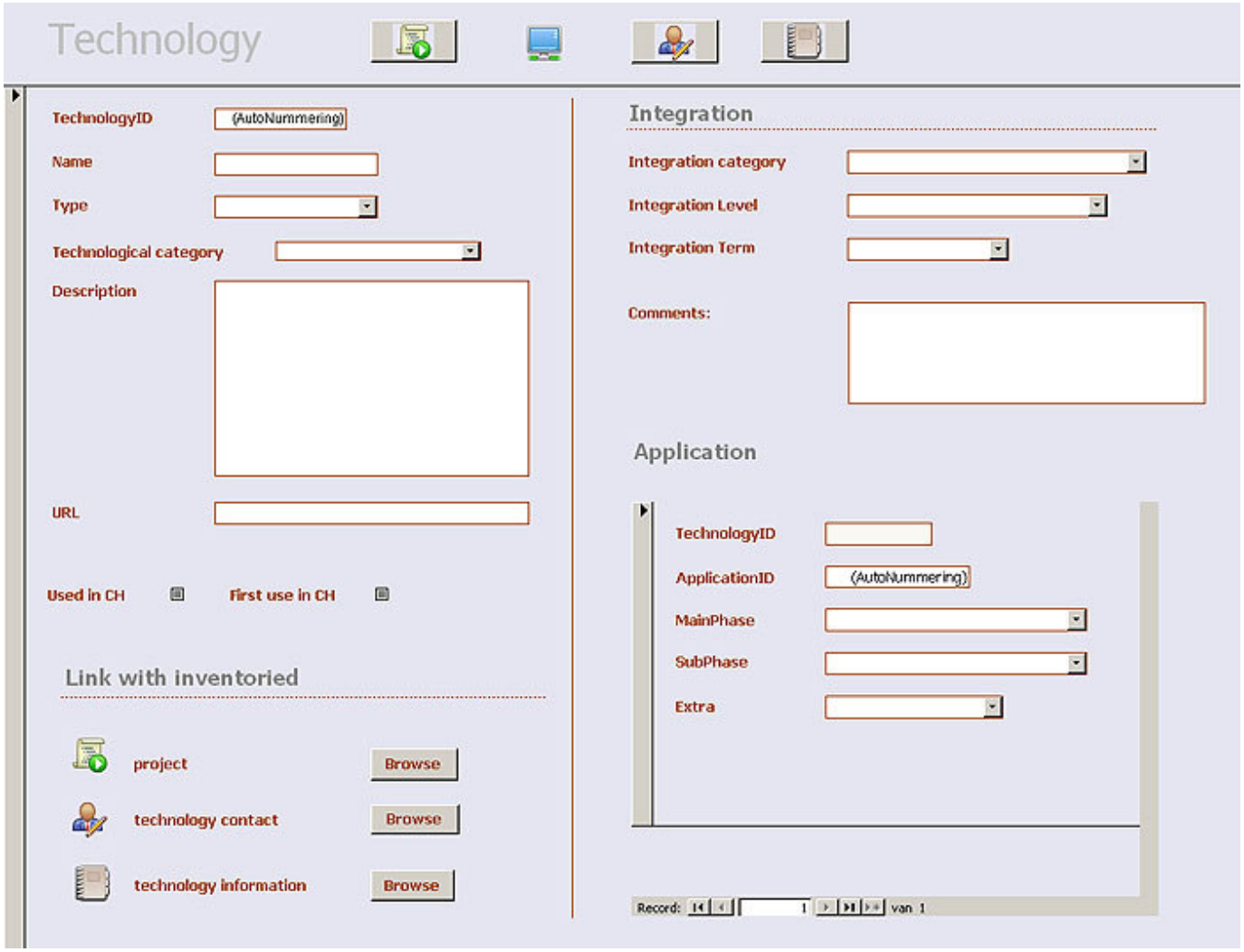


Figure 11: The technology form

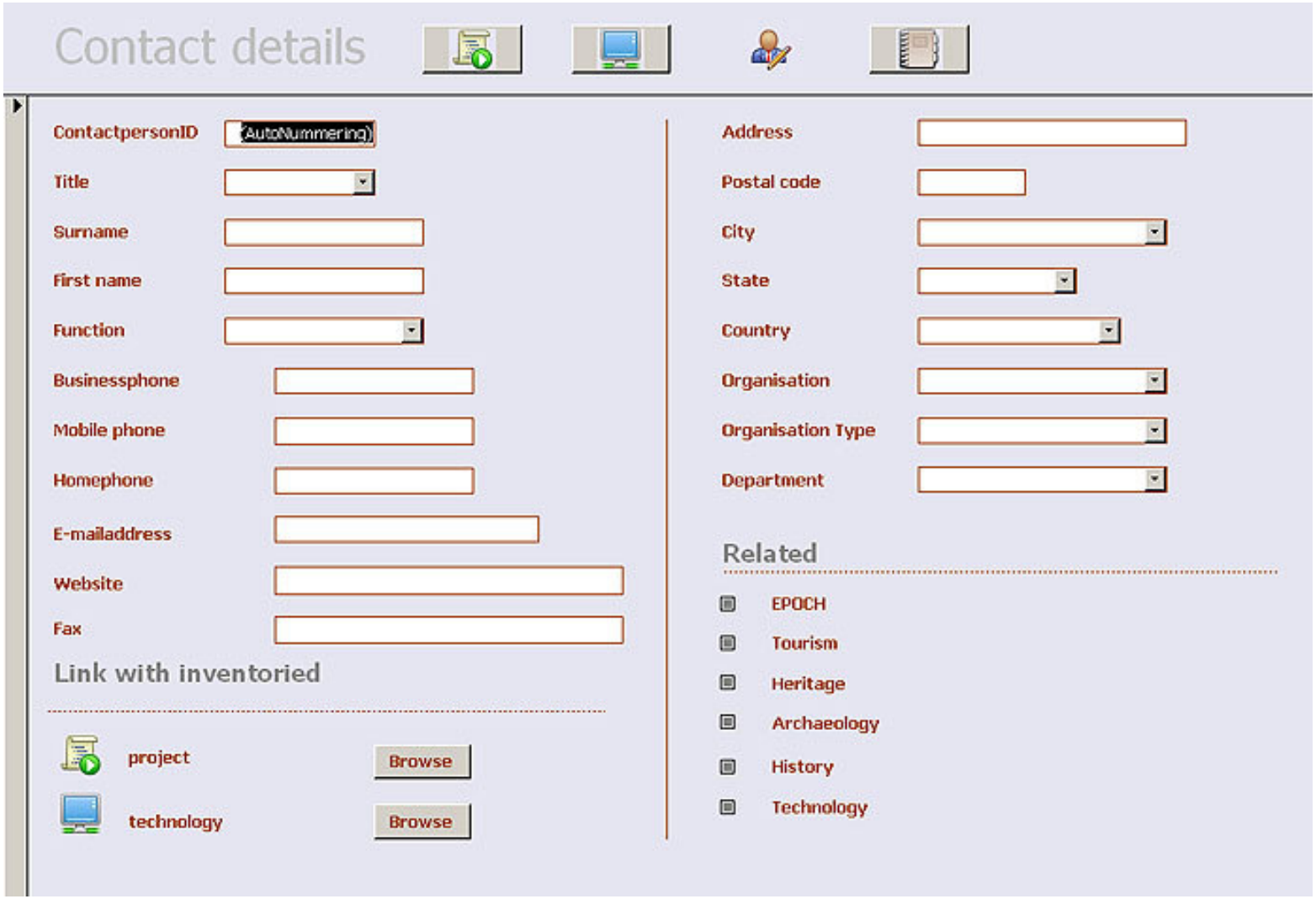


Figure 12: The contact detail form

"Contact person" contains all necessary contact details of persons involved in technologies and/or projects. This will facilitate the retrieval of technology partners in the database in order to contact them for further information on their technologies, for updating the technological information, and for sending out draft reports for review;

The contact person can also be related to a certain project and/or technology.

The information form is aimed at holding all additional information on a technology and/or project. By "source" one can choose between internal research and external input. Different source types include internet, conference and published literature. A full bibliographical reference and URL can be filled in.

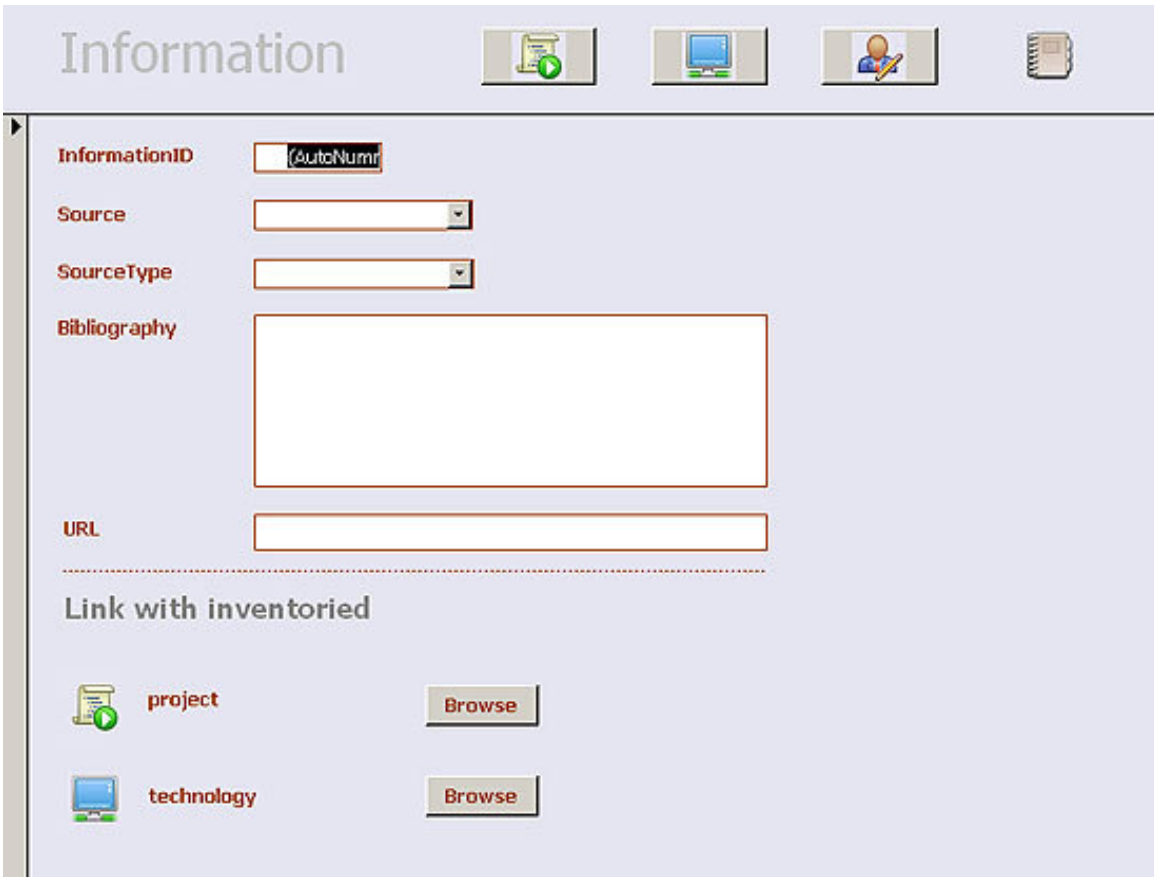


Figure 13: The information form

2.6 Towards a CH integration roadmap

The inventory and the analysis of success/failure factors and technology gap will serve as important data for the eventual construction of an integration roadmap. In order to establish clear and widely applicable definitions, we began with a collection and collation of bibliographical references pertaining to the integration of technology in CH. In the following sections, we summarize the existing points of view, and then describe our own integration guidelines on the preliminary results of the success/failure analysis.

III Preliminary research activities results

3.1 Success, failure and gaps

3.1.1 The motivation of the use of technology

The most conspicuous success factor in the use of technology lies in the nature of the motivation itself. Most museums and archaeological sites know clearly beforehand why they want to use technology for the presentation of their content. In many cases technology provides a surplus value to the content of the museum and archaeological site, but the precise identification of that surplus value is not always clear.

Although many museums and sites have specific scientific or educational reasons for adopting technology, some justify their decision on quite vague and superficial grounds such as "attracting more visitors" or "looking more modern". In these cases, the adoption of technology is seen as an end in itself, not necessarily an instrument to achieve some larger aim. Another source of weakness in the motivation to adopt is an exaggerated focus on specific target groups, for instance school children, thus not ensuring that the selected applications will be adaptable for use by other visitor groups.

The main raison for a gap in motivation by most museums and sites in the adoption of technology is a lack of money. There is simply no budget available for ICT applications. "Steunpunt re-creatief Vlaanderen" held a sample survey about the ICT in CH in Flemish museums, cultural organisations and libraries. This study showed that 20% of the museum staff has no access even to a PC and only 40% has an internet connection. Software is often limited to a basic package and a full 13% of the museums have no basic software at all. The first challenge for the technology world in the realm of CH is therefore basic: to provide in affordable hardware and software applications; in other words, to introduce most of the CH domain to digital technologies of even simplest kinds.

3.1.2 Action plan/definition of the concept

As mentioned above, in most cases a clearly defined idea preceded the choice to integrate technology.

Concerning the definition of the concept the following failures were noted:

- Museums and archaeological sites are often bound to certain procedures in their decision making process. Often they are forced to take the company with the lowest bid on an official tender, which is not always the most qualified.

- A lack of good communication between the museum/site staff and the chosen company.

- A lack of involvement of museum/site staff (internal and external) in the development and elaboration of the concept.

- A lack of control by the museum staff in the evolution of the concept process.

A primary reason for this gap in the concept stage is that staffs of museums and archaeological sites, mostly trained in humanities, lack a familiarity with the range of

existing technologies and their appropriateness for the communication of various content types.

3.1.3 Method of realisation

Where the basic definition of the concept frequently is worked out by the museum/site staff, the realisation almost always occurs through a process of public tendering as a museum/site has neither the knowledge nor the skill in integrating technology. They therefore turn to technological companies that are specialising in or ready to undertake CH applications.

Concerning the method of realisation the following failures were noted:

- Most museums and archaeological sites are sometimes limited in their choice for a company for the realisation phase. The problems are similar to those in the concept phase: often they work with public tendering and the choice of a firm can be guided by the lowest price, and not by the quality.

- The entire project can be subcontracted to one main contractor or divided amongst different companies. Communication is here the keyword: in both strategies the research revealed in some cases that communication failed.

- In the method of realisation (even more frequently than in the concept stage) the involvement of the museum/site staff is lacking or is only occasional. Sometimes other public services (for instance the technical service) assume a leading role in the realisation process.

The most important gap in the realisation stage once again the same as in the concept phase: a lack of knowledge and familiarity with the adopted technologies. Yet the lack of familiarity can be two-sided: both of the museum staff towards technologies and of the technological companies towards the specific needs of CH.

3.1.4 Content

The use of technology in a museum or site content can enhance the educational value of the museum/site visit when it used in the appropriate way. In some cases a successful combination of technology and educational workshop can be achieved. The use of technology makes sometimes difficult content more accessible towards specific educational targets groups.

However, the research also highlighted some failures in the relationship between content and technology:

- Sometimes the technology was chosen before the content was defined, so that the story was forced to fit that particular medium. It appeared that the chosen technology was not so appropriate for that particular content after all.

- Sometimes the content was well suited to the technology, but research found that the technological installations are not always used to their full potential.

- The balance between content and technology is in some cases distorted: too many technologies are used for the quantity and/or quality of the content.

- Content can fit the technology, but the technology is not flexible to the content. For instance some applications are not adapted to be used by guides

In most cases the content can not be easily after a specific technology has been adopted either because of the lack of knowledge by museum staff or because of the nature of the technology itself. Therefore the main gap in the content area is the lack of technological applications with a high degree of usability and flexibility.

3.1.5 Evaluation

Although some museums and archaeological sites may have had concerns about the eventual success of the project, it appeared that the technological initiatives were usually well received by the audience. In cases where the integration of technology was an obvious success, the museum staff would repeat the experience in the integration of additional technologies, though sometimes with a slightly adapted approach. The research found that museums and archaeological sites generally benefit in educational and visitor terms by the use of technology in their exhibits.

Concerning the lifecycle of technology most of the visited museums are aware that replacement will be required within a certain period. Some have a real action plan, others just keep in mind that replacement is something they will have to deal with.

3.1.6 Overall assessment of success/failure factors and technology gaps

The analysis and questionnaire responses collected in the initial phase of this study repeatedly raised certain central conclusions that are essential to approaching the question of the efficient integration of technology into CH:

- Most museums and sites have no in-house IT-specialist, but are rely on a jack-of-all-trades service person who can provide preventive maintenance and first line help. In most case this is insufficient. This situation usually is a matter of budget, rather than motivation.

- In some cases, when the technology malfunctions, the visitor does not receive the content information that was originally planned, thus changing his or her perception of the message of the exhibit.

- The usability of the technology is sometimes not appropriate to specific target groups, such as children, senior citizens, disabled persons.

- Technology becomes obsolete: in the case that a certain technology or hardware is especially developed for a certain museum/site it might be difficult and expensive to obtain replacement parts.

- In many cases there was no real test phase by the public. When tested, the received feedback was very useful and thorough changes were sometimes made. However, sometimes problems with technology appear when the application is in use for a considerable time;

Keeping the above mentioned failures in mind, the following issues will be addressed in subsequent phases of this study:

- It is a recognized fact technology becomes obsolete, but it is more difficult is to estimate the tempo of obsolescence. Even IT-specialists have trouble to follow the fast evolving IT-market and some general guidelines for museums and sites are needed in evaluating the adoption of certain technologies.

- There exists a clear need within CH (museum staff, guides) of training in technologies, not only which technologies are available, but also their integration possibilities in CH and how to use them once installed.

- Although there are certain technologies integrated in CH, many useful technologies with high potential for CH have not find yet their way to museums and archaeological sites. These technologies can create a surplus value for group experiences (communication, interaction, etc.)

3.2 Future development of a database of technology in CH

The further development of the database will be the next major stage of the applied research method. As mentioned above, various technology gaps were discovered in the initial analysis phase, such as difficulty in dealing with the large quantity of information, the limited geographical spread of research, the focus on only one aspect of the pipeline, etc.

Although the input of projects and technologies is still in its beginning phases, a first evaluation makes it clear that the structure of the database meets most of the above outlined gaps.

As work is in progresses, it will feasible to highlight and analyse the full range of technologies and to selectively query the database about which technologies are available for specific stages in the production pipeline, which companies are involved various stages, and which technology or cultural heritage theme are emphasized by European projects and other governmental projects. It is hoped that this database will there for be an important tool for the analysis of the current state of integration of IT within the cultural heritage domain, but it will also be a valuable resources for information and integration by both the IT and CH communities.

3.3 Integration guidelines

Although the vertical integration study is still in its initial phases, some preliminary recommendations can already be made for the effective integration of technology in the CH domain. These recommendations are primarily aimed at the adopters (i.e. museums and site staff and other CH professionals).

3.3.1 The motivation of the use of technology

- Don’t use technology as an end in itself, recognize its value to achieve clearly definable goals.

- Don't be influenced by unproven secondary factors, such as attracting more visitors, or enhancing the "modern look' of the museum or site.

- Question if technology is the only possible option to enhance the visitor's experience.

- Carefully identify the target groups for which the technology will be used.

3.1.2 Action plan/definition of the concept

- Precede the choice to integrate technology by formulating a clearly defined concept about the objectives to be achieved through the use of technology. The package is less important then the content.

- Survey the use of existing technologies: visit museums/sites that already integrated technology, collect information about technologies and their possibilities (hardware/software, usability, maintenance, obsolescence, and price), contact different technological companies, etc. So that you have a clear understanding of the existing technologies and take a well-founded decision.

- Appoint a coordinator within the museum/site who oversees the whole process of integration, from concept to realisation, and who takes care of the internal and external communication.

- Establish a clear consensus with all staff involved about the definition of concept.

- If the formulation of the concept is subcontracted, keep in close contact with the contractor and be involved in the process.

- Set up different several working groups that are responsible for specific tasks of the concept. It is important to inform all museum/site staff about the decision making process.

- Whether or not the definition of the concept is subcontracted, it would a good idea to provide a real action plan for the whole process in which the concept stage is only a part of it. Therefore the effort spent on the definition of concept and method of realisation has to be in balance.

3.1.3 Method of realisation

- The role of the museum/site doesn't stop after the stipulation of the concept, although in most cases the realisation is subcontracted. There must be constant feedback between the museum/site and the company/ies involved in the realisation.

- Make clear agreements with all staff involved in the method of realisation, so that there is a close follow up of the progress made in the realisation of the project.

- In realisation, as in concept development, it is advisable to have a coordinator who channels the whole process of realisation and who takes care of the internal and external communication.

- As the realisation moves towards its finalisation, it is advisable to check and test if the technology applied on the CH content lies within the expectations pointed out in the definition of concept.

- It is important from the beginning to have clear and detailed contractual agreements with the contractor(s), particularly about the technological part of the realisation. It is preferable to organise training for all museum staff, but at least there must be a training guide about the use of the technology, delivered by the contractor. Such training should not only provide information about the use, but also about the maintenance of the technology.

3.1.4 Content

- As discussed above, the content should be selected and formulated before choosing the appropriate technology. Nevertheless, a thorough study of the available technologies is indispensable in order to tune the content structurally (not in respect to the content) to the technology, and so that technology is used to its full potential.

- The relationship between content and technology, between message and medium, needs to be in balance.

- If the technology is intended to be used by guides, the content has to be structured, so that the technology and guide are complementary to each other.

- Apart from the balance between content and technology, the museum/site must keep in mind that technology can fail and that it must be possible for the visitor the catch the full story. Therefore a safety net is required.

3.1.5 Evaluation

- It would be no luxury to include a test phase before the official opening, not only by the museum/site staff, but also by the different target groups and the technology provider(s). This test phase has to be on two levels. The first focuses on the content: the staff checks if the content is scientifically correct. The audience and technology provider verify if the content is understandable. The second level concentrates on the technology: the staff and the public confirm the usability. The technology provider takes a careful look at the pure technical aspects of the applications.

- After the realisation stage the main task of the museum/archaeological site is to maintain, evaluate and adjust the integrated technological applications.

- As an in-house IT-specialist is not available for most of the museums and archaeological sites, maintenance needs to be subcontracted, as training is not sufficient, for instance, to solve serious problems, updating software, etc. The contract with the company should contain clear agreements about the frequency, the nature, the price, etc. of the maintenance. The museum/site on the other hand can facilitate the maintenance and/or repair by keeping a journal of technical problems.

IV Preliminary study evaluation and future directions

On the basis of the results of the first phase of the vertical integration study, some important themes and methodological challenges have been noted. These critical remarks are a starting point for outlining the future direction of the Vertical Integration activity.

4.1 Success, failure and gaps

Although a thorough, in-depth and high quality level research was carried out, some critical comments can be made:

- For initial practical methodological reasons, the research was limited to Belgium and focussed on only one thematic approach, i.e. the interpretation and presentation part of the pipeline. Both geographical and thematic foci will be expanded.

- The detailed questionnaire proved to be a useful framework for personal interviews, but this method of direct and detailed interviewing by the members of the activity staff is not feasible on a European level and the questionnaire will be used independently as a source of primary information in many cases.

- The initial research emphasized on the use of technology from the point of view of the user (i.e. museum). More attention will be devoted to other CH related partners, for instance companies (suppliers of technology).

Keeping the above outlined comments in mind, the following future actions are planned:

- As suggested in the stakeholder needs report (WP 2.1) the research should give priority to a bottom up approach, starting with data collection and processing and covering all successive steps of the "pipeline". So future research should cover all these steps.

- Broadening the research to a European level. Therefore it is advisable to provide apart from the interview technique, other research techniques, such as contacting museum & sites networks, telephonic polls etc.

- Questioning the suppliers of technology (private companies, research centre, universities) who are already partners in the Network of Excellence.

4.2 Further structuring of the database of technology in CH

Since every research project is an ongoing process, the following remarks can be formulated for the future development of the database:

- Because of the large quantity of available information concerning technologies, the inventory focussed on one main theme: interpretation and presentation. This inventory will encompass all phases of the production pipeline.

- Although the database is well structured, it uses different classifications which might be not that clear without an explanation. This is due to the fact that priority is given to establish the link to other EPOCH work packages that use different classifications for the same technologies. They are regarding technologies from a different point of view. A common nomenclature will be adopted, by consulting different stakeholders and experts within and outside the Network of Excellence.

- There will be a further development of the database structure to make it accessible online within the Network. This will certainly facilitate the involvement of the Network partners.

4.3 Expansion of integration guidelines

Critical remarks concerning the integration guidelines are:

- As this research activity is based on the results of the success, failure and gap analyses as the other phases of the study, it is obvious that the same remarks can be noted; i.e. the limited target area and the focus on one aspect of the pipeline (interpretation and presentation). These will be expanded in integration guidelines.

- In the coming phases of the study, the integration research will be elaborated towards all stages of the pipeline.

- A more geographically represented area will be studied, noting the specific needs of various regions and types of CH institutions.

- The integration guidelines will be translated into a draft roadmap. As the DIGICULT project is currently preparing a roadmap, the scholars responsible will be contacted and their results will be analysed for its usefulness in the preparation of the EPOCH roadmap.

- The EPOCH roadmap will encompass the findings of other research activities within the Network, such as stakeholder needs, horizontal integration, and common research agenda to produce a practical set of guidelines for both the CH and IT communities, thus enhancing overall integration in the European research area.

V References

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http://europa.eu.int/comm/education/policies/lll/lll_en.html
http://dtp.epsb.net/glossary.htm

Appendix

Appendix 1: List of visited museums

Kunsthal Sint-Pietersabdij, Gent: "Alison, the secret of the fallen angels" PDA
Alison is a virtual adventure through the history of the Saint Peter's Abbey in Gent. Benedictine monk Alison wanders round the ancient abbey buildings and takes the visitors for a trip through time. He guides them along unsuspected corridors and rooms and step by step he unfolds the secrets of the abbey and her former occupants.
The venue is especially fit for families with children.

http://www.gent.be/spa/03_Alison/Alison01_en.htm

Diamantmuseum (Diamond museum), Antwerp
Antwerp is home to the largest Diamond Museum in the world.
The museum is an 'image and sound' museum, a total and unique experience for the senses. Besides looking and listening, the visitor is immersed in the fascinating world of this magnificent little stone. The audio-guide enables him to visit the museum in the language of his choice and at his own level and pace. Experts and dilettantes will all find the answers they are looking for.

Moreover, the treasure chambers' splendid collections of jewellery provide a picture of diamond jewellery from the sixteenth century through to the present day (e.g. replica of the British Crown Jewels containing two of the world's largest diamonds: the Koh-I-Noor and the Cullinan i), and contemporary diamond creations.

http://www.diamantmuseum.be

Mu-zee-um: temporary exposition "De val van het nieuwe Troje", Oostende PDA (29/05 to 27/09/2004)

This temporary exposition about the siege of Ostend in 1604 is an interactive museum visit on a PDA. It's set up with 5 main themes about the attack itself, offensive weapons, etc. The visitor is guided through the exposition by an actor. He can listen to a narrated explanation, but also design his own weapons and clothes, search for his favourite portrait, play a fortress game, etc.

Ten Duinen 1138, Koksijde
This museum has 2 stories to tell. The main story is the one of the history of the Cistercian abbey Our Lady and the daily live within it. The second one is that of the function and production of religious silver from the gothic period until today, based on an exposition of the silver collection of Maldague de la Héry.
A combination of traditional techniques (do elements) and modern multimedia is used. Through the museum there are several installations: touch screens, sounds, video. For the children there is a treasure hunt.

http://www.tenduinen.be/

Hidrodoe, Herentals

Hidrodoe is the only museum in Belgium that tells about the world of water. It's an initiative of the water company Pidpa. Different aspects of water are being discussed: physical and chemical aspects, the history of the use of water, the role of water within our society, etc...
The main players of the exposition are interaction, fun, information and education, so called edutainment. The mission of Hidrodoe is to inform about and to make people aware of the importance of water via fun applications. Even so the museum is focused on schools; it's also a great learning experience for adults.

http://www.hidrodoe.be/default.htm

Archéoscope de Liège

The Archéoforum of Liège is an archaeological park under the Place Saint Lambert. It is the result of almost one century of archaeological research on the site of the former cathedral Saint Lambert. More than 9000 years of history is shown through the use of a modern and educational scenography in a journey underground.

http://www.archeoforumdeliege.be

In Flanders Fields, Ieper

The museum approaches the war from several angles. That is why it has a layered structure (Personal section, Chronological/Thematic section, General historical section and a General human interest section). In the In Flanders Field Museum, war history is related in such a way that you can understand it. Objects, documents, personal memorabilia, photographs, films, sounds, works of art, reconstructions, and interactive kiosk (etc.) help to create a context to achieve this effect. A modern museum is not merely a collection of objects, but also a dramatic portrayal of varied contents. It is likewise a meeting place for people from the past and present. In the In Flanders Field Museum you learn about the war, but you also feel it crawling under your skin and playing on your nerves; the museum answers your questions, but it also raises questions.

www.inflandersfields.be

PAM Ename: timescope technology

The Provincial Archaeological Museum of Ename is an active focus of museological experimentation, educational programming, and local pride for the people of the village of Ename, East-Flanders. It presents Flemish village culture and history — and the larger values of community identity they embody — to an international audience.
The museum's extensive use of New Media (such as Virtual Reality, interactive computer applications, film, and video) is meant to enhance, rather than replace, traditional museum displays. At Ename, technology is not regarded as an end in itself, but as a powerful tool to help visitors better understand both the individual object and its place in a wider and more meaningful past.

www.oost-vlaanderen.be/cultuur/musea/pam/e-museum.htm and www.ename974.org

Appendix 2: Identifying technologies used in Cultural Heritage

See attached paper