DigiCULT

Emerging Technologies for the Cultural and Scientific Heritage Sector

Technology Watch Report 2

Information Society Technologies

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Emerging Technologies For the Cultural and Scientific Heritage Sector

DigiCULT Technology Watch Report 2

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Introduction

This is the second in a series of assessments of emerging technologies. The first DigiCULT Technology Watch Report (TWR1) was released in February 2003. With support from the European Commission's Information Society Technologies (IST) Programme under the 5th Framework Programme *The Digital Culture Forum* (DigiCULT Forum, IST-2001-34898) monitors and assesses research and technological developments in and for the cultural heritage sector in Europe. This Technology Watch Report (TWR2) provides information resources to enable heritage institutions to continue to develop their uses of information technologies 'to provide access to the riches of European cultural heritage' as recommended in DigiCULT's 2002 report, *Technological Landscapes for Tomorrow's Cultural Economy.*

The Technology Watch Reports are part of a suite of DigiCULT's deliverables, which also include Thematic Issues, the *DigiCULT.Info Newsletter* and a participatory website (http://www.digicult.info). They are all designed to provide the cultural heritage with access to accurate, accessible information about current, near- and longer-term technological developments. In addition to examining the technologies DigiCULT reviews the experiences of its institutions as they attempt to take advantage of newer technologies, whether they be methodological, technical, or exploitative. The DigiCULT technology assessments are designed to identify developments that could be deployed without further work, those that would require further development or repurposing, and those that are still in early stages of gestation but show promise. The Technology Watch Reports offer accessible descriptions of new technologies, suggest how these might be employed within different cultural domains, indicate the implications and risks (e.g. social, organisational, financial) of adopting particular ones, and include case studies demonstrating how a technology has already been used even if on occasion only on a pilot basis. TWR2 examines technologies that improve interoperability between sectors, standards that promote long term viability of resources, approaches that support personalise experiences of the heritage, and those that support access to shared spaces, and mechanisms that enable curators and users of the heritage to participate in enriched real and virtual environments. In the Introduction to TWR1 (2003) we provided an overview of the processes DigiCULT uses to select, evaluate, investigate, and present technologies.

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Technological Landscapes for Tomorrow's Cultural Economy (2002), recognised the cultural value and the financial potential bound up in heritage collections. While the Lund Principles, adopted by the EU Member States in 2001, stressed that access for the citizen should be free of charge, at the same time, institutions recognise

that commercial exploitation of cultural services is essential and the income-generating potential of heritage assets needs to maximised. The sector should aim to become the natural source of high-quality cultural content, the first place publishers, advertisers, and others turn. This can only happen if potential users can identify possible material easily, negotiate the rights to use it efficiently, and have it delivered to them in a timely manner. Heritage Institutions need access to digital rights management technologies (DRM) and digital asset management (DAM) systems to enable them to track, exploit, and repurpose their digital assets. In TWR1 we examined DAM systems that support the acquisition, description, tracking, discovery, retrieval, searching, and distribution of digital assets. This examination outlined the technologies which underlie a standard DAM or content management (CMS) system and highlights how it can be used by cultural institutions to facilitate the most efficient and effective use of digital assets. The decreasing costs of implementing DAMS technology make them feasible for institutions of nearly all sizes. The topic received further coverage in the *DigiCULT.Info Newsletter* (December 2003) in Paul Conway's examination of the open source content management system (CMS) Zope.

Creating and managing digital assets is only a first step. Heritage institutions need access to technologies that enable them to license use of these assets and business models that enable them to increase their revenue income and reduce the costs associated with generating that revenue. Many institutions recognising the risks posed by piracy, including loss of income and control of their content, have shied away from making their content available on the networks. Digital Rights Management (DRM) and related security technologies streamline and simplify the process of granting and gaining licences for the distribution of protected content. They allow organisations to define and represent access rights and conditions, ensure that these are adhered to, and facilitate the collection of licensing charges for the use of resources. Rights management software and automated payment systems provide technologies that could enable the cultural heritage sector to become and remain competitive in comparison with commercial picture libraries and other comparable content providers. One of the real challenges is that only the largest institutions have sufficient infrastructures to do this work alone. In their current form these technologies will really only benefit small and medium size institutions if they work together. The case studies indicate how this might be done.

Many heritage institutions find themselves struggling to keep pace with the opportunities offered by new technologies and user services. The costs and support issues associated with new technologies might in some instances be reduced through collaboration (e.g. shared ownership and use across a number of institutions of collection management systems). Another emerging approach is the renting of shared computer resources and expertise from third-party providers, commonly grouped together as Application Service Providers (ASPs). ASPs are organisations that provide shared software applications and services. The choice of ASP services over in-house solutions may offer clear financial and organisational benefits to cultural heritage organisations, particularly those without the in-house technical know-how to build efficient and innovative systems. With ASPs the need for specialised IT staff is minimised, and upfront equipment expenses are reduced. ASP resources and costs (including profit margins) are shared among many potential customers. ASP services can be offered to the customers at lower rates than the individual organisations would be able to achieve in isolation. The grouping of similar collections via a shared portal is another potential benefit of ASP, but there are other ways of achiev-

ing this goal. One fundamental benefit of ASP technology for cultural heritage sector institutions is that it offers the advantages of a fully integrated client/server architecture without the responsibilities and costs of running an in-house system.

In issue 5 of the *DigiCULT.Info Newsletter,* Thomas Finholt from the Collaboratory for Research on Electronic Work (CREW) at the University of Michigan's School of Information reported on a study which found that the public sector institutions most likely to benefit from ASPs are the medium-sized organisations. These are, as Finholt explains, 'big enough to need efficient information technology and support but are not big enough to carry the costs of the equipment and staff.' ASPs give smaller cultural heritage organisations access to advanced resources, thus allowing them to offer services that they would not be able to offer individually. In the cultural and scientific heritage sector, ASP technology is most frequently employed for collection management purposes. The current and potential uses of ASP in the cultural heritage sector are outlined explicitly in this section's three case studies. The REGNET and OpenHeritage case studies indicate the possibilities offered by ASP technology and shared methodologies (even at this early stage in its development), as well as suggesting future uses to which it may be put as prices fall and the idea of outsourced and shared hardware/services becomes more widely accepted.

It is axiomatic to say that information technologies have broken down distance and enable new kinds of interactions between people whether they are in the same building or continents apart. Email, bulletin boards, and mailing lists support the passing of messages and information. In contrast to these asynchronous approaches, synchronous tools make possible dynamic, active, and engaging communication of both a personal and professional nature. Peer-to-peer technologies have enabled the possibilities for the effective and efficient sharing of resources (using the computers of community members rather than servers) to be explored and exploited. Among the possibilities for the heritage sector created by these developments is the increased ability for attracting a global audience to study or present cultural heritage artefacts through intense, varied, lower cost, and simpler communication mechanisms. They have also created new possibilities for building consortia and partnerships between cultural/scientific organisations and their existing and new audiences. They provide the basis for both formal and informal interactions, and platforms for enabling professional development. This section is not about virtual communities themselves - DigiCULT considered this in Thematic Issue 5 (January 2004) - but about the technologies that can be used to underpin them.

The case studies that accompany this discussion demonstrate a wide range of these approaches, and depict the variety of purposes to which they can be put. The eMarCon project gives a technology-driven solution to a straightforward logistical problem: how can (physically) huge artefacts be experienced in context with each other when their real-world locations are far apart? VRoma shows how collaborative resources can be deployed for multiple purposes, particularly as a medium for structured and unstructured learning. The MIRROR community of practice gives perhaps the fullest account of the benefits of these new approaches, with the goal of creating both a virtual, pan-European group of natural science museums and new methodologies for learning. The variety of technologies and approaches involved here highlight the growing importance of interoperability between collaborative systems. Improvements in the ease of sharing materials and experiences enable links between disparate spheres and disciplines to be forged and, given time, strengthened. Online digital museum exhibitions offer a platform for institu-

tions to improve public access to and understanding of the cultural heritage, but the fact that their creation remains a 'handicraft' has constrained their broad adoption. New technologies not only enable museums to reach beyond their walls through virtual exhibitions, but they offer new ways for visitors to access resources and participate in exhibitions.

These developments benefit from improvements in the human computer interaction discussed in TWR1 (2003). A wide array of devices, providing different modes of interaction based on different underlying concepts is coming into commercial use. The design of these devices reflects the needs and abilities of users, the range of human senses, from hearing to touch, that can be harnessed, and the recognition that portability is essential. New methods of human computer interaction make it possible for cultural institutions to provide visitors with dynamic and immersive tools for observing collections not currently on display or with mechanisms that can give tactile and weight sensations while they "virtually" hold fragile and restricted access items. In issue 6 of *DigiCULT.Info* the Cultural and Educational Technology Institute (Greece) described 3D multimedia tools for archiving cultural heritage materials from landscapes to objects. One of the strengths of their work is that it enables access to and display of other data types alongside the models. Future improvements at the interface between person and machine will focus on multi-modality, easier use and more immediately reactive interfaces. For the cultural heritage field this will mean a broadening of the group of prospective users and more natural communication between user and computer system. While collaboration technologies will enable the emergence of virtual communities, new mobile access technologies provide a powerful tool for making information resources available during visits to cultural institutions.

Technologies likely to have a strong influence on future institutional strategies include increasingly powerful, portable and affordable devices such as PDAs and cellular phones, and new wireless communication protocols such as Bluetooth, WAP (Wireless Application Protocol) and GPRS (General Packet Radio Service). In contrast to the use of audio guides or other specialised devices which are typically maintained by the cultural heritage institutions and borrowed by the visitors, new mobile devices are often owned by the visitors themselves. This may bring a radical change in the way heritage institutions think about formulating and financing their technology strategies. What is becoming increasingly necessary is the ability to provide wireless connection to the right information and to suitable content, with guaranteed compatibility across platforms and protocols. Visitors therefore benefit from guides that can offer an unprecedented level of personalisation and self-direction. Early mobile access devices have already been introduced in a variety of institutions, and are commonly found in museums and open-air exhibits. From museum corridors to city streets, the case studies contained in this section cover a range of approaches and purposes made possible by the development of portable devices. The ultra-futuristic, sociological ambitions of Urban Tapestries are in contrast to the more modest and practical educational aims of the Handscape and MUSEpad projects. Scenarios presented examine eTourism, preservation, and personalisation. Here again technologies that we examined in TWR1 (2003) such as Customer Relationship Management systems (CRM or eCRM) can provide the information base about visitors and other heritage institutions clients to support the personalisation opportunities created by mobile access devices and avatars.

TWR1 examined the use of smart tags which use radio frequency identification (RFID) technology to read information on the tags fixed to or embedded into an object or its

container. They either reflect or retransmit radio-frequency signals and, like barcodes, can be linked to databases such as library catalogues or museum collection management systems. As well as being used to improve the handling of the objects themselves, they can be used to manage visitor or user access to information about the objects and this is especially true in the context of mobile access devices. In the introduction to Issue 5 of the *DigiCULT.Info Newsletter* we described how heritage institutions might use visitor RFID cards in combination with geographical information systems (GIS) and CCTV recordings to distil moving image footage of individual visits—'automatically generated museum visitor video ethnographies'. New technological applications would be needed to automate the linking of the RFID time codes (giving the position of the target at any point in them) with the time codes on Closed Circuit Television (CCTV) recordings to extract automatically the moving image sequences related to each visitor. This combination could also be used to facilitate interactivity between objects and users of mobile devices. In this ways RFID, mobile device, human computer interaction, and virtual space technologies can be brought together to deliver highly immersive distributed experiences.

Increasingly we recognise the central importance of the social space, context, and interactivity that lie at the heart of the Internet. The physical and the virtual worlds are often contrasted, with the virtual world and its cyberculture viewed as uniquely different from 'real-world culture'. While it is true that there are characteristics of cyberculture that set it apart from more traditional measures of culture, the boundary between the two worlds has never been precise and continues to blur. The evolution of virtual social, information, and economic spaces has demonstrated this with remarkable clarity. We are all aware that the Internet enables individuals to share experiences, create social bonds, and construct 'imaginary communities' that take on social and cultural fabric. It is a fluid environment, as anyone who has read Sherry Turkle's early 1990s study *Life on the Screen* and attempted in the past two years to investigate some of the same phenomena she describes will know. New spaces and practices are emerging all the time, older ones are disappearing, and it is transforming the ways we participate and interact. *Avatars* are virtual representatives of human users in virtual environments, often sharing space with agents, which represent computer processes or programs. These technologies can enhance our use of both collaborative environments and mobile devices. They offer a social dimension to the computer-based communication processes.

Avatars and agents utilise similar three-dimensional graphics and animation technologies, making them seem vivid and appealing. They can be made to 'speak'. Combined with haptic interfaces, avatars can be used to study three-dimensional objects, such as sculptures and other artworks. In such cases, the user sees his or her avatar in the virtual space, and can gain the impression of touching virtual representations of the objects. The use of avatar and agent technologies is most beneficial in cases where the nature and quality of communication between users (or between users and the software) is crucial. In the cultural and scientific heritage sectors, agents are an increasingly popular option for tour guides in virtual exhibitions. Their use allows new approaches to the presentation of a collection, allowing for the personalisation of virtual tours by matching them with visitors' profiles. Case studies in this section provide an insight into the uses of avatars. For example, the Peranakans Project deals with culture, history and education, with the avatar guide being used as an immediate, visual and identifiable conduit for learning about different ways of life.

The ORION (http://www.orion-net.org) study of user practices and needs uncovered

higher than expected take-up of 3D applications as well as a very strong interest in future uses. There is widespread recognition that 3D visualisations enable learning and open up learning to wider social groups. Many European museums with archaeological collections already use 3D and they have found a place in cultural scholarship as well. In TWR1 and subsequently in Issues 4, 5, and 6 of the DigiCULT.Info Newsletter we examined Virtual Reality technologies. Virtual Reality (VR) applications can be used to allow the general public to visualise the past in ways that are not feasible with conventional presentations. In theatre studies (e.g. the THEATRON Project) and archaeological reconstructions of completely or partially destroyed structures (e.g. The Roman bath complex at Bath) VR technology has been used to great effect. As it becomes more accessible, it offers great potential for visualisation of heritage sites, landscapes, and buildings. These visualisations permit the user to "move" through the environment and see it from various angles. VR can bring to life data which are otherwise difficult to put into context. When combined with avatar technologies and mobile devices the power of Virtual Reality becomes more potent. The models become immersive, interactive and involving.

Standards play a key role in the interoperability of resources and in their long term viability. As well as changing the ways in which Web content is arranged and delivered, XML has revolutionised the ways in which organisations store and transfer their internal communications. XML offers a new way of approaching content structuring and reuse. In isolation, an XML file does very little, but it is through the combination of XML with dedicated 'helper' utilities that its power can be harnessed. Content can be stored centrally in one format, presented as XML, and repurposed/delivered as an organisation's various needs dictate; on the Web, to mobile devices, or to other applications for processing. XML scales well, and early XML documents can easily be ported into cutting-edge applications and display systems. XML representation can be enhanced over time and enable the reuse and repurposing of content. This is an exceptionally broad topic and we do not aim to provide a broad and detailed overview. The provenance and essentials of XML are outlined in brief, and then related technologies that are likely to be of the most relevance to the cultural heritage community are described. The bulk of this section is devoted to accounts of XML deployment in this sector, featuring case studies on the Pouce and COVAX projects, to name but two. There are numerous standards based on XML specially designed for use in the Cultural Heritage sector such as EAD (Encoded Archival Description) for use in managing information about archival materials, and in *DigiCULT.Info* issue 3 the CIMI XML Schema for SPECTRUM that enables museums to encode descriptive information concerning objects in their care was introduced.

In the October 2003 issue of the *DigiCULT.Info Newsletter* we noted a poster covering a museum under renovation in Museumsinsel (Berlin), one of the finest museum complexes in the world. In the words *Weltkultur beflügelt* (world culture gives wings) it asks all who pass to consider the liberating power of the cultural heritage. TWR2 and the other DigiCULT products aim to show the power of new technologies in helping cultural heritage institutions in achieving their objective of improving the care, understanding and benefits of cultural heritage to individuals and society. Technology is a tool to enable access, preservation, and use and understanding of the heritage. It is not an end in itself.

The Application Service Model

Executive Summary

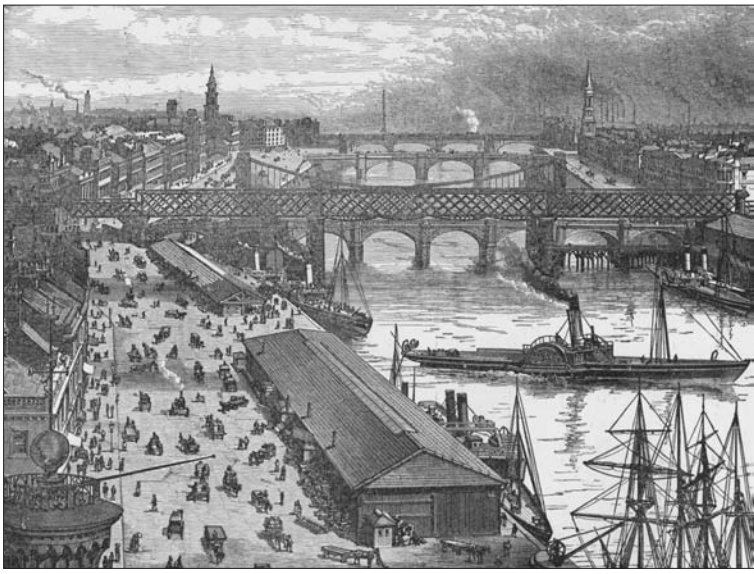
The rapid expansion of the Internet has led to a number of sea changes in the way cultural and scientific heritage institutions organise their approaches to technology, data organisation, and content delivery. As well as the new possibilities introduced for preservation of and access to collections, some of these new Web-based technologies can alter the workloads and working practices of these institutions. One promising emerging service is the renting of shared computer resources and expertise from third-party providers, commonly grouped together as Application Service Providers (ASPs).

ASPs are organisations that provide shared software applications and services over the Internet. The choice of ASP services over in-house solutions may offer clear financial and organisational benefits to cultural heritage organisations, particularly those without the in-house technical know-how to build efficient and innovative systems. With ASPs the need for specialised IT staff is minimised, and upfront equipment expenses are reduced. The minimum hardware an institution needs to start with an ASP is a single Internet-ready PC and a phone line.

Responding to the growth of outsourcing, a number of IT vendors of library management systems have created ASP departments or subsidiaries. Within these companies, resources and costs (including profit margins) are shared among many potential customers. ASP services can be offered to the customers at lower rates than the individual organisations would be able to achieve in isolation. The grouping of similar collections via a shared portal is another potential benefit of ASP, but there are other ways of achieving this goal, as we shall see.

One fundamental benefit of ASP technology for cultural heritage sector institutions is that it offers the advantages of a fully integrated client/server architecture without the responsibilities and costs of running an in-house system. In addition to this, while data security can never be taken for granted, a competent and experienced ASP is likely to ease such concerns, and the staff are freed to concentrate on other, less technical activities. Essentially, ASPs give smaller cultural heritage organisations access to advanced resources, thus allowing them to offer services that they would not be able to offer individually.

Risks include the potential unavailability of services, which may be caused by external problems such as phone line failures and power cuts. In extreme situations the data stored at the ASP can be lost, hence backup should be practised on both the ASP and the customer sides. Although very unlikely, such eventualities must be negotiated in advance between the organisation and potential service



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providers, and the resulting agreements defined in a service level agreement (SLA). An SLA, or statement of service level (SSL), is an agreement (sometimes issued as a contract) between an ASP and a customer which defines the minimum required system performance, availability, and financial penalties claimable in case of service shortfalls.

In the cultural and scientific heritage sector, ASP technology is most frequently employed for collection management purposes. Libraries are able to lease access to an Internet service instead of obtaining and maintaining their own library management system (LMS), and without the expense of purchasing new hardware and specialised software, or training dedicated technical staff members. Shared LMSs can be implemented among a number of libraries, and this is generally most successful for those of small and medium size. The current and potential uses of ASP in the cultural heritage sector are outlined explicitly in this section's three case studies. The first two studies – on **REGNET** and **OpenHeritage** – provide an enticing glimpse of the possibilities offered by ASP technology and shared methodologies (even at this early stage in its development), as well as suggesting future uses to which it may be put as prices fall and the idea of outsourced and shared hardware/services becomes more widely accepted. The third case study – on the **Corcoran Library** – shows the benefits that can be gained from ASP deployment on a smaller and more immediately practical scale. The use of ASP in libraries and archives is expanded in the scenarios which follow, coupled with valuable advice for those with a new-found interest in the technology. It is expected that developments in this area will lead to the formation of larger virtual repositories, each made up of resources from different heritage institutions and hosted by ASPs.[1] This seems very promising, but before it will take off much work needs to be done on rights management and interoperability. The current development of e-book technologies, which will influence the whole concept of digital library services, supports this.[2] In time these developments should lead to libraries increasingly adopting the role of content providers, a role for which ASPs may be helpful, and for which even smaller libraries ought to be prepared.

An Introduction to the Technology

Background

When the Internet first started to reach the public consciousness in the 1990s, academics and researchers saw in it possibilities for the distribution of information. As Internet users began to number in the tens of millions, its possibilities as an environment for business started to emerge. One of the most interesting and potentially revolutionary business models that the Web has enabled is known as the Application Service Provider (ASP) model for data storage, manipulation and distribution.[3]

1 *DAEDALUS, Eprints*, and *ROMEO* are just a few of the projects involved in such an approach. http://www.lib.gla.ac.uk/daedalus; http://www.eprints.org; http://www.lboro.ac.uk/departments/ls/disresearch/romeo/index.html.
2 E-books are forging links with XML. See Erin Joyce's article (April 2003) at http://www.atnewyork.com/news/article.php/2174291 for details of the overlap.
3 The acronym should not be confused with that of Active Server Pages, a **Microsoft** technology similar to PHP and Cold Fusion, used for creating dynamic and interactive Web content.

Since the 1980s, the standard practice for businesses and individuals has been to build bespoke software or to purchase licences for off-the-shelf software, and to install it on their own hardware. In large-scale cases, this has been done with the assistance of specialised IT staff and has involved intensive (and expensive) training of personnel. Nowadays the outsourcing of IT – i.e. the transfer of responsibility over components or organisational IT infrastructure, staff, processes and applications to an external resource provider – is becoming more and more popular. Some experts believe that this may be the ultimate model of computing.[4] Outsourcing has three key benefits: experienced staff are already in place, specialised tools and software are already in place, and no major investment is required at the outset. IT outsourcing providers can be divided into three primary categories:

- *Application Outsourcing providers* typically manage and maintain software applications. Depending on the actual ownership of the application this sector is sub-divided into Application Service Provider and Application Maintenance Outsourcing (AMO). The ASP remotely hosts and delivers software applications to the customers using its own computer resources. The client 'rents' access to the application. Usually this is paid on a per-user basis for a specific period of time. AMO providers manage a proprietary software application from either the client's or the provider's site.
- *Information Utilities and Business Process Outsourcing providers* focus on outsourcing solutions for business-specific processes such as finance, accounting, or payroll.
- *Platform IT Outsourcing providers* offer a variety of services, including hardware management, onsite and offsite support, and data security and recovery. These relationships typically involve the transfer of IT facilities, staff or hardware.

ASPs can offer services falling under one or more of these categories. While the ideas behind ASPs are not new, the Internet has made their implementation easier. ASP combines an early computing business concept of timesharing with the new delivery methods that the Internet can offer.

Application Service Providers

The ASP committee of the **Information Technology Association of America** (ITAA) defines an ASP as 'any company that delivers and manages applications and computer services to subscribers or clients remotely via the Internet or a private network.'[5]

In recent years, companies have been set up exclusively as service providers, and established software vendors such as **Microsoft** have launched their own ASP departments or subsidiaries. These companies offer a wide range of services, including (but not limited to) e-mail, customer relationship management (CRM),[6] human resource management, virus checking, and financial services.

4 http://www.ameinfo.com/news/Detailed/16721.html. Other experts disagree. Tom Siebel, CEO of **Siebel Systems**, insists that 'the hosting business model has no merit' (http://www.aspstreet.com/archive/d.taf/what,show/l,pv/sid,25/id,18541), although the links between ASPs and Customer Relationship Management are growing.

5 http://www.itaa.org/asp/presentation/harris.ppt

6 On the application of CRM to the cultural and scientific heritage sector, see *DigiCULT Technology Watch Report 1*, 2003, pp. 21-40.

The concept underlying ASPs was developed in the 1960s and was exemplified by the timesharing of mainframe applications. Now it combines new facilities for delivering data, software and services over the Internet. Thus, the fundamental shift is in the way organisations acquire and utilise their business functionality. Timesharing all but disappeared as minicomputers and eventually PCs became cheaper and more efficient. Factors that contributed to the rebirth of rental schemes include:

- The model provides small and medium-sized companies with a level of service that they could not otherwise justify financially.
- The model gives maximum flexibility to the customer, organised on a 24x7x365 basis. This contributes to increased market competitiveness, which will be of special importance for organisations that depend on e-commerce but that cannot maintain round-the-clock support for their technical services.
- By reducing the total cost of operation (TCO), ASPs offer organisations the ability to use a broader suite of applications than they could otherwise afford.
- The Internet has become more popular, faster and more secure, thus increasing the chances for stable development.
- The dramatic fall in telecommunication costs combined with the speed and robustness of modern communications services has made remote ASP provision viable.

In a traditional setting, the ASP owns the hardware, the software licences, and employs the technical staff. This leads to one essential problem with the ASP model: while services can be customised to some extent, ASPs tend to offer standard solutions, which may not meet entirely the specialised needs of some customers. For this reason, ASP providers tend to concentrate on specific, niche business areas, ensuring that the services they offer are as close to those required or desired by their target market(s). It is also possible to mix and match ASP solutions with standard software packages on a modular basis.

Principles of ASPs

Fundamentally, ASP technology offers shared access to software and computer infrastructure services at lower costs than would be possible on an individual basis. Using ASPs, IT departments in cultural heritage institutions will not be involved in the development of specialised software from scratch, but will concentrate on local maintenance and customisation. ASP brings the cultural heritage sector access to integrated systems without the costs of in-house development, maintenance or operation. The number of support staff can be reduced, as can the need for high-end servers. Responsibility for data security and server level backups can be transferred to the ASP.

ASPs: Putting Fears to Rest

Confidence is a vital factor in the adoption of any technology. With ASPs, for example, many risk-conscious decision-makers will feel uneasy about the prospect of handing their control over storage and dispersal to a third-party organisation. Other concerns that often delay institutional acceptance of the ASP model include:

- *Data security*. One of the main challenges to adoption of the ASP model is the uncertainty that may accompany the security of proprietary information. It is common for organisations to demand more stringent security standards from ASPs than they might impose internally.
- *Service and support quality*. Availability, scalability, bandwidth capacity, and data and network redundancy are examples of performance concerns that need to be addressed. Service level agreements (SLAs) can help to establish performance expectations and ensure that both the service provider and the service user have a clear understanding of their respective obligations and the mechanisms for resolving conflicts. Many SLAs do not incorporate adequate ways of measuring performance levels and of auditing security and backup services provided by the ASP. In both of these instances compensation for breaches of service delivery are unlikely to make up for the losses that could be incurred.
- *Scope and flexibility of services*. Customers expect that their ASP will possess the necessary competence to construct the appropriate implementation and infrastructure to meet their needs. At the same time, they expect their specific needs to be addressed. This balance is not easy to achieve. For fields such as library management systems this might not be too serious a problem, since such systems are based on widely accepted standards and levels of service.
- *Adaptability of software*. Little software today is truly Web-enabled. Widespread take-up of ASP services and their cost-effective delivery depend upon the increased availability of Web-enabled applications.
- *Financial security*. When evaluating an ASP, potential customers should consider the provider's financial status, customer base, business experience, and profit strategy, regardless of whether the customer has making a profit a primary objective.
- *Coping with unexpected circumstances*. Potential customers should examine worst-possible-scenario situations before signing up with an ASP. Does the ASP distribute its data service? What back-up auditing services do they have in place? What is the maximum downtime in the event of a disaster? What levels of redundancy do they have in place?
- *Audit*. Does the ASP have arrangements for independent audit of its services and working practices?

Where ASPs are Currently Used

A 2001 study[7] found the most popular ASP applications in the US to be: communications (33.6%), financial and accounting (24.8%), e-commerce (21.2%), CRM[8] (19.0%), education and training (18.2%), human resources 13.1%), project management (9.5%). Details of the primary fields where ASP services are offered are easily identified by visiting www.aspstreet.com or www.internetasplist.com. While the cultural heritage sector does not yet appear in these, there are examples of companies outsourcing management

7 *ASP e-data: Top ASP Applications are Communications, financial ZONA Research tracks market opportunities*, February 2001, http://www.itaa.org/isec/pubs/e20012-05.pdf

8 See Bob Weinstein, "ASPs grab a Piece of CRM Market" in ASPStreet (April 2003) for more on the relationship between this technology (covered in *DigiCULT Technology Watch Report 1*, pp. 21-39) and the growth of application service providers. http://www.aspstreet.com/archive/d.taf/sid,25/id,18541

systems that are focused on memory institutions, and in particular museums and libraries.

This table shows the most popular services offered currently by ASPs.

Instant Applications	Site building	Site services
	E-commerce	
	Info sharing	Backup and Storage
		E-mail & Messaging
	Administration & operations	
	Specialist	
Serviced Applications	Customer Relationship Management (CRM)	
	Financials	
	Info sharing and management	Email & Messaging
	Specialist (Web site services)	
	E-business	
	Human Resources	
	Vertical Markets	
	Enterprise Resource Planning (ERP)	
	Manufacturing	
	Desktop Applications	

As newcomers on the IT market in the late 1990s, ASP services were met with substantial interest, accompanied by rapid industry growth. According to consultants **IDC**,[9] worldwide spending on ASPs is estimated to grow from over €850M in 2000 to around €20,450M in 2005. Other studies make more conservative estimations, but the basic trend is towards growth. IDC predicts that the spending on ASP services in Europe will reach €4,930M by 2005. The activity of the ASP industry is still lower in Europe than it is in the US. Non-profit organisations may stand to benefit from the ASP approach. A case study by the Collaboratory for Research on Electronic Work (CREW) at the School of Information, **University of Michigan**, has examined the impact of ASPs in the US national network **NPower**.[10]

Initially, many companies offering any type of services referred to themselves as an ASP, regardless of whether or not they delivered applications or simply access to the Internet. Vendors nowadays are far more precise when defining the type of service they offer, hence many providers use custom acronyms which are more descriptive of the services they offer (e.g. management service providers use *MSP*, storage service providers use *SSP*). The growth in the numbers of service providers has given rise to the term *xSP*, where 'x' stands for a term which describes the nature of the services provided.

There are three types of company with a vested interest in the development of the xSP market: multinationals (including telecommunication companies, IT services companies, consultants), organisations experienced in providing outsourced services, and brand-new small companies dedicated to ASP provision. As this might suggest, the ASP industry is still largely fragmented. The xSP market has grown as customers increasingly realise

9 http://www.idc.com

10 http://www.npower.org/. For further introduction to ASP and non-profit approaches, see Thomas Finholt, "An Introduction to Application Service Providers", in *DigiCULT.Info 5* (October 2003), available online at http://www.digicult.info/pages/newsletter.php

cost savings, enhanced levels of service, and improved convenience. However, it will be the return on investment that customers receive from these services, whether measured by cost savings, revenue generation, or some other added value, that will determine the success of the approach.

When exploring the options of using an xSP, potential customers should weigh the advantages of saving time, lowering capital expenses, and making better use of personnel resources against the potential challenges, such as legacy integration, xSP financial viability, and complexity of service level agreements and contingency plans.

How ASP Technologies Work

Technological Factors Influencing ASPs

The technologies and advances that have stimulated the growth in popularity of the ASP model include but are not limited to:

- *Internet ubiquity*. The expanding capabilities of the Internet and the ongoing development of Web-enabled solutions have enabled the transition from in-house application management to a hosted solution.
- *Increased accessibility and declining cost of bandwidth capacity*. Improvements in communications networks combined with the fall in bandwidth costs have made ASPs viable.
- *Internet familiarity*. The straightforward and familiar user interface of Internet browsers has had a direct effect with the increase in popularity of Web-enabled solutions.
- *Potential of e-commerce and e-learning applications*. Concerns expressed by the e-commerce and e-learning sectors regarding security and reliability are similar to those expressed by potential ASP users. As e-commerce and e-learning developments offer solutions to these challenges the wider acceptance of hosted applications should be improved.
- *Shared applications in a client/server environment*. The similarity between remote access technologies used by the ASP model and the application delivery model of client/server architectures with which users are already familiar also helps.

Service Level Agreements

Organisations that choose to use outsourcing of software and services via the Internet should carefully consider a strategy to protect their data. Service Level Agreements (SLAs) are written agreements which 'seek to define what service the IT department will provide to users of specific applications or systems.' These are now a standard part of business practice. *Conspectus* reported that eighty-two per cent of companies were using SLAs to define their expectations and contingency plans in the event of a service failure.[11]

It may be difficult to couch these SLAs in sufficiently precise legal terminology. In the same survey, *Conspectus* discovered that only forty-six per cent of organisations use

11 Pat Sweet, "Storage at a price", *Conspectus*, May 2003, p. 4.

legal terms in their SLAs. Many SLAs are outlined in technical terms alone, or with a combination of the two different approaches.

A well-planned and well-maintained SLA should include:

- Definitions of terms related to the nature and length of contract and service;
- Expected response times for ASP services;
- Nature and availability of helpdesk support;
- Minimum bandwidth availability;
- Financial penalties in the case of system malfunction;
- Procedures for addressing breaches of the SLA before having to resort to a court of law.

It is not an easy task to put together a good SLA that anticipates all potential problems. A good starting point is to consult other institutions with experience of drafting and finalising an SLA. Model SLAs are available for purchase online from the **Consus Group**, and can be difficult to find without payment.[12]

The more specific the clauses in the SLA, the clearer the relationship between the ASP and the customer. For example, an e-commerce company with an annual income of €1,000,000, using an ASP for orders, could lose about €100 per minute if the order system malfunctions or becomes temporarily unavailable. This calculation is based on the assumption that the orders are distributed evenly throughout the twenty-four hours. In fact, if the company has peak hours of business, such losses may well exceed €1000 per minute.

ASPs and the Heritage Sector

Brief Background

The use of ASP in the cultural heritage sector is still exceptional, and despite the potential financial and organisational benefits the decision to change from a locally held and locally maintained system to an ASP service is not an easy one to take. ASPs offering services designed to meet the needs of heritage organisations are rare, if not unknown. The most popular use of ASP in the cultural heritage sector is in place of traditional LMS software in libraries. By managing library collections through leasing access to the Internet, two expensive investments – obtaining and implementing an LMS in the library, and additional staff salary and training costs – can be eliminated. Cataloguing, collection management, and access provision for library staff and users can be accomplished through a Web interface, as the case study on the Corcoran Library, below, demonstrates.

Some of the companies participating in this specialised field offer free service for very small collections, often defined as those with around 5,000 titles. Additional storage and product support may be offered to organisations undertaking service subscriptions. Records are usually provided in MARC format, which means that they can easily be acquired from the library's existing electronic records. When such databases are used as

12 http://www.consusgroup.com

a cataloguing resource, the library staff will be freed from the task of entering existing records. In hardware terms, the library only needs a standard Web browser installed on one or more desktop PCs with Internet access.

While the features offered by ASPs vary hugely, tasks such as hardware upgrade, repair and replacement, and data backup, security and restoration would typically be undertaken by the ASP. Other typical activities likely to be supported by the ASP include data migration from the existing cataloguing system, the creation and storage of user profiles, running specialised software functionality, report preparation, and staff training and support.

An emerging trend is the bringing together of the management systems of small and geographically distinct institutions, such as networks of museums or other memory institutions. As a result, their catalogues form a set of joint resources that can be searched through a shared information portal.[13] It should be stressed that this requires a degree of interoperability for which relatively few cultural heritage organisations are prepared.

A fine example of regional deployment of ASP technology is in the ongoing development of **Culturenet** across Europe.[14] Management of the Dutch Culturenet site, for example, will be assisted by the use of an ASP application called the *DEN-box*. This will enable smaller institutions to participate more fully in Culturenet's activities, and to boost their public profiles. The planned system will offer functionalities ranging from simple presentation facilities to a fully Web-oriented information system. Institutions will be able to enter and update their own information without the administrative headaches that can often be caused by the development and maintenance of a full-fledged Web site.[15] In a bid to improve access to English-language Web sites, the Human Language Technologies (HLT) *Fast Translator supporting B2B-ASP applications* project (FASP) aims to integrate a translation service as part of a multilingual business-to-business (B2B) application. The project's objective is to test a multilingual translation support tool (called *Logos*) by incorporating it into a B2B application running within an ASP environment.[16]

Case Studies

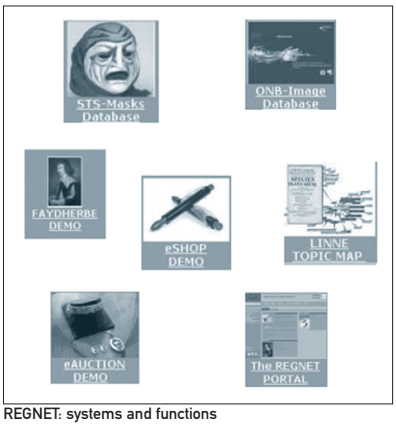
REGNET – Cultural Heritage in Regional Networks[17]

The role of the Internet and the application of new technology and tools covering areas such as eBusiness and ePublishing are increasingly significant to the cultural heritage sector. These developments put institutions in a situation where they must choose between (1) establishing an in-house technology department, including the possible contracting of technology and standards experts/consultants; and (2) using a specialised service centre for the storage and delivery of their systems. The former option has been found to be

13 See the section on the *XML Family of Technologies* (below) for case studies on **Pouce** and **COVAX**, both of which used XML to ensure interoperability for a similar end.
14 A list of Culturenet sites can be found at http://www.kulturnett.no/artikkel.php?navn=kulturnett+-+i+verden
15 http://cult.kulturnet.dk/pt2.htm
16 http://www.hltcentral.org/projects/detail.php?acronym=fasp
17 While this case study focuses mainly on the project's ASP-related elements, it should be noted that REGNET covers a number of other areas beyond ASP, including a service infrastructure and online cataloguing tools. These activities are detailed extensively on the project's Web site, http://www.regnet.org. This case study is based upon an e-mail questionnaire completed by Dr Walter Koch of **AIT Angewandte Informationstechnik Forschungsgesellschaft mbH**, Graz, Austria, and Andrea de Polo of **Fratelli Alinari**, Florence, Italy, in October/November 2003.

good policy for large, national and well-funded organisations, while small and medium-sized organisations are most likely to derive better advantage from the ASP model.

REGNET is a part EC-funded project aimed at generating a set of technical tools especially for use in cultural heritage institutions. These tools include data entry based on cultural heritage description standards and topic maps, and they are packaged together in specialised systems, with a clearly defined infrastructure and legal framework for the creation of shared cultural service centres (CSCs).



© REGNET
REGNET: systems and functions

The REGNET consortium was huge,[18] involving twenty-three partners and two sub-contractors from across twelve European states. The Austrian company **AIT Applied Information Technique Research Ltd** acted as project co-ordinator. Content providers (such as **Fratelli Alinari**, the world's oldest picture library) supplied material for testbed cases and studies. This impressive breadth of input gave REGNET the potential to become the kernel of a fully functioning network of service centres in the cultural heritage area. The size and range of the REGNET consortium allowed real international tests covering much of the European continent. Moreover, by implementing the REGNET concept the project was able to support the dissemination of European cultural heritage, and to facilitate the access for European citizens to catalogues of intellectual, cultural and scientific heritage stored in archives, libraries, museums, and other participating memory institutions.

Achieving interoperability between partner systems was crucial. The service infrastructure to be established had to facilitate the development of a growing network of CSCs throughout Europe. In order to provide interoperability between catalogues held at geographically separate institutions, the semantics for collection description had to be harmonised. Dublin Core metadata was used together with Z39.50-related standardisation work, which aims to create a compatible search and retrieval facility across different domains. The interoperability of open access catalogues was of great importance to REGNET, since this enabled the dynamic generation of shopping system catalogues based on user input. Platform management relied on the latest Internet technologies, which provided a solid basis for the middleware to act as an agent between end-users and the suppliers of services and content.

XML/XSL markup was used to structure data semantically and hierarchically. This had an effect on metadata creation, describing real objects, media objects, and bibliographic-type objects in a strict and multi-usable manner. All information within REGNET's business transactions was wrapped in XML structures, and recent developments in the field of XML business standardisation were also implemented here in the shape of ebXML[19].

REGNET provides building blocks for setting up a service infrastructure for organisations and users in the cultural heritage sector. These blocks (known as 'nodes' in the REGNET terminology) support access to cultural and scientific information as well as

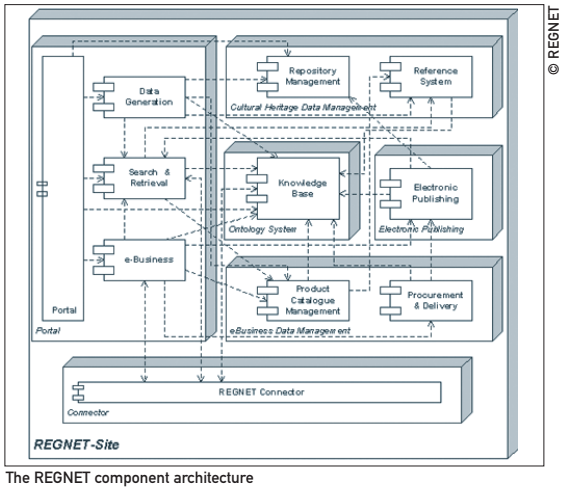
18 The project had a total budget of €5,038,000 (48.6% EU – 51.4% partners), and ran for a period of twenty-four months from 1 April 2001 – 31 March 2003. Its reference number is IST-2000-26336.

19 See the sections on the *XML Family of Technologies* and *Rights Management and Payment Technologies* for more on XML/ebXML

to product and service information offered by different organisations. They consist of:

- The REGNET-Portal, for remote data entry, distributed searching, and e-Business;
- The REGNET-Cultural Heritage Data Management node, allowing searches across distributed cultural heritage metadata repositories;
- The REGNET-e-Business Data Management node, offering access to distributed goods and services catalogues via the e-Business system;
- The REGNET-Ontology Checker, containing specifications for metadata and terminologies used in the e-Business and cultural heritage field;
- The REGNET-Electronic Publisher, which supports the production of personalised digital products based on standardised metadata and workflows.

The figure below outlines the interaction between these components:



© REGNET

The REGNET component architecture

As far as possible, open source technologies were used. This ensured platform- and editor-independence, and reduced costs. XML technologies are becoming increasingly ubiquitous, and have to be recognised in data/metadata representation, integration, presentation, and other areas. Project co-ordinator Dr Walter Koch of AIT Angewandte Informationstechnik Forschungsgesellschaft feels that REGNET has provided a real business case for the use of XML in the cultural sector.

REGNET's partner organisations were either content providers or developers. The technical partners reused existing applications and software components, thereby avoiding duplication of effort. The project has held additional benefits for the content provider organisations too: as Andrea de Polo of Fratelli Alinari says, 'The REGNET project has been very important to us. It has helped our company to gain a better understanding of new protocols such as XML and the uses of metadata, as well as providing a database solution that can be accessed and shared with other repositories across Europe.'

The service centre concept lay at the foundation of the REGNET project. This concept is increasingly relevant for small to medium-sized cultural heritage institutions, and perhaps also for larger cultural organisations that prefer to keep up with the latest developments in technology by drawing on the services of an external service provider. The REGNET team carried out a preliminary survey of existing concepts in this field, including the experiences of the **Art Museum Image Consortium** (AMICO) and the **Research Libraries Group** (RLG).[20] Neither initiative proved entirely appropriate for REGNET's service centre vision, but the model was adapted as a result of this work.

REGNET CSCs offer cultural heritage content users and providers access to the latest

20 http://www.amico.org; http://www.rlg.org

technical infrastructure and IT services, together with the capacity for storing and manipulating cultural digital objects. REGNET users can perform tasks over a dedicated servicing network, hence the anticipated benefits for non-profit organisations with limited resources. The future establishment of regional CSCs will be influenced by the diversity of national legal frameworks. The CSC approach determines the manner in which the technical infrastructure has to be configured, and each CSC must set up its own infrastructure with the necessary communication links. This is combined with a generic, adaptable portal interface for customer use, and may be tailored in response to local or regional market needs. REGNET's technical modules may be held on a single server, or be spread across a number of servers, either local or remote.

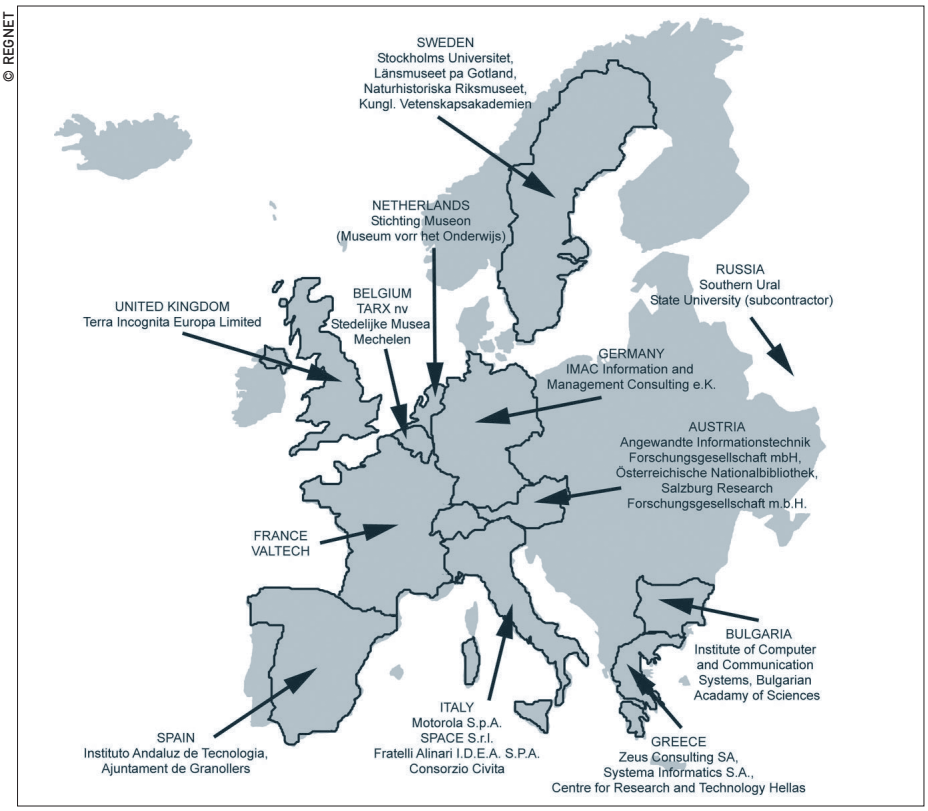
The CSCs thereby form a network of services, both technical and business-related. Each CSC will have its own specific functionalities and competence, and each CSC need not contain all of the functionalities provided by the greater REGNET project in order to utilise them; quite the opposite in fact, as all functionalities and competences of the network are available to all particpating CSCs thanks to their interconnections. A CSC must offer an adequate offline infrastructure in order to carry out presentation, demonstration, education, and test sessions to dedicated groups of users or potential customers. The shared backup performed between CSC databases provides protection against data loss and security breaches.

Within the project's EU-funded phase it engaged the global marketplace and attracted further content provider partners. A number of cultural heritage institutions (including the **MAK - Austrian Museum of Contemporary/Applied Arts**, the library of the **University of Veterinary Medicine** in Vienna, and the archive and library of the **Sigmund Freud Museum**)[21] have decided to use REGNET services.

On the whole the project has made it possible for a number of international content providers to go one step further in the Internet field: to digitise, to establish a virtual catalogue, and to offer their services and products on an eBusiness platform. Moreover, the various demonstrations and guidelines developed within the project provide for players in the cultural heritage domain a valuable decision-making resource. CSCs now exist or are currently being established in Austria, Spain, Bulgaria, Germany and Switzerland, and Belgium and The Netherlands. There are plans to establish CSCs in Greece and Italy as well. The pan-European CSC will offer future activities as organisational and technical frameworks for new project operations, as well as for regular business activities.

Since the end of the project's EU funding, the partners have been supported by the newly established framework organisation **CSC Europe EEIG**.[22] This organisation governs and manages the existing tools and services, and aims to integrate new research developments, extend the network, and generate income through its services. In addition, project results and findings are at the moment implemented in various national projects, including the extension of the CULTIVATE-Services in Austria and the cataloguing of cultural heritage resources in Italian regions. CSC Europe is now considering offering its services beyond the cultural heritage domain, and to any customer with an interest in the generation, publishing, use, and preservation of digital information in general.

21 http://www.mak.at; http://www.vu-wien.ac.at/bibl/; http://www.freud-museum.at
22 European Economic Interest Group



REGNET: Map of participating organisations

REGNET Project Participants (twenty-three partners and two subcontractors in twelve countries):

Austria: Angewandte Informationstechnik Forschungsgesellschaft mbH; Österreichische Nationalbibliothek; Salzburg Research Forschungsgesellschaft m.b.H.; Universität Wien (subcontractor);

Belgium: TARX nv; Stedelijke Musea Mechelen;

Bulgaria: Institute of Computer and Communication Systems, Bulgarian Acadamy of Sciences;

France: VALTECH;

Germany: IMAC Information and Management Consulting e.K.;

Greece: Zeus Consulting SA; Systema Informatics S.A.; Centre for Research and Technology Hellas;

Italy: Motorola S.p.A.; SPACE S.r.l.; Fratelli Alinari I.D.E.A. S.P.A.; Consorzio Civita; ,

Netherlands: Stichting Museon (Museum vor het Onderwijs);

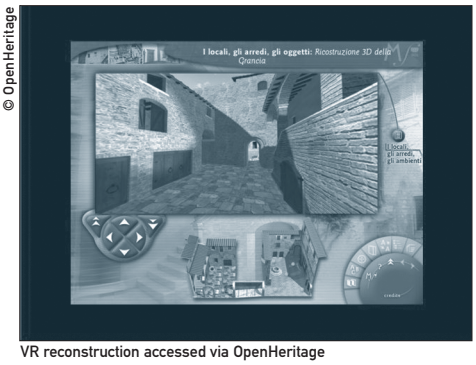
Russia: Southern Ural State University (subcontractor);

Spain: Instituto Andaluz de Tecnologia; Ajuntament de Granollers;

Sweden: Stockholms Universitet; Länsmuseet pa Gotland; Naturhistoriska Riksmuseet; Kungl. Vetenskapsakademien;

United Kingdom: Terra Incognita Europa Limited.

OpenHeritage – Enabling the European Culture Economy[23]



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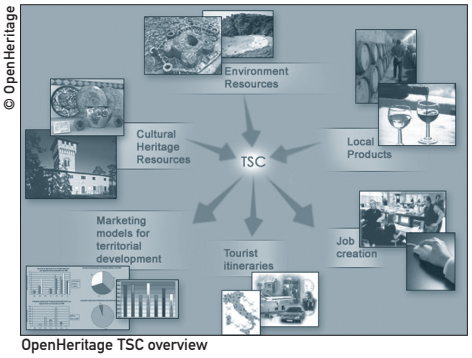
VR reconstruction accessed via OpenHeritage

OpenHeritage is a European Commission part-funded project with a duration of twenty-four months between January 2001 and December 2002. Among its aims were the creation of an IT infrastructure for improving access to regionally held cultural heritage collections via the use of Application Service technologies, and the development of a 'culturally driven' economy for contributing to local/regional economic development.

The project coordinator and partner responsible for the main technologies of the ASP was **Space S.p.A.**, an Italian company with an annual turnover of more than €1.5 million, and around thirty-five employees. Space is controlled by the Atlantis Group, which is itself a sort of agency of the Italian Ministry of Industry and Technological Innovation.[24] Of the other ten consortium members, eight were based in EU member states and two were from outside the Community.[25]

An understanding of OpenHeritage's concept of the *Territorial Service Centre* (TSC) is of key importance. TSCs are virtual portals which support memory institutions in the tasks of facilities management, customer relationship management, storage, promotion, and transaction services, all carried out through deployment of a new model of cultural ASP. The technologies used for the OpenHeritage ASP were decided upon mainly by the staff at Space, with **System Simulations Ltd** taking primary responsibility for the collection management module. The technologies deployed on the project had been found by the partners to match their technology requirements most closely.



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OpenHeritage TSC overview

Each TSC uses an **Apache/mod_perl v. 1.0** Web server, running the Perl programming language (v. 5.8) and a **PostgreSQL** database (v. 7.2.1). Two distinct modules were developed for use with the TSC system: *Templator* – a template parsing module, and *XDB* – a module for managing XML data using a **Postgres** relational database as the data repository. The system also employs two distinct protocols for data

23 This case study is based on e-mail communication between Salvatore Lusso and Aaron Craig of Space S.p.A. and Martin Donnelly of DigiCULT/University of Glasgow. Other information has been gained from the OpenHeritage Web site, http://www.openheritage.com/. The case study process took place during July 2003.

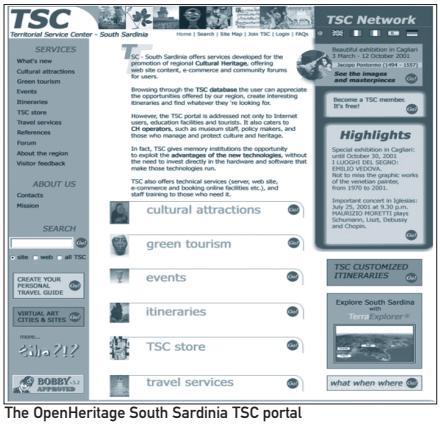
24 http://www.spacespa.it/

25 The other members of the consortium were **System Simulation Ltd** (England), **National Museums of Scotland, Musèe Historique des Tissus de Lyon** (France), **Museo Archeologico Genna Maria** (Italy), **Stichting Museon** (Netherlands), **Culture Heritage On Line S.A.** (France), **Centro di Ingegneria Economica e Sociale** (Italy), **Cultural Service Centre Austria**, the **Association for Documentation and New Information Technologies** (Russia) and **Digital Publishing Japan**. The project's total budget was €4.3M, of which €2.1M was EC-funded.

transfer: *OAI Harvester*, which connects the collection management system to the TSC database,[26] and *HTTP*, which is used for viewing and managing the TSC portals in a similar way to a standard Web browser.

The OpenBase kiosk system for use inside the museum runs through a standard **MS Windows** intranet, and communicates with the collection management system through standard HTTP. The collection management system runs a simple Web server for use inside the local network. The kiosks can be set up to allow public access to this Web server, thereby allowing museum visitors to browse the collection management system. The collection management data are made available to the TSC portal through the OAI Harvesting Protocol. Through this portal users can ask the collection management system for data about a museum's collections. Once imported into the TSC's database, this information can then be made available to the public through the portal Web site. The data on the TSC portal are managed by staff through a browser interface. Images can also be imported to the server using FTP.

The set-up technology is very flexible and can be configured to meet localised requirements. The consortium has anticipated potential difficulties in providing support for unique installations across Europe. The technology product has therefore been packaged in different modules, in order to give the client the opportunity to choose full-feature or 'light' versions of the product.



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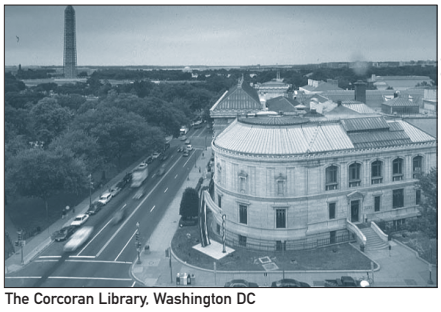
The OpenHeritage South Sardinia TSC portal

The prototype model is now (July 2003) ready for the market. According to Space's Salvatore Lusso, in some ways it feels as if the project is anticipating the market, and addressing an almost unexplored market niche with no competitors yet present. The primary innovation that the OpenHeritage team feels its work has brought to the cultural heritage sector is the integration and combination of different technologies for the purpose of financial gain, not only to individual enterprises or institutions but also to local areas. Its innovation lies in both its technological and business models.

The Corcoran Library, Washington DC[27]

Founded in 1869, and situated only a stone's throw from the White House, the Corcoran is a major player in the American art world. The museum is the third oldest in the country, and houses an impressive collection of American and European masterpieces. The museum sits side by side with the Corcoran College of Art and


© Corcoran

The Corcoran Library, Washington DC

26 http://www.oclc.org/middleeast/en/research/software/oai/harvester.htm
27 http://www.corcoran.edu/library/. This case study is based upon an e-mail questionnaire completed by Claudia Covert, the Corcoran Library Director, in Autumn 2003. Subsequent information comes from their Web site, and other sources are indicated in footnotes.

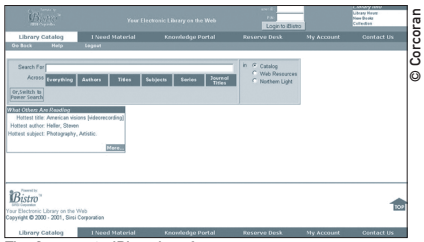
Design, one of the most distinguished art schools in the United States, and the organisation's mission is to be 'dedicated to art, and used solely for the purpose of encouraging the American genius… a living monument to art and American creativity.'

The Corcoran Library is open to all of the College's 3,500 students and staff, and hosts approximately 28,000 items. For eleven years prior to implementation, the Library had been considering investing in a computerised system, but the initial costs involved (buying the software, hardware, and barcodes) and lack of experienced staff meant that this seemed near impossible. Cost was a big factor in deciding how to proceed. The Library began looking for other ways of automating its work, finally settling upon the ASP model which was felt to offer quality at an affordable price.

Library automation includes tasks such as replacing a card-based system with a machine-searchable online catalogue, facilitating circulation tasks such as using the system to track check-outs, sending reminders about overdue items, report production, tracking serials online, placing items on reserve online, allowing patron-initiated renewals online, and a message centre for staff and users of the Library. At the time of initial enquiry (2000), many library automation vendors did not offer ASP, and (as is still the case) the exact definition of ASP differed from vendor to vendor. For example, it varies between companies whether the client is expected to buy and maintain their server with the vendor providing and maintaining software, or if the vendor provides and maintains *all* the necessary hardware and software. To come to a decision, the Library staff considered a variety of ASP products, and consulted colleagues in the field. Two nearby art libraries had recently chosen ASP products; one was migrating from a mainframe system to ASP, and the other was automating for the first time. Further research was then carried out on ASP in general, and how it was being deployed in other sectors. After much consideration, the Library selected **Sirsi**.[28]

According to Library Director Claudia Covert, time was a definite factor in introducing the technology: the college was facing accreditation and the Library had not fared well in the last accreditation, with assessors strongly recommending automation. The staff therefore had less than twelve months to accomplish this task. The contract with Sirsi was signed in May 2001, and the system was up and running by autumn, with the implementation hailed by Covert as 'fast and smooth'. In June the tape of records from the **Online Computer Library Centre** (OCLC)[29] was sent to Sirsi, by August the online catalogue was completed, and in September the staff began cataloguing online. Online circulation started in October, and reserves lists went online in January. The longest phases of the rollout were barcoding, entering serials records, and working out migration issues such as those described below. Barcoding started in September, as a joint effort between temporary student workers and permanent staff. The barcoding process was completed within nine months, but it took around a year to take the manual serial check-in system online. Each serial title record needed to be found and uploaded from OCLC, and then the Library's volume and issue holdings contained on check-in cards had to be entered manually.

The project's budget of just under $29,000 (€24,500) was divided into fifty-seven per cent for the system and forty-three per cent



© Corcoran

The Corcoran's *iBistro* interface

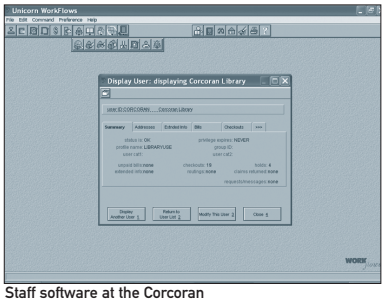
28 http://www.sirsi.com
29 http://www.oclc.org

for computers, barcode scanners, barcodes, and other hardware. Additional budgeting had to be carried out due to the fact that, as is standard among ASPs, SIRSI.net charges annually by user, with the Library paying a base annual fee and then a fee for each of the three user licences. These three licences are spread among three full-time and one part-time members of staff, and ten student workers and interns, each of whom dedicated one day per week to the project over two full semesters. Distinct staff roles were kept to a minimum for the development and rollout of the automation system. Essentially Covert acted as the Library contact/systems librarian and as the IT database person, with a lawyer being drafted in to look over the contract before it was signed, as well as a consultant from Sirsi who guided the staff through the initial phases of the rollout. A staff trainer came in to the Library for a week-long training course, and after that the staff were able to call Sirsi's helpdesk with issues as they arose. Help manuals were provided in paper and online formats, and divided by subject area. As this was the Library's first automated system, its impact on the staff was significant, but difficulties were minimised by learning from the experiences of other comparable libraries.

Since the first professional librarian was hired to run the Library in 1981, the Library has catalogued using OCLC, therefore all modern records were available electronically. Prior to this, all records remained in paper format. The staff found some difficulties adjusting to format differences between the OCLC system and that of the ASP. Many records had an unnecessary double bar in the title field, and, while this did not affect searching, it was considered unsightly. A report was run which detailed the offending records, and the staff were able to fix it. Diacritics were also not displaying correctly, and – since the Library has many foreign-language publications – fixing this was considered very high priority. The problem was solved using a special overlay from the vendor. Another problem arose once the records were loaded. The staff realised that stack locations had not been included on the OCLC records, but using the computerised system they were then able to run reports for where books were located, and correct these records manually.

Overall, the implementation of ASP technologies has been very successful in the work of the Library. Rollout has set an example for colleagues both inside and outside the institution, and administrators indicating how fast the staff were able to get the system up and running, and how cost efficient it is. With the benefit of hindsight, Covert feels that she would have hired people to do the barcoding so that it could have been done in teams and faster with fewer mistakes, less training, and with the ability to correct records. More preparatory and ongoing training for the staff is something that may also have been beneficial.

In terms of cost benefits, it will take many years of renting to equal the cost of buying a system outright. The biggest cost savings is in staff, and no additional Library or IT staff have been required – although a stable Internet connection must be maintained! While the introduction of ASP did mean new responsibilities for the Library staff, there was no additional pressure placed on IT people.



© Corcoran
Staff software at the Corcoran

Future plans for technological development, specifically in relation to the ASP, include moving away from slides and towards digital images. To this end, the staff are looking into the possibility of renting digital imaging software to search and project these images. No formal evaluation has been carried out on the new system, but informal evaluation has been positive. The staff main-

tain a list of problems and suggestions for their vendor, and these are dealt with satisfactorily. Once the system has been in place for five years, the Library plans to carry out a formal evaluation, comparing their system with those of other vendors and institutions.

Scenarios

A Group of Libraries – Using SLAs for collections management

A small regional library is having difficulty in allocating sufficient financial and human resources to maintain its growing collections database, particularly the range of e-journals to which it now subscribes. The library is invited to take part in a joint ASP initiative being put together by other similarly sized libraries, which it is hoped will act as a joint portal for searching and maintaining their datasets, while at the same time offering improved services to its patrons. It all sounds very straightforward, but the librarian needs to be convinced that this is a stable technology and one which will benefit both the library's patrons and its staff, who at the moment are sorely overworked. After carrying out some independent research into the current uses of Application Service Providers by larger libraries in the sector, she decides to join the expanding group. For some months the institutions engage in preparatory discussion and fact-finding via an online bulletin board and mailing list. Finally representatives from all of the libraries meet up face-to-face to discuss what the system should do and how this functionality can be guaranteed.

The representatives are aware that they need to negotiate a Service Level Agreement with their chosen vendor, which will set down in clear and quantifiable terms the expectations that the libraries have for their project. The trouble is that they are unsure what such an agreement should contain. They seek advice from contacts with experience in this field.

The first issue the service provider wishes to cover in the agreement is the percentage of uptime availability. For most business clients, an acceptable percentage will lie somewhere between 99.9% and 99.9999%; over the course of a year this corresponds to a range of between eight and three-quarter hours to as little as five and a quarter minutes of downtime. For a library, such high levels of uptime are not mission-critical, and so the librarians feel they can sacrifice some uptime for a lower cost service and/or improved alternative services. The service provider is willing to make this trade-off, as Internet downtime can be costly for providers if they do not cover themselves from the outset, particularly in sales-driven environments.

Nevertheless, the service provider still wishes to include a number of exceptions to the uptime clauses in the agreement. These will include hardware failure on both sides (which is less common), problems with telecommunications or routing over which the ASP has no control, negligence on the part of the library consortium, hacker attacks, and scheduled maintenance, which will be programmed for the libraries' least busy periods. The librarian reflects that it is a good thing that the libraries are all in the same time zone, or this could prove a problem with different periods of activity causing problems in scheduling downtime.

Further issues the libraries will have to consider include technological impermanence, data loss, and changes in the ways in which users are now approaching the content they offer. The service level agreement will not resolve all of these problems in a single stroke, but the libraries must ensure that their provider is able to adapt to changing demands,

and that the agreement allows for a certain degree of flexibility. It is also essential that the agreement includes a get-out clause for the libraries if the provider consistently fails to meet expected targets, as this may well be a cheaper option than seeking recompense in the courts.

A Video Repository – Accessing an existing collection

A large regional library conducts a survey of the habits, preferences and requirements of its users. While the results show that most of its facilities are satisfactory, the survey identifies an under-utilisation of the library's significant collection of videotapes. This collection spans several decades, and includes educational, entertainment, and miscellaneous materials from professional companies, amateur hobbyists, and regional documentary filmmakers.

The head librarian conducts a further study into why the collection is not achieving its potential and the results, garnered mainly from questionnaires and interviews, include the following points:

- Library users feel that the steps required to watch a video (searching the catalogue, collecting the tape from the video desk, finding the programme/clip required, rewinding the tape afterwards) make using the collection very arduous.
- Users often do not find exactly what they are looking for – especially in the case of short clips.
- Whilst textual metadata is helpful in identifying videos, many users of the amateur collections have little knowledge of information beyond the title/keyword and instead recognise programmes visually.
- The video room is small and often extremely busy. As the library has several hundred computer workstations, most already with video cards installed, users would prefer to be able to view the videos from these PCs.

The library has an additional problem in that it owns over 100 Betamax tapes and, with the production of Betamax players having been phased out, the librarians are worried about future access to the contents of these tapes, as their own Betamax player is unlikely to last more than a few more years.

The head librarian decides that an ideal solution would be to digitise some of the video collection. She would like all of the 'shorts' to be available for viewing over the library network (although this is not practical for longer programmes) and feels that it is very important to improve the success of catalogue searches so that users can find relevant tapes more easily.

Capturing and compression of the digital videos requires both specialist technical knowledge and considerable processing power, both of which are expensive in terms of hardware and personnel. The hardware and expertise required for this project is prohibitively expensive for the library. However, while researching methods of achieving digital access, one of the staff discovers an Application Service Provider who specialises in presenting moving images over networks. The ASP is a well-established company whose clients include small film and television companies, advertisers, commercial video leasers, and one film archive.

The head librarian contacts the ASP and discovers that they can digitise moving image material from film, VHS, and Betamax as well as capturing digital video (DV) formats.

Additionally, the service includes the provision of video 'surrogates' (indicators of the video content such as storyboards or speeded-up versions, which can be downloaded much faster than the entire clip).

In this case, the surrogates are produced automatically by a specialist application that discards forty-seven out of forty-eight frames and re-assembles the remaining frames, producing a 'fast-forward' view of the clip with no audio information. Content owners are encouraged to suggest a still image (one frame) which is representative of the entire clip; this is extracted and used as a simple surrogate for the video, as well as the fast-forward surrogate. The library staff are confident that access to these surrogates will greatly improve the success of searches, and the individual delivery of short clips will remove the lengthy process of searching though the videotape.

The ASP will digitise tapes and produce quick-to-download surrogates for a one-off fee (a small discount is offered as most of the metadata is already present), and for a further monthly subscription will manage the data, handle delivery, and enforce file security (e.g. ensure that no workstation outwith the library can access complete clips). It will offer technical support to the library staff where necessary. After raising concerns about data loss, the librarians are assured that they will be provided with a backup of all data.

The ASP fees are significantly lower than the estimated cost of setting up the digital video access and, as the monthly subscription costs less than taking on a specialist member of staff, the library are delighted with this solution. Some preparatory work is required to make the most of the ASP's services, which is completed within two months, and it is agreed to employ the ASP to manage the digital video system for a minimum of five years. A study is planned towards the end of this period to assess how the use of the video collection has changed and to consider any further improvements that might be made.

Service Provision and the Digital Library – The Open Archives Initiative

Up to this point, our focus has been mainly on the 'rental model' of service provision, with organisations paying monthly fees for access to hardware, software and expertise that they could not otherwise have been able to access. There is, however, one area in which the term 'service provider' applies to something a little different. In the world of digital libraries, a definite distinction is drawn between content providers and service providers. A digital library, or an individual digital repository, will have many organisations from which it sources its content. This may be done by author deposit, or by means of content/metadata harvesting. In digital libraries, the term service provider is applied to the organisation that offers facilities to search collections, and to harvest metadata from other collections. In this scenario, a naïve librarian comes across this new meaning for the first time.

Our librarian has heard a little about ASPs, but on first reflection does not think that this type of arrangement would necessarily be of much use or relevance in her work. The library is already networked with other libraries in the local authority, but this extends no further than allowing patrons to search a single online catalogue and view the status of books held by other libraries. Rather than utilising a shared portal, the library management systems were all supplied and installed by the same company, after a successful tender process.

One day while reading a short newsletter article about the Open Archive Initiative she realises that there is more to distributed service provision than she initially thought. In digital library terms, it seems, service provision means shared search tools and harvesting mechanisms rather than rented storage space or tools.

The librarian learns that a consortium of five libraries in a neighbouring local authority is planning to carry out investigation into the design, implementation and deployment of a pilot service for wider access to autonomously created institutional resources in their local area. The venture's ultimate aim is an investigation into the plausibility of a nation-wide author-deposit repository and portal, and in particular the technical and operational demands that such a project would place on participating organisations. The librarian asks to be kept informed about their progress, with a view to expanding the consortium to include the seven libraries in her own local area.

Unfortunately, the neighbouring authority's libraries use a different library management system, and compatibility appears to be a problem. Together the librarians consult staff at larger libraries, and seek advice on the best way to proceed. They learn that interoperability will be a key factor in any future success, and that the creation of metadata must be uniform/compatible across the board if the venture is to succeed. The records that are deposited must be of a verifiably high standard, and sustained and preserved in a similar way. The co-operation and collaboration between content providers and technology vendors/experts will be of key importance here as the libraries work together to make their metadata available for examination by remotely sited users.

An umbrella organisation called the **Open Archives Initiative** (OAI)[30] provides a wide range of helpful documents and advice for ensuring digital libraries/repositories maintain compatibility for cross-platform searching and the harvesting of metadata. The OAI differentiates between the two types of provision as follows:

- *Data Providers* administer systems that support the OAI-PMH as a means of exposing metadata; and

- *Service Providers* use metadata harvested via the OAI-PMH as a basis for building value-added services.[31]

The University of Michigan's *OAIster*[32] metadata harvester provides a link between the two, its mission is 'to create a collection of freely available, difficult-to-access, academically oriented digital resources…that are easily searchable by anyone.' On 1 August 2003, OAIster held references to 1,484,767 records from 195 institutions, although this is expected to have doubled by the time of going to press.

Our librarian brings what she has learned to the table, and together the libraries of both local authorities embark on a journey towards closer compatibility and interoperability, in the hope that their work will initiate a domino-type effect towards a nation-wide digital library strategy for smaller-scale institutions.

30 http://www.openarchives.org
31 http://www.openarchives.org/OAI/openarchivesprotocol.html (Note: the PMH part of the acronym simply stands for 'Protocol for Metadata Harvesting'.)
32 http://oaister.umdl.umich.edu/o/oaister/

Choice of ASP Services over Alternative Models, Business Issues, and Related Risks

Choice of ASP Services

The following issues will influence the choice of ASP services over alternative models, such as collaborative multi-institutional infrastructures:

- *Insufficient number of skilled IT personnel*. Organisations, particularly smaller ones, are unlikely to be in a position to afford the considerable expense associated with hiring, training and retaining appropriately skilled IT personnel.
- *Pace of the technology*. The ASP model allows smaller organisations opportunities to use applications that have previously been affordable only by larger organisations – supply chain management (SCM) and CRM technologies for instance.
- *Quick implementation*. Implementation time is significantly reduced.
- *Increasing complexity of the technology*. IT departments may tend to struggle with the numerous changes and increasing complexity of technology needed to run their business.
- *Obtain technical expertise*. Many ASPs focus on a particular specialised business function or application type. This focused approach is especially relevant for cultural heritage institutions who are less likely to require general communication or administration applications, but who need (for example) collection management tools. A list of such specialised ASPs appears in the References section at the end of the Report.

Business Issues

Some of the business issues that may impact the acceptance of the ASP model include:

- **Minimisation of TCO** – The ASP offers a different type of cost model, usually based on a fixed fee depending on the functionality, server space, and/or bandwidth used by the customer. It does not take highly developed economic skills to compare the options: several hundred Euros for an annual subscription fee, against the costs for hardware, software, and staff.
- **Predictability of revenues** – The ASP model is predictable to a great extent because of the payment model involved (i.e. monthly or yearly fees). The ASP's customers are not burdened with estimating costs of implementation, nor should they need to meet the post-implementation costs through increased access charges unless these are clearly listed in the SLA or the organisation's needs deviate from the ASP.
- **Focus on core competencies** – The transfer of the implementation and management of an application to a third party enables the organisation to focus on its core competencies, especially relevant in the cultural and scientific heritage sectors where staff are often redeployed to cover technological tasks in addition to their original field(s) of expertise.
- **Improved efficiency of staff** – The elimination of application management gives the internal IT staff the freedom to improve core competencies.

Related Risks

Among the related risks, the most pertinent will be:

- **Reduced immediate control** – The ASP is running procedures for data protection, system updates, hacker attacks, and upgrade. Its competence and quality of service should be verified in advance of contract.
- **Network dependence** – System performance will depend on network connectivity, and this may raise concerns about privacy, reliability, interchange speed, as well as ownership (another control issue).
- **Security** – This is among the most important risks. The privacy of records should be guaranteed, and data loss has to be prevented. The data backup services that the ASP provides may seem a convenient solution, but nevertheless organisations should take care to make copies of their data.

ASPs can provide the support infrastructure necessary to maintain 24x7 service availability, and they ensure that software (especially operating system patches and virus checkers) is up to date.

Advantages and Disadvantages

Advantages

Quick deployment – The ASP already has in-house all the experience and equipment needed.

Cost savings – Costs for software licences are minimised, and ASPs will always offer lower costs in comparison with the development of an in-house system. The need for dedicated and expensive in-house IT staff may be minimised.

Staff – Staff time can be better used for the tasks and areas in which they are expert. This is likely to lead to increased employee satisfaction.

Reliability – ASPs should be able to guarantee their systems to be reliable twenty-four hours per day, seven days per week. Should anything go wrong, organisations can claim compensation under the service level agreements.

Disadvantages

Network dependence – Without a stable and reliable Internet connection, ASP solutions are unusable. It becomes harder for organisations to exercise control on software malfunctions. There may also be security and broadcast issues, particularly with the remote storage of personal and sensitive information.

Staff – Job losses are likely if other tasks are not available for staff previously deployed on technical work.

Custody of content – There may be a perceived lack of control over ownership if the software malfunctions, and the ASP takes time to solve the problem. Risks associated with not having a verified copy of the data on-site need to be addressed in contracts with the ASP.

Introducing the Technology

Selecting an ASP Provider

Small and medium-sized organisations, including many in the cultural heritage sector, will benefit financially by using ASPs for the outsourcing of software and services. Another driving force might be the benefits gained by bringing together resources shared by a number of small institutions.

It is worth stressing that interoperability is more complicated than it may initially appear to decision-makers. The following issues will have to be clarified thoroughly in order to avoid potential pitfalls:

- What procedures for keeping data secure does the ASP have in place?
- What are the procedures for preventing hacker attacks?
- How often are data backed up, what methods are used for this, and how is the process audited?
- What is the standard of technical and application support offered by the ASP?
- Are the business processes within the ASP clearly defined, e.g. via ISO certificates guaranteeing their quality?
- What company infrastructure and business procedures are dedicated to ensuring reliability? (The fact that the ASP industry is relatively new and in a high-growth phase may itself be considered a risk.)
- Are there contingency plans in place to deal with difficulties and disasters such as power loss, fire, or flood?
- What options are available for data migration from the in-house system(s)?
- What are the conditions for terminating the agreement? For example, will the data be returned to the customer in the case of contract termination, and if so on what media type and in what format?
- How long has the ASP been in business? Does it have a record of serving similar organisations? What do the clients have to say about its services?
- How well suited is the existing software to the organisation's needs? Can it be customised, and if so to what extent?
- Has the outsourced software been used long enough? Are there reports by current users of any specific malfunctions?
- Are the operating systems of the ASP and the user organisation compatible? If not, how quickly and easily can this be overcome?
- What is the quality of the technical support? Is there information available on the number of in-house staff and their ratio to the number of installations? Is there a reliable helpdesk in place?
- How well do the organisation's strategies for organisational development (and respective software changes) match the outsourced software? How responsive is the ASP to customers' specific needs?
- If necessary, would the ASP be willing and able to develop functionality not currently offered by the software?

- Has a financial comparison been drawn up between the forecast expenses incurred through software outsourcing, the creation and maintenance of an in-house system, or the closure and outsourcing of existing in-house operations?
- Are there any alternatives offering better conditions in terms of cost, quality of service, and support? Which of these factors is most important for the organisation?

Technological Infrastructure Issues

The primary effect that the use of an ASP will have on an organisation is an immediate simplification of the technological infrastructure, which in turn should drive costs down. This is likely to mean changes in the way the IT section functions. For example, system deployment will be speeded up, as the need for software installation is reduced, and hence efforts associated with software management will be reduced. The rules an organisation follows governing software ownership will change: since the organisation no longer acquires software, this model may be reasonable for organisations with limited capital budgets.

Staff and Policy Issues

Staff redeployment or retraining is very likely to follow the introduction of an ASP-based system, with job losses a potential side-effect. Unfortunately there is no easy way around this. Repurposing staff members – or preferably returning them to their original vocations – is of course the most pleasant option for all concerned.

The XML Family of Technologies

Executive Summary

XML celebrated its fifth birthday in early 2003. In this brief period it has become a major force in the world of information management. As well as changing the ways in which Web content is arranged and delivered, XML has revolutionised the ways in which organisations store and transfer their internal communications. The first mainstream Web browser to support XML was *Internet Explorer 5.0* in March 1999; now the most recent versions of all Internet browsers support the format. As further proof of XML's rise to near-ubiquity, approximately eighty per cent of W3C specifications since 1998 have been XML-related.[33]

So much has been written and said about XML that it would be easy to imagine that it is the instant saviour of all things technological.[34] This is, of course, not so. While powerful, XML is not a solution in itself, but a new way of approaching content structuring and reuse. In isolation, an XML file does very little, but it is through the combination of XML with dedicated 'helper' utilities that its power can be harnessed

Given a little forethought, XML can act as a resource-saving utility. Content can be stored centrally in one format, presented as XML, and repurposed/delivered as an organisation's various needs dictate. XML scales well, and early XML documents can easily be ported into cutting-edge applications and display systems, as well as augmented to allow for increased functionality and utility. The uses to which XML can be put in the reuse and repurposing of content are substantial.

The extensive breadth and depth of the subject area makes producing an overview difficult; the already extended family of XML specifications continues to grow, and an in-depth analysis of the whole family would require book-length coverage.[35] We do not aim to provide such a broad and detailed overview. The provenance and essentials of XML are outlined in brief, and then related technologies that are likely to be of the most relevance to the cultural heritage community are described. The bulk of this section is devoted to accounts of XML deployment in this sector, featuring case studies on the Pouce and COVAX projects, to name but two. These are followed by sketches of potential future uses of the technology in memory institutions and academic research

The section concludes with a description of the challenges that introducing XML and related technologies

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33 Source: Kenneth Sall, *The XML Family of Specifications. A Practical Guide* (Addison Wesley, 2002), p. 19.

34 The satirical 'XML Kitchen Sink' specification addresses such hyperbole: http://blogspace.com/xkitchensink/

35 Such treatment is provided in books such as Kenneth Sall's XML *Family of Specifications. A Practical Guide*, to which much reference has been made in the preparation of this report.

may place on an institution's existing technical and staffing infrastructures. The technology demands are unlikely to be overly onerous or too resource-intensive in either the short or long term. The benefits that XML brings to content representation and management will enable heritage institutions to make effective long-term and varied use of their information assets. It provides their user communities, from curators to visitors, with richer and more flexible mechanisms for accessing and using XML-encoded content.

Introduction to XML

Background: Markup from SGML to XML

The great bulk of Web pages are written (or 'encoded') in the *Hypertext Markup Language* (HTML), a simple, effective and forgiving language. The *Standard Generalised Markup Language* (SGML) is the 'parent' language of HTML and many other descriptive tag-sets. SGML files are composed of plain ASCII text combined with tags enclosed in angled brackets – e.g. <tag> – meaning no special software is required in order to create an SGML or an HTML file. For instance, text between the tags <bold> would appear in a heavier typeface </bold> than text not so tagged. This characteristic facilitates the accessibility and longevity of the materials, and makes these file types eminently suitable for delivery across disparate networks.

The term *markup* historically referred to annotations or marks used within a text to indicate layout and presentation to typists or printers. Contemporary usage of the word has evolved to indicate any means for making an interpretation of a text explicit. SGML markup enables users to create structured documents by tagging *structural* divisions – act, scene, stanza, line, stage direction – or conveying information about *display* elements such as font changes, line breaks, or columns.

First unveiled as a W3C Recommendation in 1998, the Extensible Markup Language (XML) is a subset of SGML, intended to allow generic SGML 'to be served, received, and processed on the Web in the way that is now possible with HTML'.[36] SGML is more customisable than XML, which makes it more flexible and more powerful, although it is significantly more expensive to implement. Unlike SGML, XML was designed with Internet delivery in mind. There are now relatively few new projects that start as SGML applications, but many legacy applications are still in use, particularly in larger organisations such as healthcare trusts. Some very specific applications – such as modelling compound document sets[37] – are more suited to SGML because of features that XML has not inherited. For new cultural heritage applications, however, XML is likely to be by some distance the more suitable of the two.

Principles of XML

A distinction should be drawn between two different kinds of markup: *procedural* and *descriptive*. HTML is an example of a language that is used in a mainly *procedural* fashion,

36 Source: http://www.w3.org/TR/REC-xml
37 http://www.xmlhack.com/read.php?item=1030&v=1

hence HTML markup is more concerned with delivering and displaying content than with representing its semantics. Purely *descriptive* markup, on the other hand, allows the same document to be processed by many different software applications, and for different applications to use data in different ways. This ensures flexibility: information can be used for multiple purposes. The downside is that HTML content creators have less control over what their work will look like when it is displayed: as many readers will know, a Web site may look very different on *Netscape, Opera* and *Internet Explorer* owing to their fundamental differences, and variation in degrees of support for proprietary tags.[38]

SGML introduced the notion of a document *type*, which must be defined at the outset. A document is defined by its constituent parts and their hierarchical structure. Through the use of carefully structured documents, XML allows content to be reused and repurposed over different formats, programs, and platforms. If we know a document's type then we know what individual parts it must (or may) contain and in what order they are likely to appear. This allows us to use parsing programs to extract the information in which we are interested. It is also possible to make judgements as to whether particular documents are of a certain type, and whether other documents of the same type can be processed in a uniform fashion.

XML's explicit focus on the Web has been geared to overcome the increasingly evident shortcomings of HTML, most notably its fixed tagset and its inability to treat content as data. This first difficulty has been exacerbated by the fact that different browser vendors have allowed the use of proprietary tags, thus making certain Web pages very attractive in one browser but completely unusable in another. Apart from the differentiation between the <head> and <body> sections of a document, HTML does not support the structuring of documents. While we may search HTML documents for occurrences of text strings, content creators cannot define what the text we find is intended to *mean*.

Specific user communities may wish to formulate their own vocabularies and tagsets for easy and usable exchange of materials between remote parties: the European Parliament has already done so with *ParlML*.[39] The variety of possible tagset uses is not restricted, for example publishing companies may wish to communicate using the tag <title> to indicate the title of a book, whereas genealogists may prefer <title> to mean the word or words that precede a person's name. This might cause difficulties when a book on genealogy is being published, but these problems can easily be overcome, as we will see later in this section.

38 Originally an SGML application, HTML has recently been rewritten as an XML application called *XHTML* (http://www.w3.org/TR/xhtml1/).

39 http://www.europarl.eu.int/docman/texts/TFDM(2000)0014EN(TOC)0.htm

What XML functionality do Browsers Support?

XML support has been an increasing priority in recent releases of the mainstream Web browsers. However, the deceptively simple term 'XML support' implies compliance with a number of related specifications.
The levels of support offered in the latest releases of Internet Explorer (version 6) and Mozilla (version 1.5) are fairly comprehensive. The various types of functionality incorporated includes:

Viewing of XML documents: Each browser parses and presents the XML document as a collapsible tree view. Parse errors are displayed with the position at which they were encountered, which represents a useful feature for debugging purposes when starting out with XML if a dedicated Integrated Development Environment (IDE) is unavailable.

XML 1.0 and namespace standards: The latest browsers support the official XML specifications as outlined by W3C as well as namespace standards that facilitate the distinguishing of XML vocabularies from different domains, by prefixing tag names with unique qualifiers.

XML Document Object Model: This exposes the XML document's elements and attributes to scripting languages like ECMAScript and JavaScript. Previous versions of Internet Explorer (IE 5 and 5.5) also sought to incorporate this functionality, but based their implementation on a draft specification that was significantly different from the final W3C recommendation.

Extensible Stylesheets (XSL): A key area of browser support, and present in the current versions. As with the DOM, Microsoft's earlier browsers incorporated support for XSL based on a draft specification that would eventually be changed, so this functionality is also incomplete in IE 5 and 5.5. XSL transformations offer Web publishers the opportunity to traverse the XML document and 'transform' the XML 'source tree' into an alternative-format 'result tree'. The most common transformation in terms of the Web is to take XML and turn it into XHTML, which browsers are capable of rendering. XSLT (optionally combined with Cascading Style Sheets) has therefore become the foremost presentation tool for XML content for the Web. Access to this content is facilitated by using a browser which, by default, incorporates an XSLT processor.

XML Data in HTML: A proprietary Microsoft solution, and exclusive to Internet Explorer, this allows developers to embed XML into HTML content using an <XML> tag. This is often described as 'XML Data Islands' and may incorporate inline or linked content.

XML Schema and DTD: Support for these two XML structural definition specifications is offered by the current mainstream browsers.

In addition to support for XML Web documents, Mozilla uses XML internally too. A number of features exploit this technology:

Aurora: This is the codename for Mozilla's internal datastore, which uses XML in the form of RDF, the Resource Description Framework. This incorporates: Bookmarks, history of visited pages, search results, information on file systems, FTP locations, and Web site maps.

Smartbrowsing: A concept incorporated into the latest versions of Mozilla and Netscape whereby users type keywords into the location bar and receive additional information on Web pages from a dedicated remote server. The client/server communication is encoded for these purposes in XML.

XUL (XML-based User Interface Language): This is an XML-based language for describing the contents of windows and dialogues, incorporating support for typical dialogue controls as well as numerous widgets. XUL describes the contents of an entire window, which could contain multiple individual HTML documents. It is a helpful tool for cross-platform information exchange since it allows one user interface described in XUL to be rendered by a platform-specific implementation of the XUL engine on a different OS or hardware architecture.

It is important to remember that, unlike HTML, XML is not a solution in itself. XML defines a framework that can be used to create solutions, but in isolation it does very little apart from produce highly readable and organised documents. XML is at its most powerful as a syntax for defining other related technologies, the most relevant of which are covered below.

The XML Family of Technologies

There are four main categories of XML technologies. The first of these consists of different versions of the XML language (or *metalanguage*) itself. The XML specifications describe the concrete syntax of XML documents, and partially the behaviour of an XML processor, i.e. a software module that is used to read XML documents and to render their content and structure. Four slightly different abstract models for describing the information available in XML documents have been introduced at W3C:

- The *XML Information Set* specification provides definitions for other specifications that refer to the representation of information in a well-formed XML document.[40]
- *The XPath Data Model* is the specification for addressing parts of an XML document. XPath allows users to select elements from a hierarchical XML structure, a process similar to the way SQL retrieves information from a database.[41]

40 http://www.w3.org/TR/xml-infoset/
41 http://www.w3.org/TR/xpath/

- *The Document Object Model* (DOM) is an application programmer interface (API) for XML and HTML documents. It defines the way data in a document are structured, accessed, and manipulated. This consists of five parts: Core, Views, Events, Style, and Traversal and Range. These terms are more or less self-explanatory, but a further explication can be found at http://xml.coverpages.org/dom.html.[42]
- *XQuery 1.0 and the XPath 2.0 Data Model* are intended to define the information contained in the input to an *XSLT or XQuery* processor.[43]

Each of these four models describes an XML document as a tree structure, but there are certain differences between them that we will not discuss here, the links in footnotes point to sources of further information.

Outlines of the remaining three categories of XML technologies now follow.

XML Accessories

XML Accessories are languages intended to extend the capabilities defined in the XML specification. Examples of such accessories are *XML Schema*, which extends the definition capability of XML *Document Type Definitions* (DTDs), and *XML Names* which extends the naming mechanism to allow a single XML document to include element and attribute names that are defined for and used by multiple software modules. These concepts are becoming increasingly important and are discussed in more depth below.

XML Transformers

XML Transformers (or Transducers) are languages intended for transforming input XML data into a particular output form. Examples of this branch of the XML family are *Cascading Stylesheets* (CSS) and the *Extensible Stylesheet Language* (XSL), both of which produce an external presentation from XML data, and *XSLT* which transforms XML documents into other formats, including XML. Transformer languages are associated with some kind of processing model that defines how the output is derived from the input.

XML Applications

XML Applications define constraints for a class of XML data for a particular application area, often by means of a DTD. Examples of XML applications are *MathML* (mathematical data), *XML-Signature* (digital signatures), and *SMIL* (the Synchronized Multimedia Integration Language). XML accessories and transformers are often XML-based languages in their own right, and thus they are also XML applications. Some dedicated XML formats require a special type of player to access the content: SMIL files, for example, can be played using one of around a dozen different applications, the best known of which are **Real Networks'** *RealOne*, **Oratrix's** *GriNS*, and the open-source *X-Smiles*.[44]

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X-SMILES objectives

42 http://www.w3.org/DOM/
43 http://www.w3.org/TR/query-datamodel/
44 http://www.real.com/realoneplayer.html; http://www.oratrix.com; http://www.xsmiles.org

Interoperability and Resource Discovery: Theory

HTML markup is not as meaningful as we need it to be. Its <meta> tags are insufficiently precise for searching, and as the number of Web sites grows the need to address this problem becomes more and more pressing. Providers of Internet search engines continue to investigate ways to improve the accuracy and relevance of their Web searches. The shortcomings of HTML and the ways in which it has been used to present content mean that the search engines will never achieve the richness that would be possible were they in XML.

XML has been touted as an eventual solution to this problem. The Semantic Web, explained in more detail below, is a proposed extension to the World Wide Web which will allow automated querying and concentration of information based on meaningful, machine-readable, XML-based semantic markup.

The *Resource Description Framework* (RDF) is another set of conventions used for storing and conveying metadata in XML. It allows the interrelations and connections between documents to be defined using dedicated metadata. RDF has been used on cultural heritage projects, but its long-term future is uncertain.

The XML Wave

Where XML is Currently Used

XML has been adopted in numerous areas of business and cultural interaction. Given its usefulness as a means of exchanging information between varying systems, the XML wave has frequently been characterised as something more akin to an explosion.[45] XML has been used as a supplement and alternative to *Electronic Data Interchange* (EDI) for e-commerce since mid-1999, and most online transaction now take place using some kind of XML-based technology.

Although XML has been hailed as a significant breakthrough, there are at present significantly more HTML pages discussing the benefits of XML on the Web than there are XML Web pages. XML take-up has lagged behind the hype, but this is beginning to change and the change is becoming more apparent.

What XML is Currently Used For

XML has a variety of uses, and its influence has been felt in every area of computing and information science. For our purposes, these uses can be collected into three main groups:

- The exchange of data between applications;
- The execution of remote procedure calls (facilitating platform-independence);
- Data-storage, reuse, and repurposing.

Each of these purposes conjures up a whole world of possibilities, and the scenarios and case studies that follow give a taste of what has been done, what is currently ongoing,

45 A growing A-Z list of XML industry sectors is maintained at http://www.xml.org/xml/industry_industrysectors.jsp

and what is likely to occur in the future as a result of the use of XML and its related specifications.

How XML Technologies Work

Markup and Display: Tags and Stylesheets

XML tags look identical to their HTML counterparts, but the rules governing their use are significantly stricter. Unlike the more forgiving HTML, each and every XML tag must be opened and closed, and rules on the nesting of brackets must be observed or the document will not be parsed successfully. A fundamental advantage of XML is its *extensibility*: users can create their own tags and vocabularies. When combined with DTDs or schemata (see below) this allows content developers to define and control documents and their permitted contents to a very high degree. They can also create a rich array of possible ways of discovering information.

In terms of delivery, XML content can be uniformly displayed using stylesheet languages such as *Cascading Stylesheets* (CSS) and the more versatile *XML Stylesheet Language* (XSL). HTML users may already be familiar with stylesheets, which are used to define the ways in which certain Web page aspects such as fonts, text sizes, colours, and images are displayed. Stylesheets can be reused to enforce uniformity across a potentially unlimited number of documents or Web pages.

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```
<html>
  <head>
    <title>Book List</title>
  </head>
  <body>
    <table>
      <tr>
        <td>0-7357-1212-3</td>
        <td>Dubois</td>
        <td>Paul</td>
        <td>2003</td>
        <td>MySQL</td>
        <td>The definitive guide to using, programming, and administering MySQL 4</td>
        <td>Sams</td>
      </tr>
      <tr>
        <td>0-7645-2478-X</td>
        <td>Pfaffenberger</td>
        <td>Bryan</td>
        <td>2003</td>
        <td colspan=2>Webster's New World Computing Dictionary</td>
        <td>Wiley</td>
      </tr>
      <tr>
        <td>1-861005-06-7</td>
        <td>Kay</td>
        <td>Michael</td>
        <td>2002</td>
        <td colspan=2>XSLT Programmer's Reference</td>
        <td>Wrox</td>
      </tr>
    </table>
  </body>
</html>
```

```
<?xml version="1.0"?>
  <bookList>
    <book>
      <isbn>0-7357-1212-3</isbn>
      <author>
        <surname>Dubois</surname>
        <forename>Paul</forename>
      </author>
      <publishingDate>2003</publishingDate>
      <title>MySQL</title>
      <subtitle>The definitive guide to using, programming, and administering MySQL
4</subtitle>
        <publisher>Sams</publisher>
    </book>
    <book>
      <isbn>0-7645-2478-X</isbn>
      <author>
        <surname>Pfaffenberger</surname>
        <forename>Bryan</forename>
      </author>
      <publishingDate>2003</publishingDate>
      <title>Webster's New World Computing Dictionary</title>
      <publisher>Wiley</publisher>
    </book>
    <book>
      <isbn>1-861005-06-7</isbn>
      <author>
        <surname>Kay</surname>
        <forename>Michael</forename>
      </author>
      <publishingDate>2002</publishingDate>
      <title>XSLT Programmer's Reference</title>
      <publisher>Wrox</publisher>
    </book>
  </bookList>
```

HTML and XML: sample code

Structured Documents: DTDs and Schemata

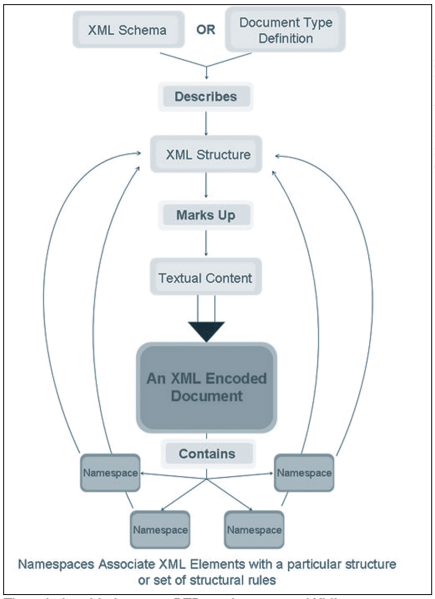
XML is often called a self-describing language, insofar as XML syntax is itself defined in XML. XML variants exist for an ever-growing number of industries and domains. Each of these will have a *Document Type Definition*, or DTD, which is a kind of glossary that outlines exactly what kinds of XML tags a document may contain, and where the tags should be placed within it. Like stylesheets, DTDs are reusable and can be shared simultaneously by multiple XML documents or Web sites. A DTD can be linked to an XML document externally using a URL, or it can be embedded at the top of the XML document it describes. The latter approach is easier, although less efficient than the former. Creating a DTD is a reasonably simple task, and learning how to do this should not be too difficult or time-consuming. The designing of a DTD is more time-consuming, but it is the crucial first step.

DTDs, however, are on the way out, and are being steadily replaced by more versatile

schemata (sometimes also called *schemas*). The primary purpose of a schema is to allow machine validation of a document's structure, and a schema is comprised of metadata designed to describe the organisation and content of related XML documents, thus augmenting the variety and usefulness of Web-delivered content.[46] A schema will list the elements that a document contains, and the order in which they appear, as well as rules governing the permitted content of elements, and more advanced cardinality restraints than DTDs offer.

XML schemata offer much more functionality and versatility than DTDs. Schemata allow more meaningful and in-depth *data typing* and provide much improved support for *XML Namespaces*, an approach by which tags are associated with a unique identifier to eliminate confusion between vocabularies. Data typing allows quality assurance checks to be embedded directly within the schema itself, instead of being linked to external processes, as is the case with DTDs. Namespaces allow the intermingling of vocabularies without the confusion that can plague the use of numerous DTDs. Further benefits and uses of namespaces are covered in more detail below. Unlike XML in its purest form, schemata are always application-dependent, and – unlike DTDs – schemata are themselves defined using XML. A working XML schema definition is therefore by definition a well-formed XML document as well.

Without the careful use of DTDs or schemata, there can be no XML-assisted interoperability between systems.



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The relationship between DTDs, schemata and XML namespaces

Interoperability and Resource Discovery: Practice

A diversity of future uses for XML will be derived from its *machine-readability*. As XML development becomes more refined and an increasing amount of Web content is created according to XML guidelines, automated searching, collocation, and cross-referencing of materials will become an increasingly fundamental facet of the Web's future.

Currently, however, there is much risk of confusion between identical tags that may have different types and uses in different fields or applications. At the moment XML elements and attributes can be identified and universalised using XML Namespaces, thus eliminating the potential for clashes between identically named tags. In conjunction with a *Universal Resource Identifier* (URI), which functions as a unique identifier rather than a separate resource, namespaces guarantee uniqueness across all applications, and provide a simple and efficient means of distinguishing between vocabularies.[47]

The platform neutrality of XML ensures its potential for interoperability, and an appli-

46 For more on crosswalks and interrelations between schemata, please see Kimberly S. Lightle and Judith S. Ridgway, "Generation of XML Records across Multiple Metadata Standards" in *D-Lib Magazine*, vol. 9, no. 9, September 2003: http://www.dlib.org/dlib/september03/lightle/09lightle.html

47 It is worth stressing that the URI does not have to point to a real Web page or resource, though namespaces may develop in the future for holding something useful such as identifying the file format of a related resource.

cation on one platform should be able to access and make use of XML data regardless of how it is stored or formatted thanks to its inherent transformative powers. Tools have been developed to connect old and new methods of interoperability, linking Z39.50 and XML, taking cataloguing beyond MARC and on towards Web-compatible material.[48]

Self-describing Objects

Self-describing data items are a fundamental of semantic representation, and facilitate the continuing increases in automation of Web transactions. In order to be classed as 'self-describing', an object's markup must describe its structure and the data type to which each element corresponds. XML objects meet these criteria, and when used correctly XML content should be fully autonomous. The *Simple Object Access Protocol* (SOAP[49]) assists in the passing of information between different applications in a decentralised and distributed environment by combining XML and HTTP to send and receive messages. Rather than dealing in specific application-centred semantics, SOAP works by defining a simple mechanism for providing a modular packaging model for messages and the encoding of their contents. Thus SOAP can be used in a large variety of systems, ranging from instant messaging systems to remote procedure calls (RPCs) initiated by platforms or operating systems other than that on which the user is working, for example a *Linux* server initiating a procedure call on a user's *XP* machine, which may be useful in developing large applications that feature multiple programs distributed across a network.[50]

XML and the Web

Because HTML is centred on the *presentation* of information, as opposed to representing its structure, it has very limited capabilities to make this information available across multiple devices and platforms. A user's screen resolution can have a significant impact on the quality and usability of HTML, with further layout issues arising when handheld PCs and mobile phones are introduced into the equation.

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X-SMILES on iPaq

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X-SMILES on mobile phone

48 http://www2002.org/CDROM/alternate/XS2/
49 http://www.w3.org/TR/SOAP/
50 See http://www.xmlrpc.com/ for a more detailed account of cross-platform distributed computing using XML and RPC.

The *Extensible Stylesheet Language Transformations* language (XSLT, sometimes also called the *Extensible Stylesheet Language Template*) is designed for use as part of XSL (see above), although it may also be used independently.[51] In addition to XSLT, XSL includes a vocabulary for specifying the format of XML documents. XSL describes how such documents are transformed into other XML documents that use the same formatting vocabulary. Due to its newness, it is estimated that around half of all Web users are unable to access all XSLT transformed XML, as they do not have a recent enough browser. However, it is possible to use the PHP Hypertext Preprocessor language (PHP), or another compliant scripting language such as ASP, ASP+, JSP, JSP+, to transform the XML on the server side, thus delivering more widely compatible XHTML in its place.[52]

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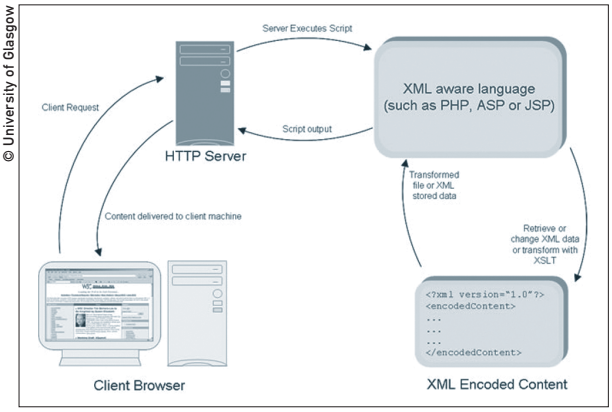


The relationship between XML, scripting language, client and server

Web services are self-contained, self-describing, modular applications that can be published, located, and invoked across the Web. A Web service performs a function, which can be anything from a simple request to a complicated business process. Once a Web service is deployed, other applications and other Web services can discover and invoke it. The Universal Description, Discovery and Integration (UDDI) protocol is a kind of directory of Web services which creates a standard, interoperable platform enabling users (and other applications) to find and make use of Web services over the Net, 'quickly, easily, and dynamically'.[53]

XML and Other Media

Although XML was designed with online delivery in mind, its uses are by no means confined to the Web. XML has applications in the Wireless Application Protocol (WAP) and the Wireless Markup Language (WML) for mobile devices, as well as in printed media.[54] Applications such as **Logictran**'s *RTF converter*[55] can be used to transform documents from Rich Text Format to XML, thus allowing them to be delivered and presented in a number of different ways.[56] Bearing in mind that XML is both a human-readable *and* a machine-readable technology, it should be clear that print and other such legacy media stand to benefit from the XML treatment as well as digital material. Working practices and internal/external communications have much to gain from the change in thinking that XML has brought into being.

51 http://www.w3.org/TR/xslt
52 http://www.w3.org/TR/xhtml1/. XHTML is like ordinary HTML, but much more strictly governed. Of course, a dedicated XSLT processor such as *SAXON* could be used instead for a more direct approach to such a problem.
53 http://www.uddi.org/about.html. See also *DigiCULT.Info 3* for more on UDDI and Web Services in general.
54 See the section on *Mobile Access to Cultural Information Resources* below.
55 http://www.logictran.net/products/
56 CDocS: http://committees.gla.ac.uk/cdocs/; Logictran: http://www.logictran.com/.

XML and Databases

A frequent entry in XML FAQ lists is 'Is XML a database?' The answer is almost always a straight and unequivocal 'no', but the regularity with which the question is posed suggests that the connections may be stronger than we may previously have thought. XML is certainly more powerful when coupled with a database, and the ongoing shift towards database-driven Web pages mirrors the rise of XML almost inseparably. In his ongoing exploration of the relations between these increasingly influential technologies, Ronald Bourret outlines the case thus:

> On the plus side, XML provides many of the things found in databases: storage (XML documents), schemas (DTDs, XML schema languages), query languages (XQuery, XPath, XQL, XML-QL, QUILT, etc.), programming interfaces (SAX, DOM, JDOM), and so on. On the minus side, it lacks many of the things found in real databases: efficient storage, indexes, security, transactions and data integrity, multi-user access, triggers, queries across multiple documents, and so on.[57]

XPath is the XML technology most frequently used for querying XML documents, and it can be considered analogous to the *Structured Query Language* (SQL) with which all modern databases can be interrogated, and indeed defined. XML can assist in ensuring the longevity of data as proprietary formatting is not used, hence migrating data between platforms is simplified.[58] Data durability concerns all information technology sectors, and the cultural heritage sector cannot afford to lag behind.

Towards an Interoperable Semantic Web?

'The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.' – Tim Berners-Lee, James Hendler, Ora Lassila, "The Semantic Web", *Scientific American*, May 2001[59]

The concept of a Semantic Web was introduced by WWW creator Tim Berners-Lee in 1998. At that time, Web content had recently begun the significant shift from what the W3C calls 'exclusively human-oriented content', best exemplified by simple, manually created HTML pages, to complex and dynamic Web sites built on top of underlying databases. The Semantic Web depends on the definition and linkage of data in ways that facilitate efficient, automated resource discovery, the automation of Web tasks and services, as well as compatibility, reuse, and repurposing across different platforms and software applications.[60]

57 Ronald Bourret, "XML and Databases", available online at http://www.rpbourret.com/xml/XMLAndDatabases.htm
58 See http://www.naa.gov.au/recordkeeping/preservation/digital/xml_data_formats.html for more on XML and data migration.
59 http://www.scientificamerican.com/article.cfm?articleID=00048144-10D2-1C70-84A9809EC588EF21&catID=2
60 For further analysis of the Semantic Web, and in particular its implications for the cultural and scientific heritage communities, see our third Thematic Issue, entitled "Towards a Semantic Web for Heritage Resources", available online at http://www.digicult.info/pages/publications.php. A good introduction to the potential and challenges of this growing topic is given by Shiyong Lu, Ming Dong and Farshad Fotouhi in their paper "The Semantic Web: opportunities and challenges for next-generation Web applications", *Information Research*, vol. 7, no. 4, July 2002: http://informationr.net/ir/7-4/paper134.html

Java and XML are suitable partner technologies in the building of applications that exploit the web of information, particularly when different classes of clients (PC, PDA, WAP-enabled mobile phone, etc.) generate and make use of information exchanged between remote servers and different system platform types. Both technologies are platform-independent and allow users to define variables, classes, methods and objects (or their XML conceptual equivalents).[61] The portability and extensibility of both XML and Java technology make them ideal for the flexibility and availability that the Semantic Web demands, and Java is by some distance the most popular programming language used by application developers working in this area. A fundamental difficulty with the usefulness of the proposed Semantic Web for the cultural heritage sector is the amount of work that will be needed to bring a significant proportion of existing Web resources into line with W3C recommendations. This will be a colossal challenge, and one for which few cultural organisations and institutions are financially equipped. The best approach would be to work *towards* Semantic Web compatibility with new, XML-powered projects, and attempt to develop strategies for the retroconversion of existing material when time and (technological, staff and financial) resources allow.[62]

XML and the Heritage Sector

Brief Background

Despite its newness, XML has already had an impact on the working practices of some cultural heritage institutions. The scalability and extensibility that are key features of XML make it appropriate for many types and sizes of organisation. Numerous fields of research and business have their own custom-designed XML technologies, for example the *Extensible Rights Management Language* (XrML) used by content owners as a standard to support transactions regarding the use and provenance of cultural content.[63]

In the cultural heritage sector, SGML and XML have both been used to great effect in archives and libraries, as well as in documentary studies[64] – a discipline in which the utility and value of markup have been familiar for decades. The *Text Encoding Initiative* (TEI) and the *Encoded Archival Description* (EAD) are two high-profile encoding schemes that have embraced XML to fulfil a number of functions, and to expand the range of the work they carry out.[65] The uses of XML for digital preservation were explored at an *ERPANET* workshop in Urbino, Italy, in October 2002. The proceedings provide an insight into the experiences of a number of European institutions.[66] The **CIMI** consortium's work on creating a DTD for the Spectrum standard for object description has

61 XML can assist in the interchange of models as well as instances using *XML Metadata Interchange* (XMI, see http://www.omg.org/technology/documents/formal/xmi.htm and http://www.oasis-open.org/cover/xmi.html for more details.)

62 For a personal, specifically library-oriented discussion of the Semantic Web and its potential for the cultural heritage sector, see Terrence A. Brooks, "The Semantic Web, universalist ambition and some lessons from librarianship" in *Information Research*, vol. 7, no. 4, July 2002: http://informationr.net/ir/7-4/paper136.html.

63 See the following section, on *Rights Management and Payment Technologies*, for more on the interrelation between XML and content transfer and reuse.

64 *The Correspondence of James McNeill Whistler* is a good example of such a project: http://www.whistler.arts.gla.ac.uk/correspondence/index.htm

65 EAD: http://www.loc.gov/ead/; TEI: http://www.tei-c.org

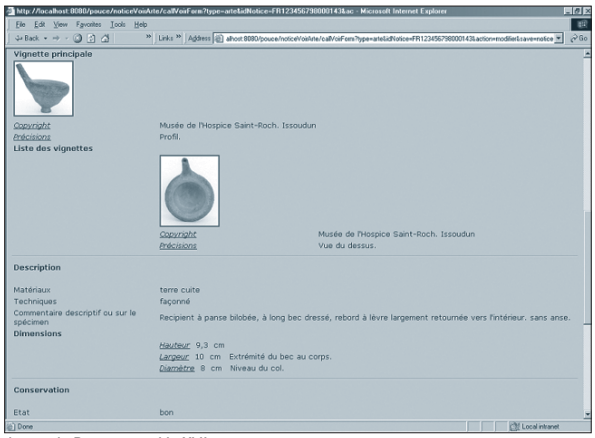
66 ERPANET: http://www.erpanet.org

followed the times and morphed into a schema.[67] This work has since been taken up by **mda**,[68] and when finished they hope that it will 'ensure that the museum community's XML products can work with related XML work from the archive and research communities'.[69] This is another example of the assistance XML can offer for the exchange and interoperability of materials within discrete (and sometimes overlapping) communities.[70]

The case studies featured here provide an in-depth and otherwise unavailable insight into a variety of applications of XML in the cultural heritage sector, from large-scale EC-funded projects such as *COVAX*, through Pouce's smart use of collaborative strategy and pooled resources, to the Swiss Federal Archives' *AMDA* audio metadata management project, which produced a bespoke application.

Case Studies

Pouce (Portails Collectifs Culturel)[71]



© Pouce

A sample Pouce record in XML

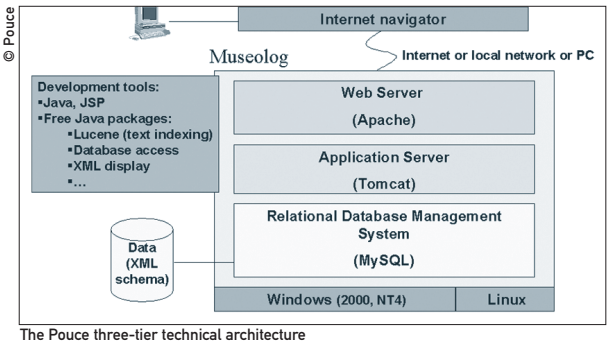
Pouce is the final stage of a three-part investigation into the potential of using XML to facilitate a methodology for supporting the cataloguing of collections at medium-sized museums. The first stage was a study, which took place between 1999 and 2000, examining the collections management requirements of small to medium-sized museums, and preparing a method for compiling digital inventories. The second stage was the **Heritage Net** project. This produced a software prototype of the digital inventory method. The European Commission contributed approximately €60,000 for the first two stages, and €120,000 for Pouce.

The Pouce project's *Museolog* tool[72] was conceived with two distinct purposes in mind: as a Web architecture, application server, and database management tool for small to medium-sized museums; and as a semantic, collective cultural portal for viewing the digitised holdings of multiple museums simultaneously.

The *Museolog* technical architecture consists of an **Apache**[73] Web server running the

67 http://www.cimi.org/wg/xml_spectrum/xml_CFP.html
68 http://www.mda.org.uk
69 http://www.cimi.org/wg/xml_spectrum/xml_long_desc.html
70 Of course, communities with overlapping interests cause the most difficulties for interoperability. Communities with no shared vocabulary can easily be mapped to one another, but when two or more subject areas use similar terminology for appreciably different concepts then the problems really begin.
71 This case study is based on a telephone interview with Michel Texier of **Valoris**, and on materials available on the Web. All material is referenced in footnotes. The interview took place on 13/03/2003. Pouce: http://pouce.valoris.com:8080/pouce/docs/PagesPouce/WebPageDescribingPouceV3.htm. Valoris: http://www.valoris.com
72 Museolog: http://museolog.unesco.kz:8080/museolog/index.jsp
73 http://www.apache.org/

Tomcat servlet container,[74] with a *MySQL*[75] database holding all of the XML objects that correspond to the digital objects and their respective metadata. One of Pouce's basic principles was that the solution should be affordable for smaller museums. To keep costs down, freeware, open-source tools were used wherever possible. XML Schema and XSLT were used to enable records to be imported from other, incompatible databases. This function of XML was particularly instrumental in meeting the aims of the project.

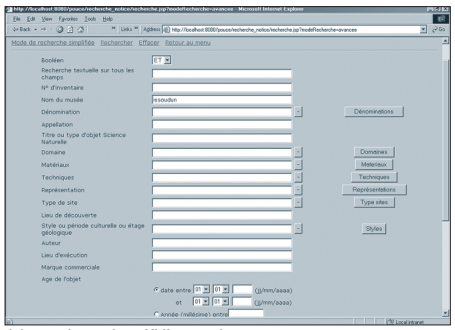


© Pouce

The Pouce three-tier technical architecture

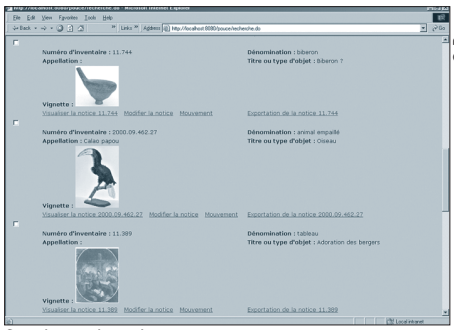
The Pouce consortium consists of a technology partner, **Valoris**, working in collaboration with five cities and regions from the central area of France. The Valoris team's work on similar European projects has given them substantial prior experience in XML development. However, the staff of the six museums had little or no experience in the installation or running of such an application, so set-up and training were carried out by the project partners. Valoris are currently in the process of planning a dedicated, executable set-up script to simplify the process and which will auto-configure Museolog for a museum's computers. However, at the moment all new installations must be overseen by the software developers.

XML has allowed the creation of a unique museum inventory system, in which any object (be it fine art, archaeology, clothing, etc.) can be defined according to a standardised XML object description system. The Museolog tool allows multiple views of the objects for different purposes, such as editing, viewing, or printing. This functionality may be utilised in the production of catalogues or books, where the necessary information can be associated with an appropriate image or set of images. When searching a database for an object, only minimal information is returned, allowing the user to browse multiple objects and identify the one in which she is interested. When the object is then selected, the full record can be displayed. This approach saves time and processor power. Essentially, the interface and functionality are geared towards the appropriate audience group.



© Pouce

Advanced search on XML records

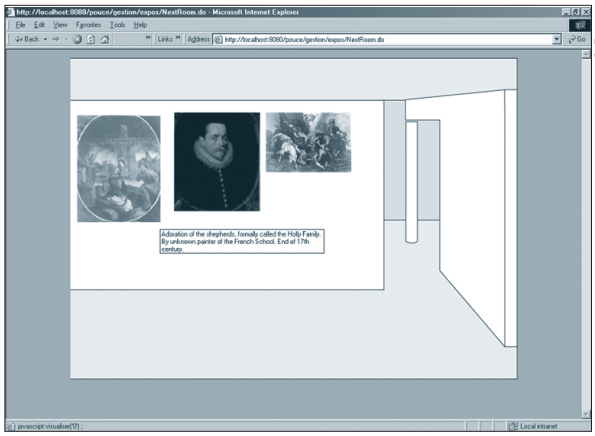


© Pouce

Sample search result

73 http://jakarta.apache.org/tomcat/
74 http://www.mysql.com/

The use of XML has led to the creation of an affordable, state-of-the-art tool which assists smaller museums in importing and exporting their digitised collections, and which facilitates the interchange of information between them. This strengthens the links between separate museums and specialisations. The independent non-technical review of the project has been positive. A technical review by Alain Michard, Scientific Leader of the *SAMIE* (Conceptual Modelling of Community-Webs) team at the French **National Institute for Research in Computer Science and Automatic Control** (INRIA)[76], recommended that the application's basic communal portal be complemented with a facility for virtual exhibits. This is an ongoing development, and it is forecast that this enhancement will add value to the cataloguing function of the Museolog tool. If time and resources permit, the Pouce team would like to work on a multilingual interface which would allow museums from many different parts of Europe to share their content via a single portal. Visitors should eventually be able to browse the digital catalogues of numerous institutions simultaneously together with subsets of their associated metadata, select a record of interest, and view the entire record together with paths to related resources.



© Pouce

Pouce: Automatic virtual exhibits

SIARD (Software Independent Archiving from Relational Databases) & AMDA (Audio MetaData Acquisition), Swiss Federal Archives[77]

© Schweizerisches Bundesarchiv

The SIARD Archive database: Analysis result

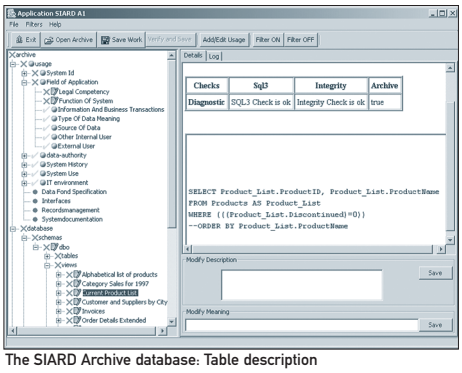
The Swiss Federal Archives' (SFA)[78] mission is 'to preserve, make accessible and evaluate valuable federal records'. The SFA has a duty to document the origin and development of constitutional rights and freedoms, and thereby ensure transparent democracy. While the SFA is primarily concerned with recording the past for posterity and guidance, awareness of new and emerging technologies has led the archives' decision-makers to realise that they will need to adopt flexible and innovative strategies in response to these developments.

76 http://www.inria.fr

77 This case study is based on e-mail correspondence between Stephan Heuscher of the Swiss Federal Archives and Martin Donnelly of DigiCULT. The discussions took place between April and May 2003.

78 Although neither project has its own URL, the homepage of the Schweizerisches Bundesarchiv can be found at http://www.bar.admin.ch/.

The SFA's *Software Independent Archiving from Relational Databases* (SIARD) has a budget of 1,000,000 CHF (approximately €660,000) over a period of three years. The project's aim is to archive existing relational databases by detaching their contents from the applications in which they are created (e.g. *Microsoft Access, Oracle, SQL Server*). This is achieved by archiving the contents of differently formatted databases in a standardised format, in this case SQL plus a description of the metadata in XML. The advantages of this approach include the wider compatibility of XML together with the likelihood that XML data will be accessible for a significantly longer period of time than data stored in a proprietary format.



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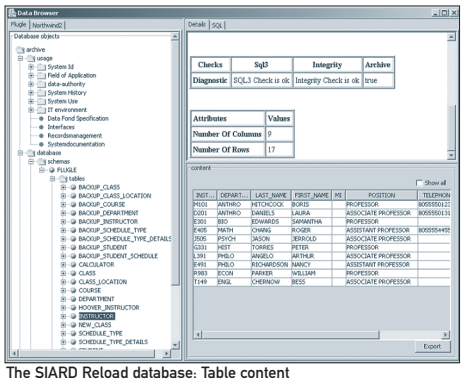
The SIARD Archive database: Table description

The major technologies used in SIARD are:

- The *Java 1.4* programming language, including *XML1.0* for input/output operations and Swing for the graphical interface element;
- *JDBC 3.0*, for the database connectivity, together with *JDBC Interface* for data retrieval and data reload;
- *Java API for XML Processing* (JAXP), which handles the XML operations;
- *XSLT 1.1*, for displaying XML data;
- XSchema 1.0, which provides consistency and integrity checks on the XML files;
- **Oracle** *8/9i* and **Microsoft** *SQL Server 2000* databases.[79]

These technologies were chosen because the SIARD team wished to achieve platform independence and ease of implementation, and their suitability was tested on a prototype. *PL/SQL*, the native programming language for Oracle databases, was used for the export of XML data on the first prototype of SIARD, but this solution was felt to be too software-specific and inflexible, and hence less useful than the platform-independence benefits gained by the use of XML and Java.



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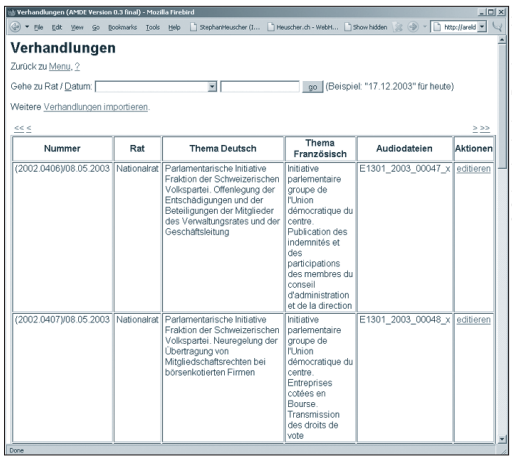
The SIARD Reload database: Table content

The personnel are a Project Manager and a Quality Controller, both of whom are based at the Federal Archives, and a Technical Project Manager and three Developers from the SFA's project partner, **Trivadis**.[80]

Audio MetaData Acquisition (AMDA) is a much smaller project than SIARD, with a projected zero budget and with only one member of development staff on board. The SFA has a duty to collect the official proceedings of the Swiss Parliament. Traditionally these have been held in paper

79 http://www.oracle.com; http://www.microsoft.com/sql/default.asp
80 http://www.trivadis.com/. Specific details regarding Trivadis' work on SIARD can be found at http://www.trivadis.com/pdf/projekte/bundesarchiv_en.pdf

form, but since the early 1980s audio recordings of parliamentary sessions have been kept, and an Access database has until recently been used to hold the essential metadata. The AMDA project was initiated both to import existing metadata into the new system, and to create new metadata automatically during the new digital recording process. This leads to two distinct benefits: the scope for error in the ingest process is minimised, and the metadata is stored in a much more widely compatible format.



AMDA: Debates overview

The fundamental technologies with which AMDA was put together are:

- *Java 1.4*, together with a **Tomcat** servlet container;
- A *JSP/Servlet*, with a *Tomcat Servlet Engine* for the GUI;
- *JDBC 3.0*, for database connectivity, together with *JDBC Interface* for data storage;
- *Java API for XML Processing* (JAXP) for XML operations;
- **Oracle** *8* DBMS.

The SIARD implementation partner Trivadis has provided some advice on technology choices; this guidance had mostly to do with complex database issues. The SIARD team defined the XML markup internally. In addition to this, the team examined other comparable solutions, including the **US National Archives and Records Administration**'s *AERIC*[81] and the Norwegian **Arkadukt** project. The primary focus of these projects, however, had more to do with plausibility and integrity checks, which – although important – are not the primary aim of SIARD.

The implementation of XML has been very successful in both the SIARD and AMDA projects, and all anticipated benefits have been met. XML was selected for its ease of editing and the fact that well-formed XML is automatically validated. The ways in which XML can be transformed using (for example) XSLT also made it suitable for these purposes. It should be stressed that neither project is completely finished yet and there is much work still to do.

User and usability tests are under way for SIARD, and these should provide valuable feedback for future versions. Another tool is in development that will facilitate the generation of metadata catalogues. It is planned that SIARD will eventually be extended to include more specialised drivers for supporting database management systems other than SQL Server and Oracle. AMDA is currently at the metadata ingest stage, and the user interface will eventually be improved in accordance with preliminary user feedback. At the time of writing (May 2003) the **Digital Preservation Testbed**[82] is testing SIARD to verify its suitability as a migration pathway.

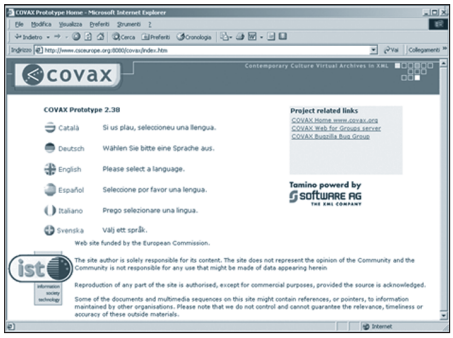
81 For more on AERIC, see Greg LaMotta's presentation from the ERPANET workshop in Bern, April 2003, available online at http://www.erpanet.org/www/products/bern/bern.htm
82 http://www.digitaleduurzaamheid.nl

COVAX (Contemporary Culture Virtual Archive in XML)[83]

The COVAX project aims to demonstrate the feasibility of integrating different content from different platforms and databases in a common XML structure, and in a distributed environment with a central engine and interface. The work was naturally split into two main streams: technical work, including issues such as standards, procedures, tools, technologies, programming, interfaces, and the search engine; and content work, including data work, refinements, content validation and translations.

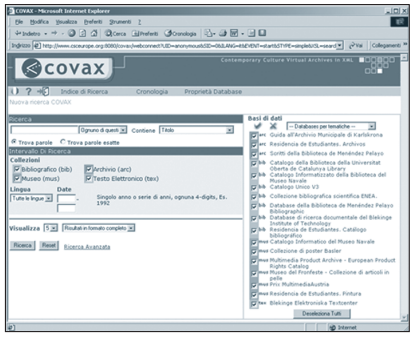
The prototype is based around a common site portal, which permits the redirection of queries to the distributed databases. The prototype was built using the following utilities:

- An **Apache** *Tomcat* server;
- A proprietary underlying metasearch engine with *Java* components;
- Multilingual interfaces, created directly in XML source and then implemented in the prototype interface;
- *Java* servlets and Web scripts created especially for COVAX;
- Graphical Web elements;
- Authentication mechanisms and logging facilities (N.B. these were temporarily disabled during production to allow more reasonable performances);
- Two different XML database management systems: *Tamino XML Server* from **Software AG**, and *TEXTML Server* from **Ixiasoft** – both of which may be beyond the budgets of many cultural heritage organisations.[84]



© ENEA

Covax language selection



© ENEA

The Covax search portal (Italian)

The decisions on which technologies to use were made by the technical project partners, and the main reasons for their choice were the prior experience the partners had in using them, and the success with which they had been applied to previous projects. Other databases were also considered, but the partners felt that the native XML DBMS used met the project's needs adequately. A complete list of the tools available – such as DTDs, databases, conversion tools, XML editors, XSL processors, parsers and validators, both free and commercial – would be long and not suitable for this type of case study, but a select list of the main standards considered in the COVAX project follows:

83 COVAX: http://www.COVAX.org. This case study is based on a questionnaire completed by Luciana Bordoni of **Ente per le Nuove Tecnologie, l'Energia e l'Ambiente** (Italy) in March 2003, and on materials available on the Web.

84 http://www.softwareag.com/tamino/; http://www.ixiasoft.com

- Bibliographical DTDs: MARC DTD, the SGML DTD for MARC Records, the Medlane Project's XMLMARC DTD, the Open Archive MARC XML DTD, and BiblioML;
- Archive DTD: The Encoded Archival Description (EAD);
- Museum DTDs: MUS-EAD, EAD the Amico Data Dictionary;
- Text DTDs: The Text Encoding Initiative (TEI) DTD, the CHIO Full Text DTD.

Other related standards that were considered include *Z39.50* and the *Dublin Core Metadata Initiative*. The prototype remains available online at http://www.covax.at/.[85]

The queries submitted and the results are all managed in a common graphical multilingual interface, in a transparent way from the point of view of the user. A set of filters allows users to filter by theme, by type of data, or by nodes. The integration of the contents in a common standard (i.e. an XML structure with several DTDs provided for all the different classes of content – bibliographical, museums, archives, and electronic text – all with an underlying Dublin Core logic) was realised via a dedicated conversion tool. The goal was to extract significant samples of data from the diverse traditional platforms used by the content providers and to convert them into XML. Problems encountered were mainly related to the resolution of incompatibilities between the structure of the original data and the strict requirements of the various DTDs. In the running prototype, some previously anticipated performance issues from the Java engine were also detected.

Once the implementation phase was complete, the consortium assessed the usability of the system by users other than content owners. Cultural institutions including archives, museum and libraries, scholars and researchers took part in this assessment. The methodology used was a scenario-based assessment approach, where representative users worked on typical tasks using COVAX, and the evaluators/observers used the results to see how the system supported the users' tasks. The evaluators obtained information about user's likes, dislikes, needs, and their overall understanding of the system by conversation, observation, and having them answer questions both verbally and in written form. In a second phase, the test users were given a short introduction to the system, with all functionalities explained by the observer, and the observer demonstrating one search together with the user. In order to become more familiar with the database, the user was given around ten minutes to explore the database on her own. The observers then provided the test users with the COVAX prototype and a set of tasks or scenarios to perform. During the assessment, the test users were asked to verbalise their thoughts, feelings and opinions while interacting with the system.

The implementation of XML technologies on this project has been highly successful. From the point of view of ENEA, unexpected benefits included the possibility to extract and treat data from their Oracle-powered bibliographical database system and the possibility to convert them into an XML source. In general, it can be said that COVAX has attained its goals: to allow the widely distributed documents from archives, libraries and museums to be accessed regardless of location. This main feature has been highly praised by users. The benefit of such a project is obvious for small and middle-sized cultural archives, which may lack the competence or confidence to make their collections available online or preserve them for future dissemination via XML/XSLT technology.

85 A complete list of the technologies and standards used and considered is included in COVAX Deliverable 12, a document titled "State of the Art". This is available online at http://www.covax.org/public_docum/p_documets.htm [*sic*].

Responses received indicate that such a service would be very attractive. To develop a viable COVAX service, therefore, it is felt that the best solution would be the creation of a scalable consortium, consisting of representatives from the institutions and organisations using the service, plus partners delivering and developing technical solutions as well as local training and administration. This scenario will be even more attractive if, in the future, it is possible to populate the technological solution produced by COVAX with more archival content and modules containing, for example, e-learning, inter-institution loans, and administration information.

COVAX ran for twenty-four months, from January 2000 to December 2001, at a total cost of €3,360,434.[86] The project Coordinator was **Residencia de Estudiantes** (Spain), together with eight partner organisations from five EU member states.

Scenarios

An Archive – XML for Document Storage

A public sector archive wishes to store internal documents in a database, allowing them to be reformatted and printed or displayed in different ways for different audiences. The archive staff are concerned about the permanence and authenticity of the documents, and need a cheap and effective means of ensuring both as part of an ongoing records management strategy.

The increase in internal communications has prompted an urgency for the archive to hold its documents in a structured fashion. Automatically generated metadata is stored together with the documents in a database. Since it is created at the same time as the document to which it corresponds, this metadata is as full and as accurate as can reasonably be expected. The initial documents are created in *Word* format and are then converted to XML, from which they can be converted to other formats, including HTML for Web delivery. The XML version is maintained as the definitive copy for archival purposes, although the original Word documents are stored as backup as well. This security measure, it should be stressed, is by no means a permanent solution, as the Word files must be converted into the latest version repeatedly as Microsoft updates its product.

Converting the RTF data into XML can be done using a program such as *MajiX*, an open-source package developed by **TetraSix** for converting documents between Microsoft *Word* and XML.[87] If the archive wishes to disseminate its documents externally, a utility such as *XMLMill* can be used to convert the stored XML into the non-editable PDF format.[88] The documents can therefore be ingested, stored, delivered, and repurposed from a central data storage space. An XML-compatible format should ensure the data's longevity as well as any rival solution. Of course, XML is not a complete preservation strategy in its own right, so the archive staff will still have to cope with such issues as ensuring the authenticity, security, and integrity of the documents.

86 Partners were **Angewandte Informationstechnik Forschungsgesellschaft mbH** and **Salzburg Research** (Austria), **Blekinge Tekniska Högskola** (Blekinge Institute of Technology, Sweden), **Software AG España, S.A.**, **Universitat Oberta de Catalunya and Biblioteca de Menéndez Pelayo** (Spain), **LASER** (London and South Eastern Library Region, UK), and **ENEA** (Italian National Agency for New Technology, Energy and the Environment, Italy).

87 http://tetrasys.dhs.org/ More detailed information on the process can be found at http://www-106.ibm.com/developerworks/xml/library/x-tiprtf/.

88 http://www.xmlmill.com

Repurposing Museum Content with XML

In its quest to keep up with the times, a large national museum has introduced small, handheld computers which users carry around and on which they can view details of the objects at which they are looking at any given time. A difficulty is soon encountered: the HTML code that the museum currently uses for its Web pages is not suitable for delivery to handheld PCs with their smaller screens and slower processors. The digitised images that complement the information well online prove unsuitable for display on a handheld device.

Using XML coupled with XSLT will allow the same data to be repurposed and delivered to a variety of devices or media – including desktop PCs, PDAs, printed catalogues, and mobile phones – without having to rewrite all of the individual markup pages. In addition, it can be used to drive the ordinary Web catalogue, the data for which are stored in a database and can be delivered as XML for the Web. A separate presentation or transformation technique (e.g. schema, stylesheet) will need to be introduced for each device,[89] but the fundamental data remain the same and these data should be compatible with most future interface devices the museum management might wish to use. The alternative would be to write entirely separate markup scripts for every device, which would be both time-consuming and wasteful, and fails to take into consideration the likelihood that other devices or ways of delivery may become prominent in the future. An XML-driven solution can improve maintainability and integrity, as all of the content is stored centrally and delivered as required, rather than stored in device-dependent structures and formats.

This course of action will require the introduction (or training) of a devoted XML coder. Using freely available online tutorial resources, an IT-savvy novice should be able to come quickly up to speed on the processes of markup, batch conversion into XML, and specifically formatted delivery via XSLT. The main question for the museum will be financial: can they afford to devote a member of staff to this on a full-time basis, and will the benefits outweigh the costs?

Academics Arriving at a Schema

A group of literary academics have heard about XML markup from colleagues, and suspect that it may be of use to them. Their dream is to link and exchange documents using a shared vocabulary, syntax and protocol. This, they hope, will speed the development of their area of study among the wider scholarly community, and popularise their ideas across a number of related disciplines. Much comparable work has previously been carried out in the academic sector, and the Text Encoding Initiative and the Whistler Correspondence project are two examples the team has investigated prior to beginning its work.[90]

Their first step will be to decide exactly what the information and materials they create will be used for, and to arrive at a shared goal through discussion and consultation. This may well be the most frustrating element of the process, as the unstandardised language used in the field is likely to be very similar if not perfectly congruent. The

89 For preference, 'no-image' options should be catered for to improve accessibility across all formats.
90 http://www.tei-c.org; http://www.whistler.arts.gla.ac.uk/correspondence/index.htm

imposition of a strict structure is apt to cause difficulties, and academics may initially begin to feel that by following the guidelines their work is being constrained. A strong sense of community will be invaluable, and a project leader should be selected to ease the collaborative discussions. Recent work of this kind in emblematic studies has benefited from the domain's sense of community and shared aims.*

Since an important element of their work involves comparing and associating specific parts of texts with other texts, *XLink* will be of great use in their efforts, as it allows multidirectional links between parts of different documents, all of which can easily be reduced to their constituent parts thanks to highly granular XML markup.[91] XLink allows for considerably more in-depth linking than HTML's standard 'one-way' system. XML's extensible nature allows further functionalities or tags to be added to the schema in the future to cover new developments in the field. This is a fundamental advantage of a schema over a DTD.

The final schema can be created and updated using a dedicated XML design environment such as **Altova**'s *XMLSpy 5*,[92] which boasts a visual interface and drag-and-drop functionality. Sub-elements, parameters, relations and constraints can be defined and edited directly in different ways (visual, textual, etc.) according to the user's preference. This should make the final stage of the schema-building process as smooth as possible.

Advantages and Disadvantages

Introduction

The benefits to be gained by applying XML will continue to grow in the foreseeable future. XML has few associated risks, but because it is so pervasive any new standard would need to support the automated conversion of XML documents. In time, XML may be superseded by something better. Having said that, the chances are strong that any successor to XML would be a related technology itself, and would likely be defined in XML terms. XML is simple, readable, and extensible. The clarity of XML's user-defined tag system will be hard to improve.

In terms of gaining a familiarity and confidence with the use of the technology, the strictness with which XML markup must be applied may be initially frustrating for staff who are used to the more forgiving HTML. The strictness of the rules that govern the application of XML is one of its strengths, and contributes to ensuring the quality of the content.

Advantages

Extensibility – XML allows those encoding content to define their own tags and define document structures according to the objective.

Platform Neutrality and Interoperability – XML files are composed of UNI-

* See the forthcoming DigiCULT special publication on the digitisation of Renaissance emblem literature.
91 XLink: http://www.w3.org/TR/xlink
92 http://www.xmlspy.com/products_ide.html

CODE text by default, although any kind of encoding can be applied. They are therefore vendor-, application- and platform-independent. XML data can be effortlessly exchanged between different systems and hardware.

Multilingualism – XML is language-independent. Chinese, Cyrillic, Hebrew, and other non-Western character sets are all equally well represented as text, whether ASCII or UNICODE.

Reusable and Repurposable – XML allows content to be stored in one format and in one place. This content can then be repurposed across potentially limitless applications and platforms simply by applying the appropriate stylesheets, namespaces, or transformations to the raw XML data.

Information Retrieval – XML defines the content of a document separately from its formatting, making it possible to reuse and repurpose content in other applications or presentation environments, but also making it possible to retrieve content within particular structures.

Dual Readability – XML files can be read by humans, and processed and 'understood' by computers. The self-describing structure permits machine parsing of XML documents.

Applications – Dedicated applications of XML now exist for many industry sectors. Standards for the application of XML are being developed by various independent, non-corporate-governed organisations, including OASIS and W3C.

Incrementally Enhanced Representations – XML-encoded documents can be further enriched with additional markup as time and needs require.

Related Specifications – XML is a core standard, with many related specifications branching off from it, each of which may be applied to a distinct subject area or function. It is expected that this growth in the XML family will continue for some time.

Disadvantages

The Future – XML is not 100% future-proof, but it is at least as future-proof as any other technology.[93]

Skills Demand – The use of XML requires skilled staff. They need skills in text analysis, markup design, and schema development.

Ubiquity – XML features everywhere, and the range of XML-related specifications can quickly become bewildering.

Lack of Browsers – Current browser support for XML is limited. Although the latest versions of all Internet browsers support XML, many computer users use older versions of browsers.

93 In any case, XML's replacement (should one arise) will itself be defined in XML!

Introducing the Technology

Selecting a Specification and Development Environment

The proliferation of similar-sounding acronyms (XML, XSL, XSLT, XHTML, etc.) can make the process of familiarisation with XML somewhat intimidating. A good first step for organisations planning on making the move into extensibility and interoperability would be the acquisition of a handbook introducing the issues in a readable and approachable way.[94]

XML can be developed by a single user at a single computer running freely available software. A dedicated, WYSIWYG development environment is more helpful and user-friendly than a plain text editor, not to mention more attractive. There are both Open Source (e.g. *Xerlin*)[95] and commercially available (e.g. **Corel**'s *XMetal*)[96] editors.

Of course a decision to introduce XML need not be overly influenced by the choices of development environment, nor need it be negatively coloured by the initially intimidating range of material. XML is not an 'all or nothing' technology, and can be introduced incrementally.

Technological Infrastructure Issues

The introduction of XML will not be technologically demanding, but may require some cultural and organisational change. In order to view and manipulate XML files, staff require access to the latest versions of Internet browsers. These can be freely downloaded from the vendors' Web sites. In terms of potential expenditure, the training and tools that may be required in introducing XML should not be overlooked.

For an organisation wishing to adopt server-side XML processing, the technical demands would be more significant. The chief advantage of this mode of delivery is that server-side processing can deliver more or less anything to clients, whether or not they have an up-to-date (XML-compatible) browser. It should be noted that the views and functionality may vary from client to client.

94 Both Kenneth B. Sall's *XML Family of Specifications. A Practical Guide* (Addison Wesley, 2002), and Danny Vint's similar *XML Family of Specifications Reference and Guide* (Manning Publications, 2001) would meet these needs.
95 http://www.xerlin.org/
96 http://www.corel.com/servlet/Satellite?pagename=Corel/Products/productInfo&id=1042152754863

Staff and Policy Issues

The introduction of XML-related specifications will have only minimal effect on an organisation's staff or overall policy formulation. A dedicated staff member may be required to ensure that the organisation stays up to date with the frequent advances in this ever-evolving field.

Conflicts may arise with the change in the approaches to content handling that the introduction of XML is likely to demand. XML can be viewed as a tool, as a strategy, or as both. Maureen Potter's account of some of the common steps involved in introducing a specific XML application (e-mails in this case) across an organisation is a helpful starting point.[97] Although this report is domain specific, the stages encountered will correspond roughly, regardless of which XML application you may wish to introduce.

97 http://www.erpanet.org/www/products/urbino/Presentations/Testbed_Erpanet_XML.pdf. The Digital Testbed team has outlined a series of recommendations for the preservation of e-mails using XML. These findings, titled "From digital volatility to digital permanence: Preserving email", can be found online at: http://www.digitaleduurzaamheid.nl/index.cfm?paginakeuze=185&categorie=2

Cultural Agents and Avatars, Electronic Programming Guides And Personalisation

Executive Summary

Avatars are virtual representatives of human users in virtual environments, often sharing space with *agents*, which represent computer processes or programs. Their basic advantage is in providing a social dimension to the computer communication process. These technologies form an important part in online communication technologies because they do not have the high bandwidth demands that other technologies which present the real user in a virtual environment do, such as video conferencing.

Avatars and agents utilise similar three-dimensional graphics and animation technologies, making them seem vivid and appealing. They can be made to 'speak' using text-to-speech technologies, or with input from the user's own mouth. Combined with haptic interfaces, avatars can be used to study three-dimensional objects, such as sculptures and other artworks. In such cases, the user sees his or her avatar in the virtual space, and can gain the impression of touching virtual representations of the objects. This enables the simulated tactile exploration of objects too delicate to handle in real life.

The use of avatar and agent technologies is most beneficial in cases where the nature and quality of communication between users (or between users and the software) is crucial. Regardless of the nature of the work, from local government, to cooperative teamwork, to learning environments, avatars and agents create new opportunities. In the cultural and scientific heritage sectors, agents are an increasingly popular option for tour guides in virtual exhibitions. Their use allows new approaches to the presentation of a collection, allowing for the personalisation of virtual tours by matching them with visitors' profiles.

Agents have a special role for presenting material in the field of performing arts, such as dance. If the traditional approach would have been the use of a human demonstrator or animated images, agents provide more flexibility to the user who would like to learn more details from a specific dance, for example. Avatars can help users to visit a virtual museum and its exhibits. When combined with robotic technology, this visit could be performed using a real robot, moving through the exhibition on behalf of a geographically distant user, thus giving a stronger and more 'real' feeling of interaction.

Case studies in this section provide an insight into the uses of avatars in three very different arenas. **SEONAID** (the Scottish Executive Online News and Information Distributor) was conceived as an outreach tool for getting younger citizens interested in the workings of their government. The **Peranakans Project** deals with culture, history and education, with the avatar guide being used as an immediate, visual and identifiable conduit for learning about different ways of life. The EC-funded

© TheGlasgowStory and Glasgow City Council (Libraries, Information and Learning)

TOURBOT Project combines avatars and robots to allow visiting of museums with surprising results. The scenarios that follow trace the uses of avatars from home television sets to mobile devices and out into the wider world. It is expected that avatar and agent technologies will develop further with an increasing emphasis on interface quality. The development of virtual museums together with the possibilities for mixing agent and avatar technologies with innovations in the haptics field has attracted the attention of cultural heritage organisations.

An Introduction to the Technology

In computer-generated virtual environments, an avatar is a representation of a human user. The word is of Sanskrit origin and means 'descent'. The first avatars were developed in 1985 when Chip Morningstar and Randall Farmer at Lucasfilm created *Habitat*, a virtual town with two-dimensional cartoon representations of users. It is an understatement to say that the technologies used for producing and controlling avatars have come a long way since the *Commodore 64* computers and dial-up modems of 1985.

The use of the term 'avatar' can be quite vague, since avatars are not the only inhabitants of virtual environments. The term is sometimes used incorrectly for *agents* or *bots*, which are representations of computer processes or programs, and may be represented in the form of a human or some other creature. We use the term *avatar* to mean a user's personification in a virtual or online environment, and *agent* to denote the representation of a computer procedure. Both concepts have much in common in the methods used to develop the virtual creatures and to make them 'live' in the virtual world.

The applications of avatar and agent technologies to virtual environments and leisure activities such as games are pervasive. In the twenty years or so that avatars have existed, they have also attracted a strong interest with their ability to enforce the social components of using of a computer system. They are now used to enhance systems providing governmental information, and multinational corporations use them to create a sense of the 'global office'. Specialists in the fields of psychology and social sciences have also turned their attention towards avatar communities. The problems of their design and functionality matched to conventional forms of human contact are being debated. In the future, this technology is expected to become actively used in electronic programming guides (EPGs) for digital television and Home Media Services (HMSs). Applications of these types allow users to select their entertainment schedule interactively, and (it is assumed) in a more light-hearted and fun manner.

Where the Technology is Currently Found

Avatars continue to be created to inhabit virtual worlds. The uses to which they have been put in recent years have become increasingly varied. For instance, avatars are now deployed in environments where the sense of presence of other users, or of computer applications, is considered beneficial. They have proved useful in cases where input from a number of users has to be supplied, especially time-critical activities, where other forms of guidance might lead to frustration or where a lack of intuitive control may confuse users.

In activities such as customer support for business users, or information provision for citizens by local governments, agents could lead to a reduction in the expenses associated with employing and training staff, and also in communication costs when the customer

and the support staff are separated by a great distance (and even a large time gap). In the medical sector, avatars and agents are used to support virtual environments for providing advice to the patients, and remote assistance to doctors who find themselves needing to perform specialist procedures. Avatars have enabled the investigation of topics and situations that have not been possible because they would put humans at too great a risk. The reconstruction of human behaviour in accident or hazardous situations and the testing of alternative behaviour or response patterns have been made possible by avatar simulations.

All these uses are given in shortened, tabular form below:

Sector	**Potential Application**
eGovernment	Friendly communication with users
"	Help to disabled users
Business	Customer support
"	Connectivity of offices on global scale
"	Bringing together information in a development team
Manufacturing	Part assembly and disassembly in potentially dangerous environments
"	Operation of machinery/specialised equipment
Simulation	Studying effects on humans (e.g. in simulation of accidents)
"	Simulating human presence in a particular environment
Leisure	Virtual communities
"	Games
Health	Support groups
"	Medical advice environments
Mass media	Virtual newsreaders
Education	Tutoring systems
Everyday computer tasks	Help providers
"	Readers of e-mail
"	Readers of any other texts

In 2004, the growth of the avatar/agent market is expected to exceed that of the e-service market by thirty per cent. Advances in speech recognition and synthesis will enable virtual agents to 'conquer' the communication technologies on the Internet.

Possible cultural heritage sector applications include:

- Tour guides in virtual exhibitions;
- Presentation of performance heritage with the reconstruction of traditional dances and theatrical performances;
- The representation of visitors in online spaces where users benefit from a sense of human presence;
- In conjunction with haptic interface and CAVE technology,[98] the tactile exploration of models of objects which for conservation reasons visitors cannot handle;
- As mechanisms to enable the study of users of historical spaces and human interaction.

98 See *DigiCULT Technology Watch Report 1*, in particular the sections on Virtual Reality and Human Interfaces (pp. 95-116 and 117-148).

While not bound to the cultural sector alone, it may be useful to add to this list assistance for disabled users, such as offering a sign language agent to visitors with hearing problems, or talking heads which read the display text for those with visual impairments or even dyslexia.

© Conversive

The Conversive AnswerAgent

Problems the Technology Addresses

Avatar/agent technology applications address the personification of users and other actors in a virtual environment. As virtual environments are more widely employed, the demand for ways to smooth the human/machine interface becomes more crucial. The recognition that improvements in the interactions between real users and the virtual environment enhance task performance and enjoyment will drive forward new developments.

The technology offers increased flexibility in how it can generate responses to the user. The ability of users to choose between various avatars with different personae in many applications is indicative of the move towards making interactions more user centric.[99] Intelligent systems able to create and follow user profiles should offer better communication. Avatars are unlikely to be the final solution to this, but they can certainly move the state of the art on in terms of increased flexibility and personalisation.

Specialised interface devices make avatar technology more immediate, the sensory interaction richer, and increase the modality of participation in virtual worlds. Users have not only a *representative* in the virtual world, but also an increasing sense of *immersion* in it. Such applications are of interest to the cultural heritage sphere, when the purpose is to offer the user an experience of studying a cultural object, or a mechanism to develop which otherwise is kept under access restrictions.

How It Works

Introduction

Avatars can take many forms. The rendering of avatars has improved dramatically in parallel with improvements in graphical and other related technologies. Three-dimensional avatars are now the norm. Some avatars (such as *Digital Space Traveller*[100], started in 1996) may transmit the actual voice of the person they present, and text-to-speech (TTS) technologies have made it possible for agents to 'speak'.

Avatars are not static, nor need their appearance be fixed. Users often design how they

99 Perhaps the best-known example of this is the animated Assistant in Microsoft Office. Users can choose between a bicycle, a paperclip, a cat, a dog, a globe (and more) to interact with while creating and editing documents.

100 http://www.digitalspace.com/avatars/traveler.html

look, what they wear, and how they behave.[101] Just as in social circles, clothing and accessories remain important in the virtual world. Studies of user behaviour show that avatars are not twins copying the physical and psychological features of their creator, but rather they have their own personality. Users may use their computerised representatives to project their fantasies, with pale geeks becoming muscled hunks, and so on. Studies have been carried out on the *types* of personifications users prefer in visual chat environments. Popular categories include *real-face, animal, cartoon, evil, celebrity, seductive*, and many more.

This section concentrates mainly on the creation of avatar personifications with *human* features, the preferred appearance for agents carrying out the role of tour guides in virtual museum environments. Personification means more than just placing the user's avatar in the virtual space; it is also connected with tracking users' preferences and knowledge. These technologies will develop rapidly in the following years, as they will be increasingly crucial in terms of user satisfaction. Robotic avatars and those used in home media servers are also covered here.

Human avatars/agents

Human avatars are either full-body or head-only animated computer images, which may or may not be able to 'speak' via TTS engines. They can be used for personal communication (to read incoming e-mails) or in entertainment and leisure applications. The development of human avatars has its roots in photogrammetry. Photosets, comprising a full-body scan (or full front and full profile in the case of heads) are required as initial data. The user is then guided to fix different data points on specified areas of the sets. The data thus acquired are processed and used to modify a standard mesh, mapping a 3D model. The result is a customised avatar based on a real person's digital image. Completed with animation transformations, the image changes to produce facial expressions, and/or gestures and other body movements. Modern avatars can be augmented allowing users to add emotional expression capabilities.

Enhanced with text-to-speech technology, avatars can speak. Despite the last two decades of advances in digitisation equipment, animation algorithms and computational power, realistic human moving images are not yet possible. CGI graphics have evolved sufficiently to allow moviemakers to assemble casts of entirely computer-generated actors with human voices, as films like *Final Fantasy: The Spirits Within* (2001) demonstrate. A crucial factor in the way an avatar is received by its users lies in the realism with which it mimics human behaviour. Avatars do not convincingly resemble real humans, and characteristics such as personal intonation and slang are not sufficiently realistic; but the technology is maturing rapidly.

By employing such tools as Macromedia Flash in place of three-dimensional modelling and video-realism, it is possible to create online characters which add a little more humanity and interaction to multimedia applications and Web sites.

Avatars can be fairly easy to use and maintain once the software has been installed and set up. The programs used to run avatars often include facilities for generating responses

101 **The Neversoft/Activision** video game *Tony Hawk's Underground* (2003, http://www.activision.com/microsite/thug/thug.html) allows users to map their own faces on to their computerised representatives, thus enhancing the immersiveness of the game. As one fan puts it, 'There's no doubt that your initial reaction to getting your face in the game will be, "Dude, That's ME!"' (http://www.planettonyhawk.com/thug/info/preview/). **Virtual Clones** allows similar treatment in applications ranging from computer games to movies and TV: http://www.virtualclones.com

to typical questions, and for changing aspects of the avatar's appearance including outfit, facial features, and mannerisms.

The most frequent means by which users communicate with Web-based avatars is by typing instructions or messages into a text box. Responses from the avatars appear in another text box. The background software running the avatar analyses a query or response for keywords, and then searches for appropriate answers in its knowledge database. The avatar's conversational abilities can be developed and made more useful and natural by monitoring the user's behaviour and updating the knowledge database that the avatar software queries. In order to view avatars on the Internet, users require a browser plug-in; this is not dissimilar to the dedicated utilities (such as those made by **blaxxun, Cosmo Software**, and others[102]) required to view virtual reality environments.

From early, largely immobile avatars, the technology has developed towards increasing realism, and data capture and animation are now used in the production of avatars. There are two main stages in this process: tracking the desired motions, and visualising the avatar.

In the first stage, the movements and motions made by an avatar (or agent) are generally tracked and stored digitally. There are currently a number of devices that can be used to digitise a person's real-time motions, including optical systems for tracking facial expressions, data gloves for capturing hand/finger movements, and sensor-enabled body suits for capturing posture. These movements are captured at a high resolution, and sequences of movements can be stored as video clips.

After these processes are complete, data from tracking systems for face, hands and body can then be combined to achieve a realistic full-body animation. To make real-time visualisation viable, the avatar's movements may follow predefined sequences. The visualisation software 'glues' the captured sequences consecutively, giving the observer an impression of continuous movement.

Creating avatars using this technology is still expensive. Data capture remains a labour-intensive and specialised task, and the image processing and animation algorithms require top-end computing resources. The process becomes still more costly when combined with text-to-speech functionality. Depending on the features and level of realism, avatar software for Web deployment can (in 2004) cost as much as €25,000 to €100,000 per annum. There are, however, companies that offer cheaper 'talking heads'-type solutions.

Robotic avatars

Robotic avatars consist of a physical mobile platform (the robot itself) and a separate workstation, with a representation of the user's avatar appearing on-screen. The workstation will typically host a database containing information on the museum, including its exhibits, at various levels of detail depending on individual visitor preferences, Web links for communication with televisitors and to the on-board control block, and a multimedia Web interface which provides interaction of the system over the Internet. Users can thereby control the robot's movements from a distance, specifying directions and objects for observation. [Roussou *et al.*, 2001 (full ref. on page 194)]

The mobile platform will typically be based upon an on-board interface which provides interaction with on-site visitors of the museum, and a control block which takes care of

102 http://www.blaxxun.com; http://ca.com/cosmo/. For more browser vendors see *DigiCULT Technology Watch Report 1*'s section on Virtual Reality and Display Technologies (pp. 95-116).

wireless communication between users/administrators and the database, and sensor commands and user instructions for the robot's navigation. The mobile platform may also feature camera controls that allow visitors to select a specific exhibition zone for detailed inspection and, among other parameters, adjusting distance, and resolution.*

Avatars and Home Media Servers

The convergence of technologies has led to the development of home media servers (HMSs), which bring together the features of television/video and computers, with different modes of connectivity. An HMS could typically serve as a wireless TV tuner; a data recorder currently supplied with a hard drive; audio/movie/PC data file server, and a wireless broadband router. With memory capacity measured in tens (or even hundreds) of gigabytes, an HMS can be used for storing large amounts of audio, video and multimedia data. The price for such a device is currently over €1000, but as ever it is expected that successive implementations of this technology will increase in popularity as the prices fall.

Digital television was initially organised in the same way as analogue TV, the only differences being the improved picture and sound quality. Digital TV gained in popularity when it started offering new services, such as Video-on-Demand (VoD), multimedia games, and Electronic Programme Guides (EPGs). EPGs combine the user interface with a programme schedule, accessed via an infra-red remote control. Since it is designed for a multi-channel technology, one of an EPG's basic uses is to assist consumers in discovering and bookmarking content. Interactive guides allow advanced searches by channel, programme, actors, year created, genre, time, and a number of other variables, hence EPGs raise a user's degree of choice to a new level.

In addition to this, home media server users are able to access information about the presence of other users by means of instant messaging technology similar to that used in the desktop PC environment. This is a very simple and very popular form of communication, and one that may be enriched by the addition of avatars. The scenario on 'Television, Avatars and an Art Gallery' later in this chapter explores these possibilities in more detail.

Personalisation

Home Media Servers have more than one way of bringing content to users. Their core capability is in contributing to a personalised user experience, with information adapted to the user's preferences. This is another attempt to respond to specific informational and emotional wants and needs of the user. Users are provided with an optimised individual experience. The system requires the capacity for constructing, storing and querying user profiles. Building user profiles can be done directly by asking users to complete a questionnaire and to specify topics of interest, asking them to choose from a list of standard profiles, or by automatically constructing profiles based on the analysis of a user's actions. Profiles should be continually updated by tracking, for example, preferred types of music and movies, amount of time spent on particular channels, and other users with whom the user communicates frequently.

Approaches to personalisation could be grouped by types of action, including selection from a list of keywords or categories, query analysis, or the intelligent filtering of preferred

* See the forthcoming *DigiCULT Technology Watch Report 3* for more detailed coverage of the combination of avatars with robotics.

content and contacts. Integrated solutions will continue to grow in popularity and in the imaginative new uses to which they can be put. It may be worth bearing in mind that such an intensely personalised user experience may lead to a form of profile-driven isolation and eventually a narrowing of personal experience opportunities. This is an issue that requires more study.

Skin Technology

The advent of skin technologies, user-defined interfaces to standard applications, gives personalised richness. 'Skins', as they are commonly known, are often found for media players such as **Nullsoft**'s *WinAmp* and **Microsoft**'s *Windows Media Player*, as well as IRC instant messaging clients.[103] Skins essentially act as stylesheets governing the delivery of standard content from the content provider's server. Factors such as font types and sizes, graphics and music will differ according to the skin chosen by the user. Skins may also act as filters, keeping certain elements of the content hidden if the user has indicated no wish or need to see it.

While their appeal has traditionally lain mainly with the youth/novelty market, skins have recently been deployed to worthwhile effect in libraries, allowing different groups of users (e.g. engineers or historians) to interact with a single library system via a dedicated 'theme' skin. Applications of this kind are designed to increase user comfort while they navigate a system, and to help them to find relevant resources both locally and on the Web.

The University of Tennessee Library has used **VTLS** *Chameleon Web Gateway*[104] skin technology since 2001. Their system employs over twenty-five different skins which can be selected according to classes of user interests, and which change with the seasons. If users wish, music can be selected to accompany the skins.[105] Chameleon uses CSS along with HTML, but there is a growing tendency towards the predominance of XML. **Dynix**'s *Horizon Information Portal*, for example, uses XSL (Extensible Stylesheet Language) in conjunction with XML-encoded content.[106]

Skin authoring is widespread among the user communities of media players and chat clients, composed traditionally of young and technically competent users. The technology is not easy, and the development of dedicated library portals/skins will require greater knowledge of interface design on the part of library staff.[107] This may be an area where the outsourcing of development work is beneficial. The same approach can be used to modify avatars, with different skin textures applied to a single underlying model to create a variety of characters and identities. This is most widely experienced in God games such as **EA Games**' *The Sims*.[108]

103 http://www.winamp.com/; http://www.microsoft.com/windows/windowsmedia/default.aspx
104 http://www.vtls.com/Products/gateway/
105 http://www.biblio-tech.com/BTR901/February_2001/vtls_2001_02.html
106 http://archive.ala.org/alonline/ts/ts302.html. Dynix HIP: http://www.epixtech.com/products/hip/. N.B. Dynix formerly traded as **Epixtech**, and the HIP product was formerly known as iPAC.
107 http://www.jisc.ac.uk/uploaded_documents/tsw_02-03.doc
108 http://thesims.ea.com

Avatars, Personalisation and the Heritage Sector

Brief Background

The combination of avatar and agent technologies with database storage of behaviours, textures, skins, and voice technologies means that avatars are becoming more easily re-purposable and less demanding on the systems that deliver them. Real-time online delivery, however, may remain a problem until fast Internet connections become the worldwide rule rather than the exception.

This section's case studies provide an insight into the uses of avatars in three very different arenas. **SEONAID** (the Scottish Executive Online News and Information Distributor) was conceived as an outreach tool for getting younger citizens interested in the workings of their government. The avatar approach has proved such a hit that Seonaid is now being adapted as the virtual face of the Scottish Executive – a form of 'branding', in advertising-speak. The **Peranakans Project** deals with culture, history and education, with the avatar guide being used as an immediate, visual and identifiable conduit for learning about different ways of life. The EC-funded **TOURBOT** Project combines avatars and robots to allow visiting of museums with surprising results.

The scenarios that follow trace the uses of agents and avatars from home television sets to mobile devices and out into the wider world, with a dance academy imagined that uses avatars both as an instructional aid and as a means for preservation.

Case Studies

SEONAID – Scottish Executive Online News and Information Distributor[109]

Outreach is always tricky, particularly when an organisation is attempting to reach out to groups that traditionally lack an interest in the material or business in question. This is seldom truer than in introducing young people to the workings of government. The **Scottish Executive**,[110] the devolved government body for Scotland, was seeking to do just this. Responsible for most of the issues of day-to-day concern to the people of Scotland, such as health, education, justice, rural affairs, and transport, the Executive delivers large amounts of information, much of it via its Web site. Its aim is to keep citizens informed in a timely and accurate fashion. The Executive's Web managers seek ways of presenting information to diverse groups of people, ways which are appealing, make information discovery and use easier, and are relevant.

The Executive launched the 'Modernising Government' programme to improve the quality and accessibility of public information and services through technology.[111] The Executive wished to add a more human dimension to the electronic interaction between citizens and government, so that technology engaged rather than distanced the citizen.

109 http://www.scotland.gov.uk/pages/news/junior/introducing_seonaid.aspx. This case study is based on answers to an e-mail questionnaire completed by Jeff Marksz of DA Group and Stephanie Baldwin of the Scottish Executive in November 2003. Other sources are acknowledged in footnotes.
110 http://www.scotland.gov.uk
111 http://www.scottish.parliament.uk/S1/whats_happening/research/pdf_subj_maps/smda00-09.pdf

They aimed to encourage visits to the Web site by providing simple, attractive and straightforward mechanisms to access information. To this end, the Executive introduced a virtual digital 'character' in the shape of a stimulating and intuitive avatar, as a way of making government more engaging for young people.

After looking at companies across Europe, **DA Group**[112] (DA) was commissioned to develop an approachable and effective way to communicate news online. Their solution was Seonaid,[113] a 'cyber' anchorwoman capable of reading the news, accompanied by all the expected animation and signs of human emotion. Seonaid is a fully animated 3D character utilising DA's patented avatar technology and is the world's first real-time virtual character on a governmental Web site.

SEONAID: the Scottish Executive Online News and Information Distributor

The first step in defining the avatar was to establish basic parameters such as age, sex, hair and eye colour. Adding extra visual and sensory characteristics together with natural body movement gave shape to the avatar's human elements. Seonaid's technology employs a 3D model integrated with a text-to-speech engine, movement programming and automated lip-synching, natural face and body movement, emotional response, and unique personality traits.

The avatar is controlled through an interface that allows full broadcast-quality video footage to be created using simple text inputs and a basic markup language (automated through DA's user interface). The avatar technology is integrated into a publishing engine that connects with the Scottish Executive's content management system, automating the creation of video files and allowing the user to create a playlist of video files. The file can then be concatenated and formatted for publishing via multiple delivery channels. DA's software coordinates Seonaid's lip movements with natural face and body movement, emotional response, and personality traits. The software allows text to be marked up with a simple set of expression or 'action' codes. In the words of Jeff Marksz, Business Development Director at DA Group, Seonaid delivers the news 'word-perfect and without rehearsal, in a matter of minutes.'[114]

The implementation of the system took around three months; however, ongoing improvements have been made since development began in September 2001. Total development costs reported in the Scottish Parliament on 30 August 2002 were £151,833 (€216,011) plus VAT. Seonaid's technical heart is in technology developed by DA Group. However, integrating the publishing engine with the Scottish Executive's content management system and the user database required some lateral thinking. This was resolved

112 http://www.digital-animations.com
113 Seonaid (pronounced '*sho*-na') is the Gaelic form of the girl's name 'Janet'.
114 http://www.digital-animations.co.uk/html/1-4_casestudies/1-4-3_seonaid.html

by using an automated replication protocol that kept all of the systems in synchronisation, and did not depend on real-time links between the systems, which would have raised many integration and security issues.

The Executive provided the project's design brief and held regular face-to-face meetings with the avatar specialists as the project progressed, making suggestions for technical and other amendments. The project drew extensively on Executive staff expertise in traditional and emerging communications channels (including mobile communications), together with DA Group's specialist knowledge and experience in the implementation of avatars and mobile solutions. Seonaid's interface was designed for use by non-technical personnel and for future scalability, hence maintenance requirements are relatively low. System use does require some understanding of transcoding (changing one format to another for use on different software or devices[115]) to manipulate the publishing templates. The control system is easy to use, according to Stephanie Baldwin, senior editor of online news at the Executive. 'We just type in the news story or feature that we want Seonaid to read, then we use pull-down menus to select her wardrobe, the camera angles and presentation format that we want to use, and the software effectively does the rest.'[116]

Seonaid is now fully operational and is a permanent feature on the Executive's Web site. The character was given a Scottish accent after a year (developed by Edinburgh firm **Rhetorical**[117]), in order to maximise Seonaid's local attractiveness while broadening her audience appeal, and to provide increased variety and control.

Seonaid's first appearances were on the *Junior Exec* Web site, reading news and hosting events. Since then her popularity has blossomed, and the character has become more broadly associated with Scottish Executive communications. Seonaid now appears in mainstream news announcements, marketing initiatives, and other communications such as conferences, exhibitions, and promotional videos. She is treated as the online 'face' of the Scottish Executive.

Since Seonaid's introduction, the Executive's Web site has seen page impressions increase by sixty-three per cent, with a thirty-seven per cent increase in unique users (October 2003 figures). Search engine-generated traffic has almost doubled, at 177%,[118] with the avatar's unique attraction being borne out by the increase in Web traffic since her introduction. Seonaid's formal evaluation is carried out through regular analysis of Web site statistics. Seonaid is currently undergoing further development with input being gathered from invited stakeholders such as teachers and parents, education authorities, and organisations such as Learning and Teaching Scotland. It is planned to test these proposed changes on the Junior Exec site early in 2004.[119]

For her developers, Seonaid is helping to break down the barriers of traditional human computer interaction while her persona is concurrently helping to change young people's perceptions about politics and online news delivery in general. Development on the Junior Exec Web site is geared towards using Seonaid to facilitate the use of online learning resources by children between the ages of eight and twelve.

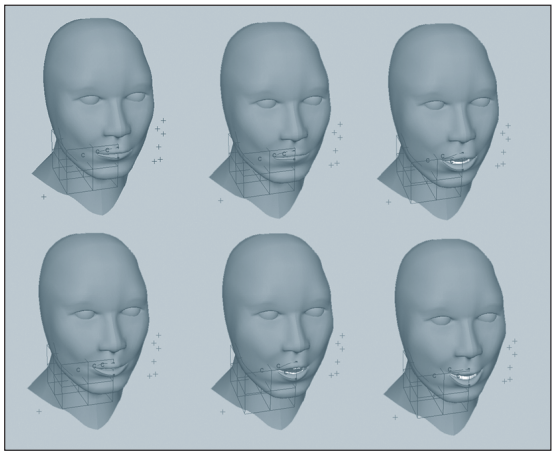
There may be further scope to extend Seonaid's usefulness to include video mobile messaging: a pilot to test her effectiveness in this medium is currently under way, and is

115 For more on transcoding see http://searchwebservices.techtarget.com/sDefinition/0,,sid26_gci515589,00.html
116 http://www.wired.com/news/culture/0,1284,55446,00.html
117 http://www.rhetoricalsystems.com
118 http://www.wired.com/news/culture/0,1284,55446,00.html
119 In the past, students have also been asked to assess her design and presentation, resulting in fashion design students from **Heriot Watt University** submitting designs for an image makeover.

expected to be completed in the first half of 2004. In the interests of improving communications with citizens further, the Scottish Executive has been investigating combining the success of Seonaid with the emerging possibilities of colour mobile devices. The pilot scheme has been conceived to test the efficacy, in terms of both technical feasibility and popularity among citizens, of multimedia messaging of Scottish Executive communications. There may also be the possibility to incorporate a range of languages (including sign language) into Seonaid's repertoire as the technology develops. In the words of the Scottish Executive's Finance and Public Services Minister Andy Kerr, 'Seonaid has the potential to… open up Scotland to the rest of the world, and to Scots whose first language is not English, at the touch of a button.'[120]

The Peranakans Project[121]

The Peranakans are descendents of an early Chinese community that settled in the Malay Archipelago around the seventeenth century. This unique community developed distinct customs, cuisine, and even their own language, blending Chinese and Malay ways of life to form a rich new culture that enriched Singaporean society.[122]



Synchronising avatar lip movements with speech

The Peranakans project is a digital heritage venture that employs 3D modelling techniques in order to integrate a virtual avatar tour guide with realistic Peranakan heritage objects. The project's objective is to combine state-of-the-art virtual reality (VR) and avatar techniques with the culture of the Peranakans in order to produce an application that will inform users about the history and culture of the Peranakan people. With many heritage and cultural sites being destroyed or lost to urbanisation, pollution, neglect, and even tourism, the need to preserve, restore, and interpret cultural heritage sites in new and innovative ways has increased tremendously over recent years.

The project, which began in late 2001, is likely to run for five years. It is the work of the **Centre for Advanced Media Technology** (CAMTech[123]), a joint research and development centre involving the **Fraunhofer Institute for Computer Graphics** (IGD) of Darmstadt, Germany, and the **Nanyang Technological University** (NTU), Singapore. CAMTech is a member of **INI-GraphicsNet**,[124] and the CAMTech project team currently comprises two Directors, Dr Wolfgang Mueller-Wittig and Dr Tony K.Y. Chan, and two Research Engineers, Meehae Song and Thomas Elias. The CAMTech

120 http://www.scotland.gov.uk/pages/news/2002/07/SENW058.aspx
121 This case study is based on an e-mail questionnaire completed by Meehae Song and Thomas Elias of the Centre for Advanced Media Technology in November 2003, and on material available from the Web. All sources are given in footnotes.
122 http://www.inigraphics.net/publications/topics/2002/issue5/5_02a06.pdf
123 http://www.camtech.ntu.edu.sg/index.html
124 http://www.inigraphics.net

team has benefited from access to expertise developed on other INI-GraphicsNet digital heritage projects such as the *Dome of Siena* project, which was showcased at the *EXPO 2000* in Hanover, Germany.[125]

The project has two chief research objectives:

1. To recreate a high-quality, three-dimensional scenario of a complex digital heritage environment, capable of real-time rendering using virtual reality technology;
2. To develop and use transparent and intuitive, context-specific, and user-friendly interaction techniques.

In developing a project of this type, a first step must be to select the cultural and historical content that will be digitally recreated and presented. Preliminary research has been carried out on Singapore-specific cultural and historical content, and this research continues via a collaboration between CAMTech and Peranakan experts.

© CAMTech

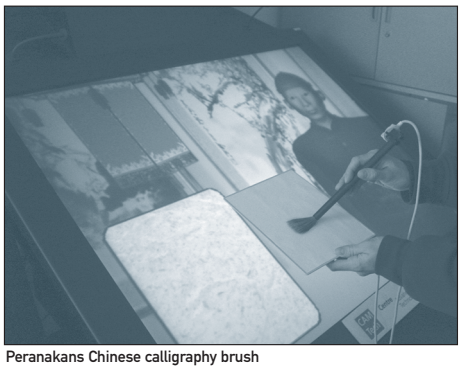
The Virtual Tour Guide in his chamber

The Virtual Tour Guide in his chamber

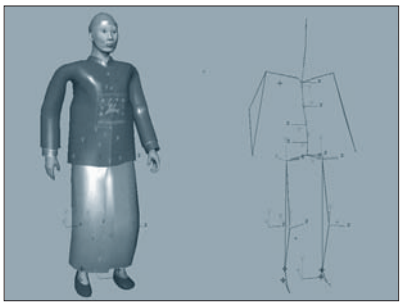
Technical work on the project has so far centred on the development of a Virtual Tour Guide (VTG) for directing visitors around the virtual environment. In keeping with the Peranakan profile, the VTG is of Chinese ethnicity, and is dressed in traditional Peranakan clothing. The VTG interacts with visitors by showing them around the Virtual Environment and providing information on Peranakan history and culture. The VTG talks to the visitors, and also provides supplemental information in the form of text, images and video. A visitor can explore the Virtual Environment and all the objects it contains by walking through the virtual rooms alone, or the visitor may ask the VTG for a guided tour. During the tour the visitor follows the VTG and receives additional information on exhibits. The visitor can interact with the VTG at any time: if she wants additional information on an interesting exhibit, she simply selects the exhibit and calls on the VTG to provide further information.

As well as the avatar tour guide, a Chinese calligraphy brush has been implemented as an interface, allowing users to execute commands and move around the virtual environment. The VTG is used to introduce new visitors to the Virtual Environment, and to show them how they can use the brush for interaction. He explains the Chinese characters that the visitor can write as commands/instructions, together with their associated functionalities.

125 Behr, J., Fröhlich, T., Knöpfle, C., Kresse, W., Lutz, B., Reiners, D., Schöffel, F. (2001) "The Digital Cathedral of Siena – Innovative Concepts for Interactive and Immersive Presentation of Cultural Heritage Sites", in *Proceedings of ICHIM 2001*, pp. 57-71.


© CAMTech
Peranakans Chinese calligraphy brush

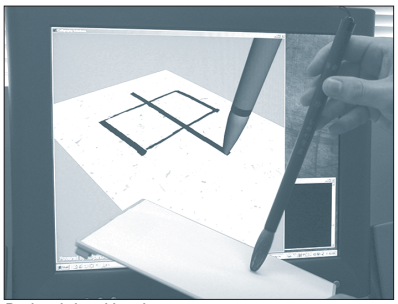
The impetus behind the decision to use avatars was based on the conviction that they contribute towards a much more compelling learning environment than static and passive interfaces. A virtual avatar seemed to be the natural interface for user interaction as it replicated real work modes of communication. Given CAMTech's expertise in VR technology, the team was able to recreate fully immersive environments of historical heritage objects and environments that can be entered and viewed in real-time. By providing innovative interaction techniques and methodologies that are specific to the reconstructed environment, a relevance of interface to content is created, which aids understanding of the historical and cultural content. This leads to a 'learning-by-doing' scenario, wherein the user is able to participate actively in the virtual environment rather than merely experiencing it as a passive observer. Learning-by-doing scenarios have been proven to be more effective than conventional (passive) learning techniques. The application's main goal is to educate the public effectively on the history of the Peranakans and their culture. By using VR technology with the tour guide and the calligraphy brush as the interface between the application and the user, the project allows users to 'enter and explore' the virtually recreated 3D environment, thus enhancing the learning curve.


© CAMTech
The Virtual Tour Guide and his moving parts

The 3D Modelling for the VTG and the various exhibits and architecture for the Virtual Environment was carried out using **Discreet**'s *3D Studio Max* and **Alias**'s *Maya*.[126] The VTG's modelling is divided into two parts: face and body modelling. For the face modelling, a base face was created and viseme 'face-sets' were derived from the base head.[127] The base head uses the different visemes as targets to 'morph' between the mouth shapes to create an appropriate relationship between mouth form and the analysed sound files for speech generation. The VTG's body was modelled and mapped to a base hierarchical skeleton in order to generate animation sets to support movement such as walking and climbing stairs.

Both in-house software and *OpenSG* were used for the real-time visualisation. The source code of both systems is available to the programmers, and it can be adjusted to suit a range of needs. This made possible the skin and bones system, and the avatar's speech generation. The Chinese calligraphy brush was chosen for the interaction tool because it is unique, fun, and fits the Peranakan context well. The brush is tracked by an electromagnetic tracker, a device that the team has employed effectively on earlier projects. An interface for this tool had been developed for a previous project, and this code was reused without any need for modification.

126 http://www.discreet.com/3dsmax; http://www.alias.com/eng/products-services/maya/maya_unlimited/index.shtml
127 Visemes are the mouth positions/shapes of a particular sound in speech.


© CAMTech

Real and virtual brushes

The only suitable alternative technology to OpenSG was Java3D. OpenSG offers superior performance and flexibility when compared with Java3D. So far, creation of the avatar has been the most challenging part of the project. The skin and bone system and speech generation required to realise the avatar were the deciding factor in the choice of C++ and OpenSG. All of the 3D models are exported to Virtual Reality Modelling Language (VRML[128]) format. As Maya's standard VRML exporter does not export the avatar textures (skin and bone, and other materials) satisfactorily, the team had to write their own exporter for this purpose.

The implementation of avatar technologies lies at the core of the Peranakans project. The VTG avatar increases the edutainment value of the application. It also establishes a user interface that is much more personal and natural than those driven by buttons or menus. The tour guide analogy makes his purpose immediately understandable. Visitors come with expectations of tour guides; for example, they know the VTG can show them around, give information on exhibits, and answer questions where conventional buttons and menus may not be so intuitive.

The CAMTech team has developed a demonstration program that shows a three-dimensional Peranakan chamber complete with selected furniture models. The purpose of this program is to test the real-time rendering of the 3D models, as well as the user interaction with the calligraphy brush. Visitors can use the brush to navigate around the environment by pointing with it at the screen, or they can write simple Chinese characters with it to execute commands. This is trickier, and visitors usually have to try it a few times before they can manage to form characters that the system recognises. This is due to the simple recognition method used by the system; visitors must write the character stroke by stroke, and lift the brush off the writing board between strokes.

Evaluation and user testing of the VTG remain to be done. Future evaluation will include analysis of user interaction with the avatar; visitors will be encouraged to select questions, ask the VTG for recommendations and advice, and follow him during a tour. Close collaboration with Peranakan content experts will continue in order to construct a detailed and content-rich portrayal of the Peranakan culture. Other development tasks include constructing a storyboard, the enhancement of the Peranakan object library with more digital cultural artefacts, improved natural behaviours for the VTG, and a more intuitive and seamless interface between the virtual and real environments. One major benefit of this avatar model is that it can be repurposed for other applications simply by changing its outfit, underlying information database, and behaviour settings.

There are many potential future application areas for this project. While the application serves as content for the local market in Singapore and the outlying regions, the intuitive character will make it an effective vehicle for reaching a global audience. Within the Singapore market, there are few ongoing digital heritage projects and almost none with CAMTech's extensive expertise. The team hopes to create a niche market for digital heritage applications specific to Singapore and its region, by diversifying its focus into applications such as museum installations, the World Wide Web, and games.

128 For more on VRML and Java3D, please see *DigiCULT Technology Watch Report 1* (pp. 98-100 and 102).

Scenarios

Selecting an Agent for a Museum Guide

In this scenario, an open-air museum is famous for its high-quality presentation of everyday life in a small village set in mediaeval times. The museum was started as an open-air exhibition area with buildings where wax figures of people were installed to illustrate the work of various craftsmen and some typical rituals. In recent years live craftsmen and women have been hired to demonstrate how work was done in bygone days. These professionals are dressed in authentic clothing to match their environment. Wax figures are still used in the places where public ceremonies are shown, because it would cost too much to hire real people to populate religious ceremonies, tournaments, and market places. The local historical re-enactment society is unable to take part in these festivities at the scale and on the regularity desired by the management team.

The museum managers noticed an increase in visitor numbers and excitement after the introduction of the live actors and craft specialists, with visitors starting to ask questions of them. The craftspeople began to find their roles blending with those of the exhibition guides; however, they were sometimes not able to answer some subsequent visitor questions, particularly questions on general history, practices, the arts, and the Church. Sometimes they were asked if they spoke the mediaeval language, which they were unable to do. Training courses for craftspeople were held several times, but some felt uncomfortable with taking on a 'guide' role, and were unwilling to spend additional time and effort learning mediaeval phrases.

When the museum decided to set up a virtual exhibition, the question of what its virtual presence would be like was crucial. The museum already kept detailed records on typical users and FAQs heard in the exhibition area, but it was clear that the move to the virtual world could well change the audience and its interests. A team including HCI designers and museum guides was appointed to define what the agent should be like. The team discussed three central issues: *What is the primary goal in creating a virtual exhibition; how should different types of visitors be approached; should the user be represented by an avatar, and what technology will be required for this?*

The management suggested creating a virtual version to be made available on the Internet, and which would serve to raise awareness and promote visits to the real exhibition, and support preparation for a visit to the open-air museum, or for additional personal study after a visit. These three activities differ – in the first case, the attraction power is most essential, while in the second and third cases the exhibition guides opined that the most important factor would be the level of detail of presentation of the historical period, the exhibition as a whole, and of the various objects shown there. One additional issue was how to present various skills in case visitors wanted to learn more about a particular craft. The museum was used to organising workshops for adults and children, but how could this be transferred into the virtual world? The team decided that action learning should be used as one of the attraction factors to bring people to learn and practise in the real museum workshops.

The exhibition guides had good skills in presenting stories to children and adults, whether the visitor had little knowledge about the subject or was an expert. The team agreed that, when the user entered the virtual world, her profile (including age, preferences, level of knowledge) and goal of the visit (just browsing; preparing for a visit;

studying additional material after a visit) should be established to offer her content of greatest personal interest. This information would contribute to defining the personal features of the avatars that the user would meet, the level of knowledge it would present, and its interface functionality.

The team examined two approaches: whether the agent should look like a person from the historical period presented in the virtual space (this would mean that all comments would be made from the perspective of someone who lived at that time) or a contemporary person (this would allow comments to be contextualised from a present-day perspective). The group decided that agents who acted as craftsmen and/or participants in ceremonies would be dressed according to the historical period and that the guide should appear as a twenty-first century person. It was intended to combine two means of communication: chat and TTS (text-to-speech technology). The user was able to decide whether the inhabitants of the virtual worlds should speak in their own language (in this case translation into the modern language appeared in the chat window), or speak in the contemporary language. The chat window was also used to display facts about the exhibition.

In terms of avatars, the team agreed unanimously that the virtual visitor should see her own actions in the virtual world. A pressing issue was how to select a character that would not be mistaken in the crowd. The team left for the future 3D scanning of the visitor who would appear in the virtual world as one of the inhabitants of the village.

While working on the project, the team agreed that the use of agents would not be the only factor for the success of the virtual world. They realised that providing flexible content and following users' preferences requires hard work to collect and organise the material properly. The managers decided that content providers should start with story-boards addressing the largest groups of visitors: children with general interests, children with interest in pottery, painting or religious life (these were the first fields that the museum presented in detail), adults without specific interests in the collection, adults with an intermediate level of knowledge about the period, and adults with expertise. A basic objective was to raise interest in specific crafts that would bring people to the real museum to take part in the workshops organised there. The team suggested that logs of the visitors' questions and profiles should be stored in order to analyse typical questions and wishes of virtual visitors to lead future developments.

The team is now expecting that the feedback from the introduction of the virtual exhibition, and information on the dynamics of the visits will be collected in order to see what influence the new technology has on the day-to-day activity at the museum.

Avatars for Dance Instruction

A respected national dance school has a large number of students specialising in different areas of dance. Some are performers, some choreographers. The school has an excellent reputation for theoretical and historical study stretching from individual national folk dances to the development of modern styles. The school runs evening classes for the local community in addition to its daytime teaching activities. As well as being an educational institution, the school is an artistic venue, presenting performances by international dancers and its own students. Its rehearsal and performance spaces and resources have recognised local value. The school has two sound and lighting technicians, and two dedicated ICT professionals.

After an appraisal of the school's activities, it emerges that some staff and students feel that the programmes and curriculum are being limited by practical issues, and the issues

are identified through staff-student meetings. Although the school's knowledge resources are excellent, it is felt that there are areas for improvement regarding support for the *practice* of dance. Students currently practise in the dance studio which has a mirror and a music system, but little else. In addition to this, the number of students studying a single subject area imposes serious limitations on the size of a performance and the number of dancers it can involve. The number of students in a class ranges from five to twenty and, although classes collaborate on performances, dances with more than forty dancers have always been logistically impossible. The choreography students in particular feel the adverse effects of this limitation, since experience of doing choreography for large casts is both challenging and demanding.

While the school has some excellent multimedia resources (including video and slides of past productions and visiting performers, purchased videos and DVDs, files of 'footprint' dance patterns), these items tend to be underused in comparison with traditional teaching methods. Students and staff alike feel that these learning resources, although useful for theoretical study, lack 'physicality' and are of little practical use.

With avatar and motion capture technology having progressed to the point where – although still fairly expensive – it is within the school's budget, the ICT and teaching staff decide to implement a collaborative multimedia dance and choreography resource that will use motion capture and human body avatars to record and present dance movements.

The school begins by investigating sources of male and female avatars that move realistically within their surroundings. They discover several experienced companies who already have this technology in place and specialise in kinaesthetic motion capture. After commissioning and reviewing a requirements capture, the project is put out to tender. By this stage the school has decided that the resources and applications will be organised in two themes – 'Learning and Practice', and 'Creation and Presentation'.

The Learning and Practice section will have a searchable database of dance movements from all styles and periods (with appropriate metadata), each with an animated avatar who 'performs' the movement. This is linked to other material such as the dance pattern, still or moving images (from the existing collections) of the movement within a dance, and textual historical and contextual information about the movement. Finally, a drum rhythm or repeating musical sample will be incorporated which can be set at various tempos to help in practising the step.

The Creation and Presentation section will allow users to capture a movement which will be mapped onto an avatar, and subsequently viewed, stored and recalled. This must also allow the user to 'instruct' the avatars according to steps and movements already stored in the database, or with real-time input. The timing and synchronisation of movements and the placing of avatars on a virtual stage, thus visualising an entire performance, should be the ultimate goal.

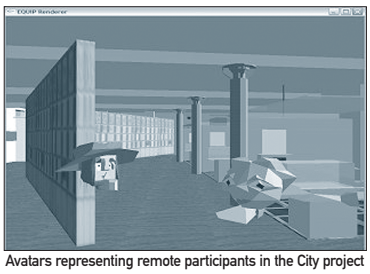
It is expected that performance specialists will be the group most likely to use the Learning and Practice modules, although all students are expected to develop a thorough theoretical knowledge which will be enhanced by this interconnected resource. Both dancers and choreographers will benefit greatly from the dance visualisation applications and it is anticipated that fully realised avatar performances may be submissible as coursework for the choreographers, and made accessible to a wider community.

The ICT and teaching staff work together with a digital avatar specialist, developing and testing the application, and finally installing the system in a new multimedia room, which combines a large space with motion capture equipment and several workstations. The system is installed in the school's computer lab, and staff and students are consulted

on defining the interface. Eventually the entire school community is offered the opportunity to use and evaluate the system as it develops. Encouraged by the system developers, the school plans a low-key, six-months evaluation and intends to make the results known to other schools and colleges. They plan to use the results of the evaluation to support a grant to facilitate the take-up of the system.

The novelty of the new system invokes a huge amount of interest from around the world, not only from other dance schools, and gains attention from the media when a visiting international dancer has a short performance captured and replayed. This 3D record of his visit is stored in the database, and the school decides to record as many visiting dancers as possible for posterity. The staff also begin to contact national folk dance societies in order to increase the avatars' dance range and repertoire.[129]

Television, Avatars and an Art Gallery



© EQUATOR

Avatars representing remote participants in the City project

A keen television viewer with her own home media server decides to watch a programme about an art gallery in Moscow. She selects the channel, and her avatar appears in the corresponding room in the virtual environment. This room serves as a virtual art gallery with paintings that can be studied in detail, together with background information and links to related works. If there are other viewers with compatible set-ups, their avatars will also be walking around in the space, and there may also be an agent (or a group of agents) providing guided tours.

The user chooses a particular painting. It presents one of the popular squares of Moscow in the seventeenth century. The guide explains to the user what the scenery is, and suggests watching a video which shows how this place looks now. Since one of the buildings in the painting is of major historic importance, the guide also suggests entering its virtual model.

Thus the user is able to see the building first on the painting, and then on a video presenting it in modern times. The virtual model adds even more. The user is able to study architectural and design details which are impossible to see even if she visits the real building, since part of it is closed for reconstruction, and many details on the ceilings and pillars cannot be seen up close. The user is now accompanied by a new guide. The guide is dressed as the chief servant in the house. He knows everything about the rooms, and the furniture and fine arts stored in them. He is also well informed about the history of the family. To keep the interest of the visitor, the servant shares funny, sad and scandalous stories about the people who lived in the house. Some past members of the family also appear as agents.

The visitor is invited to join a tea party in the afternoon, and a masked ball in the evening where she meets other avatars. She is able to interact with the agents and with other avatars using instant messaging technologies, although other developments are planned. Thus she discovers other people from the real world interested in that historical period.

129 For an account of the procedures required to build a repertoire of avatar movements and behaviours through motion capture, see Jehee Lee *et al.* (2002) "Interactive control of avatars animated with human motion data", available online at http://portal.acm.org/citation.cfm?id=566607&coll=GUIDE&dl=ACM&CFID=14533226&CFTOKEN=36034789

Should she change the channel, the user will have the option of moving her avatar there and meeting another group of avatars and agents in new scenery. She decides to widen her study to include painting in the eighteenth century. She enters a studio where she meets an artist, his models and his students. The artist first explains the technology behind a painting. He is dressed according to the time period, but is knowledgeable in modern painting, as he compares watercolours and oil-colours in the eighteenth century with contemporary painting materials and techniques. The artist also knows information about other artists from that time whose paintings are hung in the gallery. The visitor can examine preparatory work for a painting to gain a greater understanding of the artefact. The visitor is joined in the virtual environment by someone whom she had met earlier – the fiancée of another artist. These experiences could be shared only with friends, in this case fans of art, or a user may choose to make her avatar visible and capable of interaction with other, previously unknown, visitors. She lives a long way from Moscow, but the cultural life, both historic and modern, is now just one click away.

Advantages and Disadvantages

Introduction

There are many benefits to each of the technologies outlined thus far. Agents could become ideal tour guides when they are well constructed and do not distract the user too much with their appearance, movements, or speech patterns. When they are intelligent and reflect the visitor's profile, a good level of tour personalisation can be achieved. Since a full understanding of cultural heritage requires background knowledge of many disparate areas including art history, history, religion, and politics, there will always be a need for detailed and accurate explanation and guidance.

A core benefit of avatar technology is in the improvement of social communication in virtual environments. An active presence in the digital world could be interpreted as a form of escapism from the real world, and critics of this technology claim that it can lead to real world isolation. We are reminded of the degree to which the virtual world has become embroiled and intermixed with the real. The world preferred by a specific person becomes an issue of personal choice, and many can inhabit numerous worlds at different times, some real and some virtual.

Avatars and agents are generally considered to be entertaining and amusing. On account of the insufficient levels of realism possible and the limited (some may say 'prescribed') communication patterns, some users might end up disliking the idea of talking to a computer-generated agent. As novelties they may be amusing, but as agents become commonplace, like automated telephone systems, the loss of human contact may come to be considered more and more of an irritation.

Avatar technology cuts real communication costs. It is cheaper than videoconferencing and can offer a sense of anonymity, when this is a desirable factor. At the same time, avatars can provide an enhanced sense of presence, which could lead to the fulfilment of certain psychological needs.

The uses of avatars in museums are still new and have a long way to go, but their potential is staggering. Robotic avatars in particular may have a number of advantages over the current technologies used in museums and galleries. In particular, visitors will be able

to enjoy a personalised tele-guided tour in the real museum environment, and to set parameters related to viewing quality, optimising these for the device on which they are working.

Riskwise, the main psychological risk to be highlighted is that immersion in virtual worlds that is empowered by agents and avatars could lead to a form of isolation in the real world.[130] One obstacle to an increase in avatar technology in the near future is that the best current implementations are either prohibitively expensive, or are the results of research projects without sufficient standardisation, portability, or generic exploitability. The enthusiasm to show that the chosen approach is the right one may sometimes lead to unrealistic optimism about the perception of agents. While the use of agents or robotic guides in exhibitions is still rare, visitors may regard them as new toys rather than superior guides. Because the specifics of avatars differ from project to project, the cost of developing and using them is still difficult to measure. It is unclear how to charge users for such services, and prices can vary significantly between developers.

Advantages

Personalisation – Avatar museum guides can be geared towards target audiences, and the linking of avatars with databases allows a wide range of behaviours and information to be embodied in a single piece of avatar technology. Skins can help in repurposing interfaces for individual users and groups of users.

Fun – Avatars are entertaining, and serve to improve the social elements in computer environments and particularly computer-assisted/computer-based learning. Avatars can be integrated into Home Media Servers for personalised entertainment.

Conservation and Access – Used in combination with haptic interfaces, avatars may be used to 'examine' delicate and fragile artefacts in a virtual environment, thus leading to users developing an improved 'sense' of the objects.

Disadvantages

Lack of realism – Avatars are not yet convincing. Their novelty leads users to accord them a high 'forgiveness' factor, which as they become less novel will diminish. In addition to this, studies have shown that ninety per cent of human communication is non-verbal. Avatars are as yet unable to handle a broad enough range of non-verbal communication methods (e.g. gesture, eye contact).

Costs – Avatars are expensive to develop and maintain, but, as the Scottish Executive case study demonstrated, a couple of hundred thousand Euros can produce one which transforms how we use resources. As skills are developed and the technologies become more pervasive and simpler, avatars will become cheaper to create.

Charging – Charging for heritage information sources is still in its infancy, and we do not yet have any good models for charging for avatars.

Hiding behind an image – Using another identity is not always met with enthusiasm.

130 See the *DigiCULT Thematic Issue* on Virtual Communities: http://www.digicult.info/pages/Themiss.php

Introducing the Technology

Policy and Organisational Framework

New developments in avatar, agent and guide technologies are definitely changing the way in which exhibitions will be organised in the future, and how access to these shows will be provided. Electronic publishing offers additional sources of information, but these tend to be rather static and passive/non-interactive and the costs of updating the information are high. Avatar/agent technologies add a social component to virtual exhibitions; they could, for example, be used for interactive, long-distance storytelling. Their incorporation into home media servers will dissolve even further the idea of access points and fixed routes in a cultural heritage institution.

To start employing avatars/agents, a cultural heritage institution should define clearly what is the real setting and purpose to which they will be put:

- Is there a current virtual exhibition that visitors may like to study, and do visitors or guides need to be presented as avatars?
- Will one agent accompany every avatar, or will groups of visitors be formed?
- What should the agent look like? What images will appeal most to the visitors expected at the virtual exhibition? What choices should be offered?
- Would the organisation be able to develop special agents for users with disabilities, for example using sign language?
- What will be the balance in initiative in leading the tour between the computerised agent and the human-directed avatar?
- What interface method (trackball, mouse, joystick, touchscreen, haptics) will be best for controlling the avatars?
- Should the agent's appearance be contemporary to the original timeframe of the exhibition (if it comes from a definite time period), or to the visitor? Will the user be more likely to engage with and trust a contemporary agent or a modern one?
- Is the collection setting suitable for the use of robotic avatars?

What Existing Technological Infrastructures are Needed?

The crucial factor when applying avatar and/or agent technology for the first time is to use it in conjunction with an existing virtual exhibition. The development of a virtual exhibition itself is a huge task, requiring extensive digitisation, rendering, and processing work. If the collection already exists in digital form, the primary matter is whether an agent would contribute towards a better comprehension of the material within it.

The application of an agent into an existing virtual environment will require a certain amount of effort directed to building routes, supplying the necessary information, and carrying out tests and evaluation. Such effort should be planned and performed in collaboration with the collection managers and curators, and IT staff (if the organisation has any). Initial testing would be best performed in-house, followed by some external testing with users of various profiles.

Agents with advanced and intelligent user profiling features are still at an experimental

stage. Organisations may experience difficulties in drawing up detailed user profiling procedures, if such practices have not been carried out in the past. A good foundation might include factors such as age, preferences, periods/styles of interest, specific objects to include, and so on.

What Organisational Structures Make the Technology Appropriate?

Avatars and agents tend to be developed by large research consortia, and private development companies. At the moment, the best way for a cultural heritage organisation to gain an introduction to avatar technology would be by becoming involved in such a consortium. This will give the financial backing and technical wherewithal to produce a quality product, as well as the freedom to experiment with different approaches. If the organisation does not wish to get involved in a research consortium, another route would be to study the results of projects that are already complete, and investigate the possibilities of adapting their products in practice.

Staffing Levels and User-base Issues

The application of avatars and agent requires more than a supply of knowledge, expertise and information; rather it should combine the efforts of different staff members and departments together with their different views on exhibition and presentation strategies. The implementation of avatar technology may be viewed as a challenge to cultural heritage sector institutions, because, while it can be built around traditional routes of studying the exhibition, the technology's potential will flourish when different options are offered to match users' expectations and preferences.

The implementation of the technology could be centred around one core team, collecting as many creative ideas about the collection presentation as possible. The motivation of staff members to contribute to such a process will be one of the key success factors. Brainstorming sessions and studying various profiles of users' behaviour in traditional exhibition settings could be two techniques used to gather ideas on organising the virtual environment and its future denizens.

Mobile Access to Cultural Information Resources

Executive Summary

To facilitate access to exhibits and visitors' experiences and learning, cultural and scientific heritage institutions traditionally offer complex on-site information via labelled exhibits and docent-led tours, together with a variety of printed documents. When used, digital technologies are typically represented by multimedia kiosks and portable, pre-recorded audio guides.

Publishing background information and collections of digitised images on the Internet gives visitors an opportunity to prepare for their visits, or to gain further knowledge after a visit.

New mobile access technologies will be a powerful tool for making information resources available during visits to cultural institutions. These applications currently come in two primary types: the first is influenced by *positioning ability*, indoor or outdoor; the second supports the process of obtaining information on *specific items* at specific times, which can be considered a natural progression from standard, conventional audio guides.

Technologies likely to have a strong influence on future institutional strategies include increasingly powerful, portable and affordable devices such as PDAs and cellular phones, and new wireless communication protocols such as **Bluetooth**, **WAP** (Wireless Application Protocol) and **GPRS** (General Packet Radio Service).

In contrast to the use of audio guides or other specialised devices which typically required to be maintained by the cultural heritage institutions and were borrowed by the visitors, new mobile devices are often owned by the visitors themselves. This may bring a radical change in the way heritage institutions think about formulating and financing their technology strategies. What is becoming increasingly necessary is the ability to provide wireless connection to the right information and to suitable content, with guaranteed compatibility across platforms and protocols.[131]

Visitors therefore benefit from guides that can offer an unprecedented level of personalisation and self-direction. They now have the opportunity to follow the most suitable learning content that matches their interests most closely, and to combine information on the collection with Web content in a convenient and intuitive manner.

Early mobile access devices have already been introduced in a variety of institutions, and are commonly found in museums and open-air exhibits. This field is expected to undergo rapid changes over the coming years. A major concern at present is the understanding of the difference between the wired and wireless network approaches. Wireless applications require further development of new information architectures, and imply specific human/device interaction challenges. The costs of operating wirelessly are still much higher than wired alternatives, but these costs are steadily decreasing. The basic benefits that they promise are those of radically improved personalisation and connectivity.

© TheGlasgowStory and Glasgow City Council (Libraries, Information and Learning)

131 The Wi-Fi™ endorsement, awarded to wireless products that have passed rigorous interoperability requirements, can help with this. For background information, see the Wi-Fi Alliance at http://www.wi-fi.org/.

From museum corridors to city streets, the case studies contained in this section cover a range of approaches and purposes made possible by the development of portable devices. The ultra-futuristic, sociological ambitions of **Urban Tapestries** are in contrast to the more modest and practical educational aims of the **Handscape** and **MUSEpad** projects. Scenarios presented examine eTourism, preservation, and personalisation.

An Introduction to the Technology

We begin with three questions:

- How can we make a cultural collection available from anywhere and at any time?
- How can we match the user with his/her ideal guide?
- What form/format will these ideal guides take?

Wireless access, combined with handheld digital devices, may provide the technologies underlying a solution to these questions. In future it will allow users to access informational resources from almost any location, and without limitations on time. The use of a portable device to access a cultural institution's information resources may give visitors greater freedom to design their own visit.

Handheld devices, such as personal digital assistants (PDAs) and cellular phones, are currently among the most popular and affordable consumer technologies. Experiments with their use in the cultural heritage sector indicate that they have the potential to transform how we visit and experience heritage institutions. Handheld devices are flexible, have increasing amounts of storage, and provide multimedia support for audio and video content. The merging of functionalities (e.g. mobile phones with cameras, audio players, organisers) has led to a radical change in the ways in which mobile devices are and can be used.

If a device can be connected to a local network, it can be used to send, receive and share information. PDAs may provide the next step in the development of audio guide-type devices. Although audio guide technology offers flexibility in formats and modes of access, new mobile devices have the advantage of Web connectivity and the facility for displaying increasingly high-quality images.[132] In addition, such content can easily be updated without the use of wires or other direct physical connections. Their implementation moves us a step closer to offering an augmented reality experience.[133]

As with many new and emerging technologies, handheld devices are subject to intensive research and development, and with each new product they are faster and cheaper. Cellular phones and PDAs can now render restricted texts of Web pages via wireless communication protocols such as the *Wireless Application Protocol* (WAP) and *General Packet Radio Service* (GPRS), as well as rapidly improving capabilities for handling larger portions of audio, video and written text.

132 This may lead to rights issues. Recently in Japan, steps have been taken to clamp down on 'digital shoplifting', or the photographing of magazine pages with mobile phones.
See http://www.theage.com.au/articles/2003/06/30/1056825333352.html for the full story.
It is not difficult to imagine how this might affect cultural heritage organisations.

133 For a cultural heritage approach, see Scagliarini *et al.* (2001), "Augmented reality and mobile systems: Exciting understanding in Pompeii through on-site parallel interaction with dual time virtual models", online at http://portal.acm.org/citation.cfm?id=585007&coll=Portal&dl=ACM&CFID=14624569&CFTKEN=19937062

Mobile access technologies are one of the key factors for the growing popularity of handheld devices. The idea of wireless networks is not new. Earlier technologies were centred on the use of radio-based devices. Infra-red technologies have been used to link two computer devices over short distances. In recent years, the implementation of larger and more affordable wireless networks has become possible using cellular telephony as a communication link between the end-user device and the local area network (LAN), thus making access to the Internet a reality.

PDAs have hidden potential. The first PDA (the *Newton*) was launched in 1993 by **Apple**,[134] and since then much effort has been invested in creating tools to support data transfer (or 'synchronisation') between handhelds and desktop computers. The installation in public places of 'beam stations' has given roaming users of handheld devices access to information resources.

With the implementation of wireless and mobile networking technologies it has become standard practice for a user to set up her own *personal area network* (PAN), interlinking different devices such as notebooks, laptops, PDAs, and mobile phones. **Bluetooth** is currently the leading protocol for such a task, and the **Institute of Electronics and Electrical Engineers**' *802.15 Working Group* is leading an effort to establish a standard.[135]

© MOBIlearn
Using a handheld and stylus

The symbiosis between cellular phones and handheld devices, as well as the appearance of hybrid devices that share the functionalities of two or more discrete types, provides mobile access to the Internet. Instead of speaking about 'wireless', which is a narrow technical term, it is more appropriate and fruitful to speak of 'mobile' computing. Despite changes in location, while roaming the user does not lose their connection to the Internet, and so long as the use remains within the area covered by a mobile service provider the location does not necessarily matter.

Although not shaping how mobile access technologies develop, cultural and scientific heritage organisations are already becoming devoted users of them. User satisfaction with mobile technology can be influenced by interface characteristics, bandwidth, the potential for personalisation, device durability, functionality, battery storage and recharge capabilities. Some of these factors will influence the ways in which the cultural heritage sector can deploy solutions built on this technology. For instance, display limitations in terms of size, resolution and clarity may discourage potential users of image-heavy content, or limitations of bandwidth will restrict its usefulness for video. Solutions to the shortcomings of the current generation of technology will be addressed gradually as the technology continues to mature. In the interim, the use of mobile devices may for some applications require a multi-technology approach, based on the combination of mobile devices and fixed services.

134 http://www.apple.com
135 http://grouper.ieee.org/groups/802/15/. This group is developing Personal Area Network consensus standards for short distance wireless networks, or WPANs.

Where the Technology is Currently Found

PDAs were initially launched as all-in-one personal calendars, address books, memo pads, and to-do lists. For a decade manufacturers have continually invested in improving their capabilities: the market has grown consistently. The quantity of content that is accessible by PDA users has continued to grow. Every day travellers, tourists and business people use PDA maps, hotel and restaurant guides, travel guidebooks, currency converters, weather forecasts, transportation schedules, and information on cultural events. With the appearance of wireless networks and cards for handhelds, the technology is now widely accessible and affordable. The interface is familiar to many people.

The types of organisation most likely to be interested in the use of mobile technologies include *educational institutions* interested in maximising e-learning possibilities, *corporations* (both for-profit and not-for-profit) interested in finding better ways to present their products to potential customers and to provide the customers with quality support, and *professional associations* interested in advertising and promoting their activities. What possibilities do these developments open up for cultural heritage institutions?

What place, then, do cultural heritage institutions occupy in this area? There are in fact several ways in which virtual communities can be merged with their activities, as the following paragraphs will illustrate.

Problems Addressed by the Technology

A fundamental concern of users of mobile access technologies is the ability to gain access to informational resources from any location, at any time, and independently of whether they are using a laptop, a mobile phone, or a PDA. Another important component is the tracking of users and/or objects. Current developments in these technologies are leading towards a convergence of handheld devices with mobile phone technologies, to the extent that the line between the functions of cellular phones and PDAs is now well and truly blurred.

It is important to stress that the convergence of several technologies remains a key issue not only for the cultural heritage sector. Wireless connectivity, global positioning systems, mobile computing, and new human-computer interaction devices will be integrated into the personal mobile device within five years. The conjunction of mobile technologies and digital libraries will eventually enable 'on-demand' delivery of textual and other content to handheld devices, regardless of location. Museums will be able to revolutionise the ways in which secondary resources are presented to visitors in relation to artefacts: exhibitions can be arranged according to entirely new themes, not necessarily arranged in traditional chronological patterns, and visitors will be empowered to create virtual exhibitions using their own portable devices.

At the moment, mobile devices are seldom used to overcome specific problems; instead applications generally focus on an increase in convenience and accessibility both for visitors to heritage institutions and for the institutions themselves. In combination with RFID tagging of objects, libraries and archives can assist the location of specific books or items with a mobile device which directs the visitor towards particular objects or shelves. A more advanced level of personalisation is also possible due to the integration of mobile technologies with other delivery methods such as the Web and institutions' own intranets.

For example, visitors to exhibitions can 'self-program' their visit, accessing learning materials based on their own needs and preferences. The opportunity for a higher level of personalisation is particularly significant for visitors with special needs, for example audio descriptions of exhibits. Advanced personalisation using mobile devices has great potential for all types of cultural and heritage institutions and outdoor sites. The potential for a ubiquitous connection offered by wireless networks is also significant for users of heritage resources. No longer is a visitor to a gallery or museum reliant upon the availability of staff in order to ask a question about an exhibit, nor is a library user reliant upon the availability of a workstation in order to search the catalogue.

Mobile devices open up other new opportunities, especially in understanding how visitors use the resources offered. A handheld device can keep track of the resources investigated by a user (e.g. Web pages) and furthermore can enable the tracking of a visitor's physical path around an exhibition or outdoor site. It can provide information about which areas are visited, how long a visitor spends looking at each object, and when exactly in the course of the visit particular resources are accessed. This detailed examination of user behaviour is extremely valuable for the evaluation of individual displays, exhibitions and services.

How Mobile Access Technologies Work

Bluetooth

Bluetooth is the name of a standard developed by a group of more than 1000 electronics manufacturers, including **Ericsson**, **Intel**, **Motorola**, **Siemens** and **Toshiba**,[136] which allows different types of electronic equipment (such as computers, peripherals, telephones and interfaces) to be interconnected wirelessly without requiring the user's intervention. Bluetooth is a standard both on the physical level (it uses radio frequency) and as a communication protocol.

Bluetooth uses the frequency range of 2.45 GHz, which has been reserved by international agreement for industrial, scientific and medical applications. A number of other devices use this radio frequency, including cordless (not mobile) phones, microwave ovens, baby monitors, and garage-door openers. Bluetooth devices avoid interfering with each other as well as with devices working in the same frequency band by using very weak signals (which limit their operational range to around ten metres) in conjunction with a technique called *spread-spectrum frequency hopping*. This technique involves constant random change (1,600 times per second) of the working frequency, which minimises the probability of the same frequency being accessed by two competing devices simultaneously. When Bluetooth devices are within range, they start to communicate automatically, and then determine whether there are data to be exchanged or whether one device needs to control the other. Thus Bluetooth devices establish personal area networks (PANs) called *piconets*.

Taking into account the range limitation of ten metres, devices using Bluetooth technology can be applied for indoor exhibitions. They can be used to trace the patterns of observation of certain exhibits, and a user's own Bluetooth-compatible devices will be

136 http://www.ericsson.com/; http://www.intel.com/; http://www.motorola.com/; http://www.siemens.com/index.jsp; http://www.toshiba.com/

immediately compatible with those supplied by the institution for engaging with the collections.

Global Positioning System (GPS)

© Blast Theory

Image from Blast Theory's 'game' Uncle Roy All Around You

The Global Positioning System (GPS) was developed to support military technology, military navigation systems, and tracking. In the early 1980s the GPS infrastructure was made accessible for public use.[137] Aviation, maritime navigation, military operations, surveying, and recreation are all common application areas for GPS. It relies on twenty-seven solar-powered satellites orbiting the Earth (twenty-four in day-to-day operation, plus three backups), each of which makes two complete circuits a day. Their orbits are arranged in such a way that at least four satellites are accessible at any time from any point on the globe.

When used in conjunction with handheld devices, GPS allows for the transfer of remote information with simultaneous registration of place and time of the observation. This information is transferred to a central database, where it is correlated to produce a dynamic map, and thus the data collected here can be used for a variety of studies and purposes, such as ecology, animal behaviour, illegal trafficking, and so on. The use of GPS in conjunction with Radio Frequency Identification (RFID)[138] technology may also be worth exploring, as a combination of the high power of satellite-driven GPS and the accuracy of RFID will allow more sophisticated and accurate applications.

The global position of objects is determined using a method called *three-dimensional trilateration*. This is achieved by calculating the distance between a given point and at least three satellites, and then using trigonometry to pinpoint the location. GPS receivers, which use high-frequency, low-power radio signals received from the satellites, assist in this process. The functionality of GPS receivers is not limited to determining the coordinates of static objects; they can also be used to trace paths, hence GPS can be used in tracing visitor movements in outdoor attractions, such as archaeological sites, when combined with tracking databases.

GPS technology can be used for both communication and positioning purposes in cultural heritage exhibitions. As a technology with a currently rapid rate of development, it is impossible to say which of the numerous capabilities to utilise even now. The differences between the numerous devices make it difficult to make coherent plans for utilising specific features – small, testbed experimental implementations may prove to be the most prudent deployment of GPS while the state of play continues to change so quickly.[139]

137 http://www.forbes.com/2001/10/02/1002gps.html
138 RFID technology is sometimes also known as 'smart labels' or 'smart tags' – see *DigiCULT Technology Watch Report 1* (pp. 63-93) for a detailed analysis of RFID and its potential use in the cultural heritage sector.
139 For a fuller account of GPS technologies, see the forthcoming *DigiCULT Technology Watch Report 3*.

Mobile Phones

Modern cellular phones provide an incredible set of functions, and new functionalities are being added at a startling pace. Phones can be used to store contact information, make task or to-do lists, keep track of appointments and set reminders, provide access to calculators, send and receive e-mail, download information (e.g. news, entertainment, stock quotes) from the Internet, enable users to play games, take pictures with in-built cameras and send them via the Web, and integrate with other devices such as PDAs, MP3 players and GPS receivers.

In terms of architecture, cellular phones comprise a circuit board containing analogue-to-digital (for the incoming signal) and digital-to-analogue (for the outgoing signal) converters, the digital signal processor, memory (ROM and Flash), the radio frequency and power components, radio frequency amplifiers, a keypad, a display, a speaker, and a microphone.

Cellular phones are sophisticated radio devices, the cellular approach having been introduced as a successor to radio-telephone systems. This relies on the division of geographic areas into cells (typically sized at about twenty-six square kilometres, although in densely populated urban areas the cells can be smaller), analogous to a collection of hexagons on a large hexagonal grid. Each cell is equipped with a base station, comprising a tower with antennae and corresponding radio equipment. A unique set of frequencies and corresponding voice and data channels are used within each cell, thus avoiding collisions between adjacent cells. Additionally, cell phones and base stations use low-power transmitters and the same frequencies can be reused in non-adjacent cells. Each provider employs a Mobile Telephone Switching Office (MTSO) from which all phone connections to the normal land-based phone system and all of the base stations in the region are controlled. Mobile phones have special codes associated with them which can be used to identify the phone, its owner, and the service provider. The connection of each phone to the network and the logs of cell phone movement from one cell to another are controlled by the MTSO and the corresponding base stations.

There are two basic categories of cell phones – analogue and digital. The analogue cell-phone standard called the *Advanced Mobile Phone System* (AMPS) was launched in 1983. Digital cell phones use the same radio technology as analogue phones, but they use it in a different way – digital signals can be compressed and manipulated in order to transmit more channels within a given bandwidth.

Three common technologies are used by cellular phone networks for transmitting information: frequency division multiple access (FDMA), time division multiple access (TDMA), and code division multiple access (CDMA). FDMA is used for analogue transmission, and although digital information *can* be carried using this standard it is not very efficient. TDMA acts as the access technology for Global System for Mobile Communications (GSM) systems, which use encryption to make phone calls more secure. CDMA systems allow multiple calls to share the same channel involving GPS technology.

Personal Digital Assistants (PDAs)

Personal Digital Assistants (PDAs) are small handheld computers used to store addresses, phone numbers, and daily appointments. Unlike paper organisers, PDAs offer additional possibilities such as playing music, watching video files, or browsing the Internet.

The power hidden in handheld computers has made them extremely popular among users. Although **Apple** released the first PDA, it was the introduction of the *Palm Pilot* in 1996 that sparked the growth of the PDA industry. PDAs are intended to complement desktop or laptop computers, rather than to replace them. They can be divided into two basic groups: handheld and palm-sized.

Woman with handheld and headphones

As one might expect, handheld computers are the larger and heavier of the two. For data input and output they use larger liquid crystal displays (LCDs) and small keyboards, combined with touch-screen technology. Palm-sized computers use smaller LCDs, stylus/touch-screen technology and handwriting recognition applications to support data entry.

PDAs are small computers and they include all basic computer hardware and software blocks: microprocessor, memory (they are not equipped with hard drives and rely only on solid-state memory chips), display (currently, LCD displays are used for both output and input of data), input devices (miniature keyboard and/or pen-like stylus combined with a touch-screen; voice/speech recognition technology is expected also to be available in the near future), input/output ports for synchronisation, infra-red communication port, modem or wireless communication, and power supply (battery pack and AC adapter), operating system (*Palm OS* from **3Com** or *PocketPC* from **Microsoft**)[140] and personal information management (PIM) software. Some PDAs are equipped with special features, such as e-mail, word processing, MP3 players, MPEG movie players, wireless Internet, video games, and GPS receiver.

Of special interest for their application to cultural heritage institutions is the potential for wireless connection to a LAN. Through this the visitors equipped with PDAs are able to use museum guides without difficulty.

Mobile Access and the Cultural Heritage Sector

Brief Background

As well as utilising portable devices for advertisement of their work and current exhibits, cultural and scientific heritage institutions may utilise mobile access technology in two basic, fundamental ways: exploiting the communication potential of mobile access

140 http://www.3com.com; http://www.microsoft.com

devices, and using their positioning potential. In the first case, providing informational resources and tour guidance leads to increased freedom for visitors. Visitors are freed to follow the route of their choice, and to consult the guide according to their personal needs.[141] Presenting informational resources on the collection may now be better organised in ways that suit specific visitors' requirements and/or special needs. In addition to this, the function of 'bookmarking' interesting objects for later exploration contributes greatly towards enhancing the learning process.

Using the positioning potential of mobile access technology, on the other hand, will further improve the delivery of informational resources to the visitor by taking his or her exact location into account. This helps in offering guidance through exhibits, both indoor and outdoor, and marks a shift from mobile access into the beginnings of augmented reality.[142] The visitor is thus able to receive additional information automatically depending on location, rather than by having to make explicit requests.

A number of organisations in the cultural heritage sector already utilise the communication potential of mobile access technologies. This work may be viewed as a natural further extension or development of the work carried out with audio guides, particularly when these are used in conjunction with positioning devices. While information resources are delivered concurrently with the visiting of collections, one concern is that the use of handheld devices may distract visitors from really observing the objects in an exposition, or may isolate them from other visitors.

The sharing of experiences within a museum or gallery is a strong social component, and it is important that this should not be lost. Such warnings are important, but the use of handheld devices is already so popular that how best to incorporate them into the current practices has become a major issue. Museum visits are far from being the only daily activity changed by these new technologies. **MOBIlearn**, for example, aims to create models for effective learning in a mobile environment, together with instructional design and eLearning content development for mobile learning.[143]

© MOBIlearn
Synchronising a handheld and laptop

Research on the take-up of new technologies in museums has so far been encouraging. A survey on digital technologies in general offered to visitors of art museums is published in [Schwartzer 2001 (full ref. on page 198)]. The survey was mailed to 169 museums, seventy-four of which responded, and sixty per cent of these were using digital technologies. Fifty-three per cent of these institutions gathered visitor comments, all of them positive.

141 The **PAST** project (http://www.beta80group.it/past/) is an excellent example of the non-intrusive, augmentative use of handhelds in the exploration of outdoor archaeological sites.
142 The overlap between mobile/ambient computing and mixed reality is pronounced. See the *Augurscope* (http://www.shape-dc.org/highlights/augur.html) and *ARCHEOGUIDE* (http://archeoguide.intranet.gr) projects for demonstrations of the possibilities.
143 http://www.mobilearn.org

The case studies that follow examine applications of portable devices from museum corridors to city streets, all made possible by the development of portable devices. The ultra-futuristic, sociological ambitions of *Urban Tapestries* are in contrast to the more conservative and practical educational aims of the *Handscape* and *MUSEpad* projects. The scenarios presented indicate how the technologies can be used in eTourism, preservation, and personalisation.

Case Studies

Urban Tapestries[144]

Urban Tapestries investigates the possibilities of location-based mobile and wireless systems. The project team is currently building an experimental location-based wireless platform covering the Bloomsbury area of central London. This prototype will allow users to access and create location-specific content whether as text, audio, pictures, movies, or a combination of these media.

The project as a whole is therefore also a type of forum for exploring and sharing experience, stories, knowledge and reactions, allowing users to record and annotate the paths they trace as they traverse their area via handheld devices such as PDAs and mobile phones. The user community's collective memory will grow organically. Users can add new locations to the shared corpus, append their own reactions and content to locations, and draw new paths or 'threads' between different locations and contexts. Mobile communication technologies enable new types of interaction and creativity which will produce unanticipated social, cultural or political consequences.

The project was conceived and developed by **Proboscis**, a cultural organisation and creative studio, in collaboration with the **London School of Economics** (LSE), **Hewlett-Packard Research Laboratories** in Bristol, and mobile phone company **Orange**. In addition, **Birkbeck College** of the University of London contributed programming effort, the British **Ordnance Survey** provided assistance with mapping resources, and **LocustWorld** provided wireless networking expertise. The UK **Department of Trade & Industry** (DTI)'s Next Wave technologies programme, **Arts Council England**, and the **Daniel Langlois Foundation for Art, Science & Technology** co-funded the project. Significantly it is the first project jointly funded by the DTI and Arts Council England. **Apple Computer UK** and **Sony Europe** sponsored hardware used in the prototype. The ten-month project (from February to December 2003) had a budget of £115,000.

The Proboscis team has acted as project leader, bodystorming/films producer, system architect, information architect, content producer, interface designer, and conceptual designer. LSE conducted sociological/ethnographic studies. While these roles may at first seem clear-cut, it should be stressed that all aspects of the project's development were shared and indeed collaborative: Proboscis assembled a multi-disciplinary team. While partners had responsibility for specific 'task areas', all partners shared their expertise

144 This case study is based on an e-mail questionnaire completed by Giles Lane, founder and chair of Proboscis (http://www.proboscis.org.uk) during August 2003, and on face-to-face discussions between Giles Lane and Danny Angus of Proboscis and Martin Donnelly of DigiCULT in London, May 2003. http://www.urbantapestries.net

through meetings and contributed to shaping the final prototype.

According to Proboscis founder Giles Lane, the Urban Tapestries venture strikes a balance between the use of mobile devices, knowledge, and emotions. The prototype system aims to create an opportunity for users to embed what they consider to be 'knowledge' into the fabric of the urban environment through wireless technologies. It grants them access to their own and other participants' content and impressions through a range of filtering and decision-making techniques that can be programmed to reflect their emotional state, a process known as 'mood filtering'. Each Urban Tapestry should have its own flavour, whether it was installed in an urban setting around a local area, or within a museum as, for instance, a means for visitors to exchange reflections and comments on the exhibits.

The project began with a proposal to use the 802.11b wireless networking protocol together with **PocketPC** handheld computers (specifically *iPAQ* PDAs). As the limitations of the system were explored, the team established a series of protocols and frameworks that are as platform and network independent as possible. While the project intended to anticipate future uses of new technologies over a three-to-seven year horizon, the proof-of-concept demonstration was constrained by the technical limitations of existing devices and networks. The limitations of GPS use to support location awareness led the team to implement an alternative solution based on direct user input of street address and pointing at a digital map as a way of indicating a location. The prototype trialled in December 2003 combined *GPRS* & *802.11b* network access, GPS and user input for location awareness, and a combination of PocketPC PDAs (iPAQs & *Jornadas*) and **Sony Ericsson** *P800 Symbian OS* mobile phones.[145]

A number of compatibility and interfacing issues arose during the development of the project. Devices were not interoperable and some did not support emerging standards for mobile applications (such as *Java 2 Micro Edition*). Many devices are tied to a particular form of networking and are unable to switch dynamically between networks (for example wireless protocols 802.11b and GPRS).[146]

During a nine-day trial in December 2003, twenty users had an opportunity to take part each day. User interviews are being planned by project partner Orange, as well as an online feedback system allowing trial users to offer their thoughts and feelings. Evaluation of the LSE's 'Experimental Ethnography' will be completed early in 2004. While the results of the trial were not finalised as we brought this report to press, the success of the project's proof-of-concept prototype has encouraged the Urban Tapestries team to continue its exploration of emerging devices and networking standards.

Urban Tapestries focuses on what emerging wireless technologies could make possible. It aims to anticipate their social, cultural, economic and political implications. As Lane explains, 'Our aim is to demonstrate that, by placing the tools of creation in the hands of everyday users (rather than creating closed systems purely for consumption of pre-authored content), a whole new world of possibilities lies ahead that is limited only by the imagination of its users.'[147] Approaches of this kind lie at the heart of twenty-first century creative industries.

145 http://www.sonyericsson.com

146 Steven J. Vaughan-Nichols' concise and straightforward outline of the issues involved with the use of wireless protocols (2002) can be found at http://siliconvalley.internet.com/news/article.php/1472641

147 For more on Urban Tapestries, see Giles Lane, "Urban Tapestries: Wireless networking, public authoring and social knowledge", *Personal and Ubiquitous Computing*, no. 7, pp. 3-4, July 2003: http://portal.acm.org/citation.cfm?id=950508&coll=Portal&dl=ACM&CFID=14624569&CFTOKEN=19937062

The MUSEpad Project[148]

Some cultural heritage institutions already use mobile access technologies to enhance communication with their visitors.[149] The MUSEpad Project implemented in **Indiana University's Mathers Museum of World Culture**[150] is a good example of the application of this technology. MUSEpad was designed, developed and evaluated by a group of people from Mathers Museum, in partnership with **Information in Place**.[151] With the help of a Small Business Innovation Research Grant by the **National Institutes of Health** (NIH),[152] they ran a six-month feasibility study to determine whether a mobile computing tool that enables users to customise and optimise their own learning experience within a museum could serve as a useful device for people with disabilities.[153] They focused on customising content for users with impaired vision or hearing, or mobility problems.

A crucial innovation of the MUSEpad Project was the decision to enable content to be accessed interactively and customised for an individual user, rather than having it pre-packaged by disability category. This approach takes account of the personal, social, physical, and mental context of specific visitors. It responds not only to individual disabilities, but also to moods, preferences, and personal circumstances.

Self-selection of the presentation of content in a museum enriches not only the interpretation of each exhibit or artefact, but the wider learning activities of the visit. Using MUSEpad, museum visitors could select content in various formats, whether text, sound, image or graphic, to aid their understanding and interpretation of specific exhibits. They can also select tools (e.g. multimedia games) to facilitate interaction with the museum's resources. Information might be an audio description of the artefact, either in scholarly form for adults, or as a story for younger children, music from an appropriate musical period, text in large print, graphical representations of the object, photographs of other related objects, or simply more detailed information.

MUSEpad is based on, and enabled by, the *WorldBoard*[154] concept: the idea that information can be associated with (and 'attached' to) any location. Conceived at **Apple Computer** and developed at Indiana University, WorldBoard is an extension of the Web that utilises the convergence of handheld computing devices, wireless networking, and positioning and proximity devices to enable visitors to access Web-based information correlated to physical locations or objects. This notion of 'putting information in places' lies at the core of the development of augmented reality systems.

The development of WorldBoard began in the mid 1990s as an attempt to bring about improvement and innovation in educational tools. Organisations from higher education, government and industry collaborated in the development of authoring tools, new models in mobile computing, and building online communities to interact with and improve this

148 This case study is based on materials available over the Web. All sources are given in footnotes.
149 Judy Kirk (2001), "Accessibility and New Technology in the Museum", *Museums and the Web 2001*: http://www.archimuse.com/mw2001/papers/kirk/kirk.html
150 http://www.indiana.edu/~mathers/home.html
151 http://www.informationinplace.com
152 http://www.nih.gov
153 *Electronic Guidebook Forum* (2001): http://www.exploratorium.edu/guidebook/forum/report/HH1.pdf
154 http://www.worldboard.org

content. This research formed part of a **National Science Foundation** (NSF) funded project to support learning in context.[155]

The three features at the heart of WorldBoard could form the core of systems built around a wide range of mobile devices. WorldBoard can be thought of as a spatially addressable bulletin board, containing geocoded (longitude, latitude, and elevation) messages.[156] The delivery of the concept reflected a realisation by the WorldBoard developers that information can seem to be in a physical place, that it can be customised to reflect user preferences, and that information about properties and attributes associated with a physical space can be linked to that place. The fact that information can be organised by its characteristics and viewed according to different 'channels' at the request of the user distinguishes WorldBoard from the standard Web-based interfaces, and allows multiple means of access that make truly augmented reality applications such as MUSEpad possible.

MUSEpad handheld devices, as enabled with WorldBoard, allow visitors to choose specific personalised channels which could offer local or global Web content, and will therefore permit unique, customised tours. The content could range from a scholarly discussion of a particular work of art, to another visitor's comments, to detailed historical information about the artist, buyer, or acquisition of the piece.

At the outset of the project, the concerns and needs of the target populations were investigated in order to determine what functionality would be required of a handheld device. Audience profiles were developed using observational and interview techniques. In the subsequent design, care was taken to ensure that visitors with impaired vision or hearing, or mobility problems were able to access meaningful content by using MUSEpad. The project team concluded that it needed to strike a balance between functionality that would benefit the majority of users and the desire to enhance access for visitors who may need more assistance. A primitive application was tested at the Mathers Museum for feasibility and to evaluate its effectiveness formatively, and different modes of content and authoring were also explored.

One of the strengths of WorldBoard and MUSEpad lies in their extensibility. Developments of technologies of this kind (as well as the strategies used and theories advanced) could lead to new modes of access and enhanced user experiences. They could be used in conjunction with other maturing technologies: natural language processing, location-based systems, or haptics. While experiments have mainly involved museums, these technologies are applicable to a broader range of learning and heritage environments.

EQUATOR – The City Project[157]

City, a first-phase **Equator Interdisciplinary Research Collaboration** project,[158] focuses on the integration of physical and digital interaction by bringing together researchers from a variety of disciplines to address technical, social and design issues.[159]

155 James Spohrer (1999), "Information in Places" in *IBM Systems Journal*, vol. 38, no. 4, 1999: http://www.research.ibm.com/journal/sj/384/spohrer.html

156 *Cf.* Spohrer (1999), "Information in Places".

157 http://www.dcs.gla.ac.uk/equator/city.html. This case study is the result of a questionnaire and e-mail correspondence between Areti Galani and Dr Matthew Chalmers from the Department of Computing Science, University of Glasgow, and Martin Donnelly of DigiCULT. The case study process took place during November/December 2003.

158 http://machen.mrl.nott.ac.uk/

159 Equator is a collaboration between eight academic partners: the Universities of Glasgow, Bristol, Nottingham, Sussex, Southampton, Lancaster, University College London, and the Royal College of Art. It is funded by the Engineering and Physical Sciences Research Council (EPSRC) for six years from September 2000. The project's ongoing phase examines technology that supports tourist activities in the city.

© EQUATOR

Different approaches to content in the City project

The project started in March 2001, and the first phase, concentrating mainly on museums, concluded in autumn 2002.[160] Five universities collaborated in the first phase: the **University of Glasgow**, **University of Nottingham**, **University of Bristol**, **University College London** and the **University of Southampton**. Glasgow took the lead role, with responsibilities covering initial visitor studies, the final integration, and the evaluation of the system. The local project partner was the **Lighthouse Centre for Architecture, Design and the City**, situated in the heart of Glasgow.[161]

The system combines virtual environments (VEs), hypermedia technology, handheld devices and ultrasound tracking technology. Equator's shared tuple space infrastructure, *EQUIP*, co-ordinates the components.[162] For system trials, a custom-made ultrasound location system from the University of Bristol was put in place in the Lighthouse's *Mackintosh Interpretation Centre* (the 'Mack Room', dedicated to the understanding of the work of Scottish architect, designer and artist Charles Rennie Mackintosh),[163] and a wireless communications network installed in the Lighthouse. This allows three visitors, one on-site and two remote, to visit the Mack Room simultaneously. The on-site visitor carries a location-aware handheld computer which displays the ongoing positions of all three visitors on a map of the gallery. The off-site visitors use two different environments: a Web-only environment and a VE. The Web visitor uses a standard Web browser that displays the gallery map, while the VE visitor uses a first-person, 3D model of the same gallery with avatars representing the other visitors. All three visitors share an open audio channel, and wear headphones and microphones. The system supports the provision of multimedia information to off-site visitors in the form of Web pages that are dynamically presented upon movement in the map or VE. Content delivered to the off-site visitors is similar to the content available in the labels in the gallery. This automatic presentation follows the spatial organisation of the exhibition schematically, so that all visitors can 'look' at the same display while in the same location. In this respect the system supports interaction around corresponding exhibits in the Mack Room and in digital form, or 'hybrid exhibits'.[164] A prototype system was developed for a trialling period in the Lighthouse, but this has not been installed in an institution for long-term use. The City project aims to demonstrate the viability of the concepts it was investigating, and to produce the theoretical and methodological breakthroughs necessary for others to be able to deliver permanent applications.

As is often the case with collaborative research projects, technology choices for the system were based on the partners' expertise and experience with similar systems and

160 The overall budget is undefined, as this was set in a wider collaborative context. Essentially, the project was self-sufficient.
161 http://www.thelighthouse.co.uk
162 For more on this, see MacColl et al. (2002), "Shared visiting in EQUATOR city", in *Proceedings of Collaborative Virtual Environments 2002*, ACM Press, pp. 88-94.
163 **The Charles Rennie Mackintosh Society**, http://www.crmsociety.com/
164 For more details on this concept, see Brown *et al.* (2003) in the list of publications on page 196.

approaches. The specific technologies were also selected/developed following a literature review because they fitted with the technological research questions being asked by the project, and equipment donations from **Hewlett Packard**'s *Art and Science Programme*. In the project's early stages, the team looked into the possible use of wearable computers, such as a University of Bristol 'cyberjacket' for on-site visitors. At this stage the team decided not to pursue this line of investigation. Initial visitor studies found that museum visitors often leave their outdoor coats or jackets in the cloakroom, and researchers felt that it would be awkward to ask people to don an extra jacket. It was also felt that a cyberjacket would impose an additional challenge on efforts to evaluate the system in naturalistic manner.

© EQUATOR

The Mack Room floor plan on a Pocket PC

Among the project's main goals was the exploration of mixed reality technologies and the social interactions that these might create. In this respect the City project's implementation has proved very successful; the project team was pleasantly surprised that participants in the trials were easily immersed in their museum experience without being distracted by the prototype character of the technology. Participants were recruited through poster advertisements as friends and museum-goers, with a total of thirty-four (ten groups of three and two groups of two) taking part. Each visiting experience lasted approximately one hour and comprised an explorative part and an activity-based part. In the first part, the members of each group were encouraged to familiarise themselves with the technology and to explore the gallery according to their own interests. In the second part, they were given a mixture of open-ended and focused questions about Mackintosh's work, and were asked to come up with answers based on evidence from or experience of the exhibition. The group's activity and discussions were recorded, and a semi-structured interview followed each visit. Analysis of the data was qualitative, and looked at both usability and interactional aspects of use. In the trials no category of visitor became dominant; they acted in a complementary rather than a hierarchical relationship. For further studies and uses of this type of technology, this conclusion indicates that virtual and physical visitors can be integrated into seamless social visitor communities.[165]

For the mobile aspect, centimetre accuracy in the Mack Room was not necessary, as participants were able to adapt to cruder levels of accuracy appropriate to the scale of displays and objects. Similarly, exact symmetry of content provision between the three 'visit types' turned out to be unnecessary: while strong overlap is required, a degree of variation appropriate to the tools at hand creates differences in the views that facilitate communication between the visitors.

The richness and topical coherence of visitors' interaction with each other and with the exhibition form the basis of the team's claim that local and remote museum visitors

165 Results of the evaluation and tests can be found in: Brown, B., MacColl, I., Chalmers, M., Galani, A., Randell, C. and Steed, A. (2003), "Lessons from The Lighthouse: collaboration in a shared mixed reality system", in *Proceedings of CHI2003*, Fort Lauderdale, Florida. ACM Press, pp. 577-584; Galani, A. and Chalmers, M. (2003), "Far away is close at hand: shared mixed reality museum experiences for local and remote museum companions", in *Proceedings of ICHIM03*, Paris, France; MacColl, I., Millard, D., Randell, C., Steed, A. et al. (2002), "Shared visiting in EQUATOR city", in *Proceedings of Collaborative Virtual Environments 2002*. ACM Press, pp. 88-94.

experienced a shared visit. In this respect, they believe that mixed reality environments may have immediate benefits in two interrelated areas of museum practice: *accessibility* of collections and *educational activities*. Mixed reality museum visits, for example, may enhance communication and collaboration among remote school groups and offer access to communities otherwise disenfranchised because of geographical or other barriers.

Current research, in the second phase of the City project, aims at combining synchronous encounters among participants with asynchronous interaction. Users might use this to show their friends where they have been and what they have done. In more general terms it enables them to use the past as a resource for the present visit. Visiting and tourist activity in the city streets and other urban spaces is also supported. This work is informed by the way that museum experiences extend beyond the time, the people, the media and the place of the 'official' visit, to the visitor's everyday life and to the city as a whole. The team's belief is that this is in accord with contemporary cultural institutions' work towards becoming more effectively integrated with the activities that tourists and visitors actually engage in, and also reflects their view that museums are best seen not as isolated or insular, but as being connected with and contributing to city life.

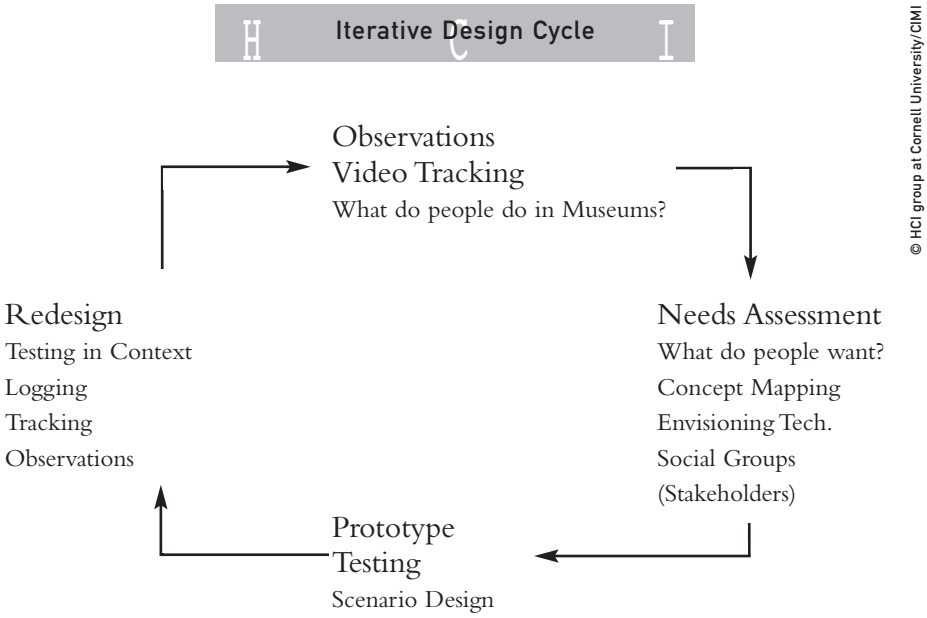
CIMI Handscape – Mobile Computing in Museums[166]

Handscape, a three-year CIMI Consortium[167] project to investigate potential use cases for mobile computing in museums, began in 2001. The overall objective is to investigate how visitors can be affected before, during and after the museum visit, and the resulting impact on the design of such services.[168] The project is directed and managed by John Perkins of CIMI, and its research co-ordinated by Professor Geri Gay, Director of the Human Computer Interaction Group at **Cornell University**.[169] **The Field Museum** (Chicago), **The Royal Botanic Gardens** (Kew, England), and the **American Museum of the Moving Image** (New York)[170] are partners in phase one. They will be joined in later phases by the **Herbert F. Johnson Museum of Art** at Cornell University and the **Smithsonian American Art Museum**. The project's $250,000 (€212,500) budget is supported by a research grant from **Intel Corporation**.[171]

The Handscape project investigates two hypotheses. First, it is examining whether mobile technologies offer museums an opportunity to alter how they relate to and communicate with their visitors. Second, it aims to establish whether new applications and services designed for these devices can, by using the information resources of the museum, positively enhance the visitor experience. The project is concerned with the design of systems through the identification of cases in which the use of a mobile device coupled with an appropriate design for delivery of information works in tandem to deliver the desired experience. Phase one research focused on prototype installations at each of the partner institutions. Technologies employed varied and their selection was driven by the

166 This case study is based on an e-mail questionnaire completed by project co-ordinator John Perkins of **CIMI**, Angela Spinazze of **ATSPIN consulting**, and research co-ordinator Professor Geri Gay, Director of the Human Computer Interaction Group at **Cornell University**. The case study process was carried out in November/December 2003. The Handscape project Web site can be accessed at http://www.cimi.org/wg/handscape/index.html. For more on Handscape, see Angela Spinazze's article "Handscape: Investigating Mobile Computing in Museums", *DigiCULT.Info 3*, February 2003.
167 http://www.cimi.org
168 http://www.museum.cornell.edu; http://www.nmaa.si.edu
169 http://www.hci.cornell.edu
170 http://www.fmnh.org; http://www.rbgkew.org.uk; http://www.ammi.org/site/site.asp
171 http://www.intel.com

partner museums. All of the installations studied used pen-based handheld devices with either infra-red or wireless network connectivity. This enabled the device to talk to content servers. Users were engaged throughout the process of development, testing and evaluation.



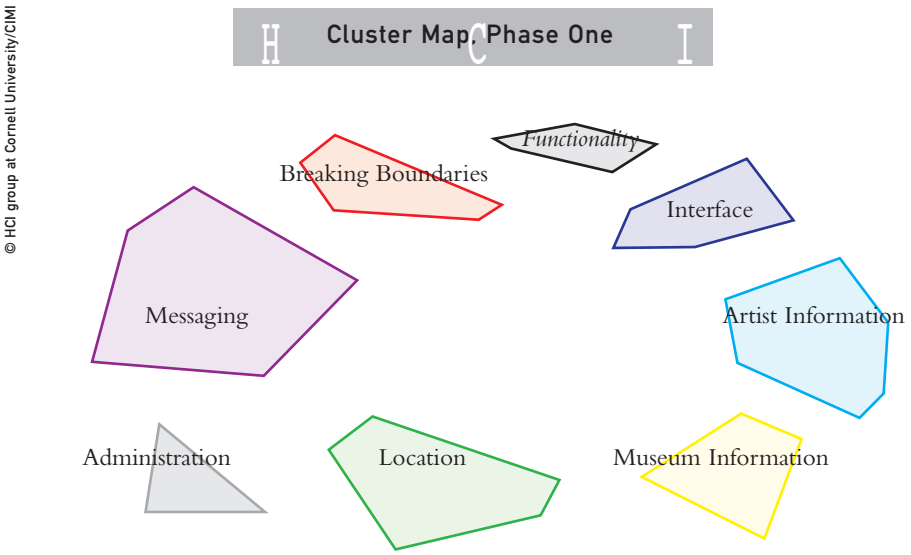
© HCI group at Cornell University/CIMI

While the outcome of the project is our primary focus, the project's use of the iterative design cycle may point the way for other similar projects (see figure above). Over 100 individuals participated in an online concept-mapping exercise including software application designers, educators, museum patrons (from teenage to retirement age), and museum administrators (chief information officers, information technology managers, and technical support staff). From this the team generated a list of specific expectations for the technology, and the interrelations between them. At the outset of the exercise participants were asked: 'What design feature, or functionality, would you expect from a mobile, wireless application for museums?' Respondents reported that it would need to have:

- an easy-to-learn, customisable (and potentially multilingual) interface;
- the ability to download information and take it home, together with a facility to create notes about the exhibits;
- the ability to support instant messaging between users, together with a positioning feature displaying locational information of groups of users;
- 'beamable' pictures with text details of the work;
- the ability to track the exhibits at which visitors spend the most time, with a 'visitor counter' displaying the total number of people that have toured the exhibit;
- directions to and information on other exhibits that users might find interesting, based on the exhibits already visited, and with relevant links to information about merchandise in the museum shop.[172]

172 For more analysis of this evaluation, see Gay, G., Spinazze, A. and Stefanone, M., "Handscape: Exploring potential use scenarios for mobile computing in museums", *Cultivate Interactive*, issue 8, p. 15, November 2002: http://www.cultivate-int.org/issue8/handscape/

Participants were asked to group their statements by conceptual similarity, and to rank each statement based on how important they felt it was. Statistical techniques (e.g. cluster analysis) were then used to generate a concept map representing the key concepts that had emerged from the online brainstorming sessions. The results of these exercises were combined across the entire group of participants and similarity matrices were computed for each participant. Similar analyses were applied to help understand how the statements were placed together, grouped, or sorted in a similar fashion across the entire group. Altogether, these analyses were used to produce the graphical representation of the relationship between concepts, known as a cluster diagram (below).



© HCI group at Cornell University/CIMI

Ongoing research during 2003-2004 focuses on case studies at both the Johnson Museum and the Renwick Gallery at the Smithsonian American Art Museum, and on the development of a dynamic feedback tool. The first phase of the Renwick case study was completed at the end of July 2003 – this included a review of the design process pre-launch and an outline of issues for testing. The Renwick houses the premier craft collection in the United States. These objects and their setting were chosen to test the impact of mobile technologies in the museum for a number of reasons, including the fact that they are often misunderstood, the artists unknown, and the objects are displayed in a stationary fashion, when in fact many of them contain movable parts and hidden treasures. The Smithsonian staff set out to bridge the gap between object and viewer through three basic questions: 'Who are the artists?', 'Where do they work?', and 'What are the secrets hidden within the objects?'

After the launch, the team returned to the Renwick for user testing in late August, and conducted twenty-two interviews over a period of three days. In addition, survey results collected from launch to date have been analysed, and the team is currently in the process of extracting and analysing click-stream data. The team returned to the Renwick at the end of October for further observation and collection of survey data and the logs of participant responses. The final case study will include this triangulation of data (interviews, surveys, and click-stream analysis) in the assessment, as well as a

discussion of broader implications for the design of handhelds in museum settings. Further discussions with Newbury Networks (the contracting developer) will be held in order to include details of the architecture and technical issues in the final report. The final report of this case study, including a movie file/DVD of the handhelds in action, was due to be made available in December 2003, but due to CIMI's cessation of operations this has yet to appear. The Handscape project will, however, run to completion in mid-2004.

The second case study has the Handscape team working with the Johnson Museum as design advisors. The Johnson created a new handheld application specifically for third-graders (children between nine and ten years old) as part of their OMNI (Objects and their Makers: New Insights) educational programme. The Museum is currently collaborating with **Spotlight Mobile**[173] and the HCI group at Cornell to develop the handheld application and content, due to be launched in mid-February 2004.

The Dynamic Feedback Tool was envisaged as a 'proof-of-concept' tool for exploring how museums can use handhelds to evaluate visitor experiences. It was imagined that, if an evaluation component was built into the handheld application itself, and other activities were logged through the device, the combination of these data and their analysis would record visitor patterns and preferences, and capture information useful in understanding visitor experience and helpful for making future design decisions.

The project team is in the final stages of developing a proof-of-concept demonstration application of the dynamic feedback tool principle – a museum simulator – with this functionality and with the ability to present information in ways that might be useful to both curators and visitors. In order to generate visitor patterns and preferences, the simulator accepts input data of known generic visitor behaviour. It then overlays this against the backdrop of a museum floor plan with 'hot' objects, as well as the information map for each hot object. The museum simulator creates a data file that can then be used to experiment with different visualisations of simulated visitor data. These initial visualisations are being demonstrated to curators and museum visitors for feedback in terms of whether the displays grab attention, provide valuable information, and/or potentially influence their behaviour.

The original objective of the simulator was to generate data for experimenting with visualisations for museum curators and visitors, but the algorithms for defining typical visitor behaviour could be modified to correspond to actual visitor behaviour. The visualisation component of the tool is also intended only as a proof of concept in order to help curators think about what kind of information they might want to track and display when they are developing handheld applications. Feedback from the Renwick and Johnson museums has indicated that a museum simulator tool would be of use for future exhibit planning. At this time, however, the museum simulator has been designed only to generate back-end data for the visualiser. Making the museum simulator user-friendly will require additional funding and an extension of the Handscape work. In early 2004 results of the experimentation with the simulator are scheduled to be available from the Handscape Whitesite. It is anticipated that this will include a walk-through of the simulator and visualiser screen shots, a discussion about building evaluation devices into a handheld application, and an online or downloadable demonstration of the tool.

172 http://spotlight-mobile.com

Scenarios

Visiting a museum: convenient information, booking and payment

A group of tourists are due to arrive for a stopover in a large city. None of them has visited the city before, and the tourists are not familiar with the list of attractions that the city can offer during their short visit.

One of the tourists owns an electronic travel guide and purchases an add-on card dedicated to the city at the departure station before travelling. During her journey, she browses the main city attractions and the tourists are very excited about the prospect of visiting one of a number of museums that hold artworks and artefacts of international renown. The tourists connect to the city's tourist information Web pages via a link from the travel guide. While browsing this site, they also notice an urgent announcement of a city bus strike, unfortunately limiting their choice of museums to those located within a short walk or taxi ride of the station.

Upon arrival, infra-red beaming hardware at the station automatically connects to the travel guide, delivering up-to-date data about the city's main attractions, nearby landmarks, and other local information, including offers of discounts at nearby restaurants. The management of one of the local museums has taken the opportunity to present information on their current exhibition, attracting the group's interest and leading them to decide to visit this museum.

The museum's pricing information shows that advanced booking of tickets for a group of six or more works out significantly cheaper than paying on the door. One of the tourists reserves and pays for the tickets using her mobile phone while the group takes lunch. Using the travel guide, another of the tourists refers to a map of the city centre, and using positioning technology he highlights their quickest route to the museum, sending the highlighted map to his co-travellers. Noticing from this that their route passes within two blocks of one of the city's most celebrated landmarks, they decide to take a short detour to see it.

At the entrance to the museum the ticket booking reference is accepted by the gate computer, and the tourists enter without a hitch. The tourists check out the current exhibition, as well as several other exhibits that were mentioned in the electronic guidebook. While moving around the exhibition, the visitors are able to 'bookmark' objects of interest and add personal notes and impressions in the travel guide's memory, with the option of submitting comments to the producers of the city's e-guidebook for inclusion in next year's updated version.

An hour before the group's train is due to leave for their next destination, the travel guide flashes up a reminder and the tourists begin to leave the museum. Before boarding the train, the tourists can use GPS technology to save the latitude and longitude of the city in memory, thus allowing the creation of a virtual 'breadcrumb trail' detailing their travels around Europe.

A personalised museum visit

In order to enhance the experiences of its visitors, a museum's Web site has a section developed specially for visitors to check out prior to their visit. The Web site prompts users for basic profile information (e.g. age, gender) on their first visit, and for each

subsequent visit they are encouraged to answer a short series of questions about their forthcoming trip. This information is sifted by a specialised piece of software and the results of this analysis are used to suggest a personalised tour of the exhibits, matching the individual requirements and interests of the visitors. The computer application can correlate new information with previous data and feedback entered by the individual to suggest related tours or exhibits that may have been missed on the previous visit, to recommend items in temporary exhibitions, or to remind the user of the location of a favourite display. The museum's computer also amalgamates the feedback of all users, producing statistics from which it can calculate associated relationships between different exhibits (e.g. visitors who liked the whale skeleton almost always also liked the dinosaur exhibit) and different visitor profiles (e.g. the collection of Beatles memorabilia tends to be most enjoyed by women aged between the ages of forty-five and sixty-five). Comparing these data with the user's profile and previous preferences, further focused visit recommendations can be made.

The personalisation software also suggests items from a collection of learning resources (for example, worksheets for children that can either be downloaded and printed out before the visit or collected from museum reception), and links to further information about recommended exhibits, learning games, and multimedia on other pages of the Web site.

Information gathered from the survey includes:

- How long is the visit expected to last? Data from the museum visitors are used to calculate average viewing times for each exhibit/area and can then be applied in order to suggest a tour of an appropriate length.
- Are there any children in the visiting party and what are their ages? The software can then suggest worksheets of an appropriate level, interactive games, and stories for exhibits that appeal to similarly aged children.
- Is there anyone in the party who has a disability? For visitors with visual impairments, a full audio tour can be added to the personalised visit, and other resources may include Braille worksheets, textual descriptions for visitors with hearing difficulties, and a map of the most convenient wheelchair routes through the facilities.
- Does the visitor have one specific exhibit in mind that the tour must include? If so, the personalised tour can use this as a fulcrum, thus allowing the visitor to return to the exhibit with the benefit of the experience of other exhibits still fresh in the mind.

The user can save his or her tour profile, and its unique reference number can be accessed by staff at the museum's reception desk. Naturally, certain details will be kept private. The reference number is then used to create a download of tour information onto the visitor's PDA, and the handheld interface is used as a guide throughout the tour. The museum has some PDAs of its own which visitors can borrow, although a small deposit is required. The device acts as a location identifier – Bluetooth technologies throughout the museum track each visitor's position and, using the downloaded tour information, these trigger the delivery of information as visitors approach a specific exhibit. Sound and lighting effects can also be triggered for each individual display, and can be set to play audio descriptions automatically if the party contains someone with a visual impairment or learning difficulties.

Many exhibits include facilities for providing immediate and explicit feedback, ensuring that the data held by the personalised tour system are non-static and remain up-to-date.

Therefore, not only does this system facilitate specialised tours for every visitor, but the information gathered by the mobile devices is absolutely invaluable when the museum performs evaluation studies on its new approaches.

It is possible to 'save' a personalised tour by paying a small fee for the museum to burn the route, information and images about the exhibits viewed, related multimedia resources, and visitor comments onto a CD or DVD. This provides a further resource (complete with links to the museum's Web pages and extra worksheets) for exploring the learning potential of exhibits, even after visitors have returned home. The DVDs prove especially popular with school field trips, but are also affordable enough to be bought and enjoyed by families and individuals.

Manuscript exhibition in a library

A library offers an exhibition of precious medieval manuscripts and would like to find an original and versatile way of popularising them. There are enough manuscripts to fill both the library's main exhibition space (which consists of a large hall and several smaller adjoining rooms on the first floor) and a smaller presentation space within the main entrance hall of the building.

The manuscripts present many different literary, historical and artistic cultures and can be linked in various relationships. For example, a library visitor might be interested in manuscripts from a particular period (e.g. Carolingian) and wish to see all the manuscripts the library holds that are attributed to that period. An art historian might be more interested in illuminated manuscripts and would like to see only exhibits that include illuminations depicting agrarian activities. The exhibition manager has established a number of different views of the collection, but realises he can not predict the likely popularity of each of these different views and/or interpretative routes. Moreover, the library has some difficulty in deciding how to arrange the manuscripts in a way that will be most meaningful and convenient to the majority of visitors.

To solve this problem, the exhibition manager uses his specialist knowledge in conjunction with the collection metadata in order to identify the themes and associations that are likely to be the most common. He then begins preparation of an engaging, interpretive path through the exhibits based on each theme. As the architectural image in medieval manuscripts is one of the central topics of the exhibition, the corresponding viewing order follows exhibits with images related to this topic. Another order describes a specialised history of the collection and of the library itself as users view manuscripts based on date of acquisition. Other routes likely to be popular are viewing the manuscripts according to the date of their creation, subject, and origin.

The exhibition manager commissions full textual commentaries for these five sequential views of exhibits, and sources complementary material for the exhibits such as contemporary music from the time. He uses mapping software to try out different arrangements of exhibits in the space available, plotting paths based on the five major themes. Eventually an arrangement for the manuscripts is finalised, laid out in such as way that the most likely routes are convenient, accessible and do not involve too much 'doubling back' for the visitors.

When the exhibition opens, the library allows visitors to borrow a PDA on which they can download the floor plans of the exhibition via the touchscreen and stylus. Visitors can also use their own devices, registering at the reception desk before receiving information from the beam station in the entrance hall space. The PDA interface encourages users to

choose a path through the exhibits, whether this is one of the suggested routes or a self-designed route that can be created on the fly by automated querying of collection metadata.

The five main tours have an audio commentary giving a general overview and interpretation of the collection which is delivered through headphones. Although there is necessarily some overlap between the commentaries, the exhibition manager ensures that each theme is clearly linked to the commentary in order to provide tours which are sufficiently different to maintain interest for a visitor taking multiple paths through the exhibition. Itineraries are mapped onto the floor plan, with individual exhibits highlighted and marked with an icon showing that further textual information and/or multimedia (e.g. recordings of the texts) is available. Users can call up more information using the stylus, and peruse it at their leisure before restarting the general commentary.

Icons also display whether the individual exhibit appears in supplementary material offered for sale by the library (for example, a glossy catalogue of the exhibition, books on the author(s) and postcards/bookmarks showing a reproduction of the exhibit). Users can order these items from the library shop using a 'single-click' facility, although the sale is not confirmed until the user has had a chance to view their choices and completes the transaction either through the PDA or by more traditional means.

As digital photographs are prohibited within the exhibition, the library also offers digitised images which can be ordered during the visit. The library plans to use funds raised from the sale of electronic or printed merchandise to help towards the cost of digitising the remainder of the manuscript collection.

Advantages and Disadvantages

Introduction

Mobile access technology provides visitors with potential access to a rich array of information during their visit. Other technologies (electronic publications, for example) can be used to offer products for consultation either before or after the visit. This feature makes mobile devices ideal for deployment as museum guides, not only being available during the visit but also providing flexibility and freedom of choice as regards what paths to follow during a visit. This flexibility can be used to create a bridge between various types of institutions (museums, libraries, archives) and other organisations from outside the memory/cultural heritage sector.

For most visitors these technologies are familiar. Visitors are increasingly likely to come equipped with devices they feel comfortable and adept in using. Some visitors may not yet be owners of such devices, and institutions need to address their needs also. The size of this class of visitor should continue to decrease. To ensure inclusion, institutions should, wherever possible, be able to provide a sufficient number of devices to meet the needs of these visitors.

Mobile access devices can feed visitors' expectations. This might be especially appealing to those visitors who prefer to read from their cellular phone or PDA instead of following printed labels and guidebooks, or participating in guided tours. This mode of access is increasingly popular with the younger generation. Use of mobile access devices provides visitors with various learning styles or with disabilities a means to access content specific to their needs. These technologies can provide and use position-dependent information

comparable to smart label technology.[174] While smart labels need special antennae and adhesive tags in order to function, here the basic infrastructure is provided and maintained by the telecommunications companies and geo-positioning satellites.

The possibility to present information on a specific collection in a more active and interactive fashion is believed to lead to increases in real visitor numbers, and to an attendant increase in revenues (e.g. through visitor spend in the shops), though we are unaware of any in-depth studies on this to date.

Common problems associated with PDAs and cellular phones include user dissatisfaction with their interface. The small size at which text can be presented on screen, the small button size for keypads, and the non-intuitive user interface designs are all examples of the shortcomings of current implementations of mobile technologies. These weaknesses will be eliminated as hardware interface developers improve and fine-tune their designs in response to a better understanding of user needs and technological developments. In everyday situations users create 'work-arounds' to bypass these shortcomings.

When it comes to employing these devices to present large amounts of multimedia information to unfamiliar users, interface limitations become critical. Another problem is the lack of a customisable interface. Cultural heritage institutions often aim to address different learning styles and to meet the personal preferences of a range of users. Customisable interfaces (or 'skin' technologies) for mobile devices remain an immature technology. As the technology matures, it will provide a richer meeting-place between person and machine. As developments make the interface more flexible and more suitable, the devices may risk promoting visitor isolation. In museum visits, users equipped with personal devices (especially those utilising audio headsets) tend to lose contact with their companions, thus detracting from the social aspect of museum-going. Some visitors even lose contact with the exhibits themselves, following only the resources covered by the mobile guide or spending more time dancing through the menus than exploring the institution they are visiting.

The impact of equipment malfunctions should be anticipated. Few institutions will be able to provide adequate support to address all possible causes of failure, and the limitations of support should be planned and acknowledged. As devices become more sophisticated and incorporate sensitive recording utilities, cultural heritage institutions that prohibit visitors from making records of their visits may find it increasingly difficult to enforce such restrictions.

Advantages

Accessibility – Mobile devices offer visitors flexible access to resources. They can be employed to support multiple learning styles and to improve the experiences of users with special needs.

Flexibility – Users can create their own profiles, define their own paths, and manage the depth at which they receive and use information for themselves.

Convenience – Institutions become more appealing to the class of users that may prefer to use handheld devices to access label information because, unlike printed labels or guidebooks, they can configure the form, language and depth of the information. In

174 The reader is invited to see the Smart Labels and Smart Tags section in *DigiCULT Technology Watch Report 1*.

addition to this, users may own and be familiar with their devices. Another benefit is that the network needed for delivery of location-dependent content is built and maintained by the mobile communications sector.

Content sharing – The lines that separate different cultural heritage institutions are dissolving. The ability to search across institutional resources enables content developers and users to build their own links and interconnections between information units.

Disadvantages

The technology 'gap' – There are still large groups of visitors who do not have their own devices or whose devices will not enable them to take maximum advantage of the available resources. Institutions need to ensure that new technology does not become yet another barrier to inclusion.

Visitor isolation – Individualised ownership and use of devices will isolate visitors from each other, although at least two of the projects described earlier in this chapter suggest that novel uses of these devices can actually create new kinds of communities and communication opportunities.

Interface issues – The process of interaction between user and device is not always convenient. There is a general lack of customisable interfaces. There is also a lack of cross-organisational standardisation in this area.

Technology-centric – The use of mobile devices may have the potential to distract visitors from the items on display. Seamless linking between devices and artefacts is still very difficult to achieve.

Equipment malfunctions – While mobile devices are extremely reliable, the interfaces between them and the local content servers provide a key point of failure.

User power – The increasing presence of visitors to institutions with handheld devices with sensitive cameras worries many custodians because they realise their limited ability to stop users recording images of what they see or sounds of what they hear.

Lack of back-end services – Few institutions have the back-end content management systems and data about their holdings to support rich applications of technology.

Introducing the Technology

Policy and Organisational Framework

The standard approach in museum design is to allow the objects on display to speak more or less for themselves, with some contextual or explanatory information provided on wall-mounted labels or plaques. Traditionally visitors have been treated as passive recipients of information rather than active participants in its packaging, interpretation and use. As a result, presentation materials were designed to provide visitors with similar impressions of and information about an exhibit. If there was a difference in impression, this was nurtured by the guides who delivered information with their own styles or emphasis. The delivery of content to match the interests, level of knowledge, and ways of learning of a particular visitor was dependent on the skills, knowledge and experience of the guide and, to a certain extent, the curator.

Nowadays, however, designers of museums aim to ensure that they are enabling the telling of the story (or stories) about or behind the objects. How an object is best presented may also differ from visitor to visitor depending on their interests, preferences and cultural background. Much current work in information technology is focused on the personalisation of delivery. Virtual communities and avatar guides can play a role here.[175] The problem is not only to introduce new devices into the museum setting, but to develop content that will suit the needs of various types of visitors.

In summarising the problems that the new technology addresses, it becomes clear that its successful implementation will depend on following a few simple guidelines:

- Content must be presented in a way that satisfies a diversity of user groups, including access issues for users with disabilities.
- The interface of the device used must be effective and convenient enough to offer the visitor a personalised experience.
- Mobile devices offer a number of functions that can be better met by other technologies (for example, anything involving a large amount of text). They should only be used where no other device can perform as well or as conveniently.
- Education and enjoyment potential must be maximised.
- Inclusion must be emphasised.
- Institutions must consider whether they will continue to be able to afford to develop the content and the forms of its presentation so that it does not become stale and repeat visitors begin to lose interest. With the use of technology comes the expectation of freshness and newness on each subsequent visit.

What Existing Technological Infrastructures are Needed?

The necessary technological infrastructure will differ according to the specifications of the solution that is to be implemented. An institution might consider which of the following features they wish to implement, and plan personnel and technological deployment accordingly:

- The creation and maintenance of user profiles;
- Whether profile-defined tours will be used or whether a single tour will be offered for all visitors;
- The use of positioning and tracing/tracking functions;
- Whether games will be developed and how often they might be renewed;
- Links between mobile devices and a virtual community comprising current visitors, past visitors, and friends of the institution.

Some of these are targeted specifically towards keeping in touch with the visitors. The core features for mobile access technologies will be the positioning component, user profiles, and the personalisation of tours. At the heart of these services must be a rich information base from which to draw content that can be packaged and presented in different ways.

On the technological side, institutions intending to use PDAs in conjunction with

175 See the sections on *Cultural Agents and Avatars, Electronic Programming Guides and Personalisation* (above) and *Collaborative Mechanisms and Technologies* (below) for more links between these related topics.

Bluetooth for tracing the position of visitors will have to implement a Wireless Local Area Network (WLAN) following the IEEE 802.15 standard, with access points connecting the wireless network to the wired one. They will also require wireless devices (whether PDAs or cellular phones) for receiving the informational resources, and probably one or more beam stations for the synchronisation of data between systems.

What Organisational Structures Make the Technology Appropriate?

The implementation of handheld devices in cultural heritage institutions requires careful preliminary planning as well as costing. A number of questions should be discussed with staff members during the project, for example:

- How will we select the handheld that best fits our organisation, its needs and its audience?
- Will users be able to use their own devices, or will we start by lending/hiring our own?
- Will the mobile access devices be used simply as communication tools, or are positioning features also important?
- In cases where positioning is necessary, what are the distances involved in tracking the visitors' locations? If visitors will be less than ten metres from the exhibits, Bluetooth, infra-red devices or smart labels will be suitable. If the distances involved are greater, GPS should be considered.
- What kind of interface will match the needs of the audience best? Will it be possible to offer designated guided tours to users with different levels of ability, for instance visual, auditory or mobility impairments?
- What information delivery methods will work best? These should be considered for a number of situations and types/sizes of group.
- How will the handheld be used as a means of finding one's way around? Who is doing the guiding: the visitor, the device, or both?
- How can user interest be tracked for studying visitor response to an exhibition?
- How can we ensure that the new devices do not distract/detract from the exhibits themselves?
- By providing more information to the visitors, will their appreciation increase, or is there a danger that they will feel overwhelmed by information?
- Is there enough content to justify the use of mobile devices? Are there similar institutions that could provide feedback and guidance?
- How will information about material held in your institution be linked with material held at other institutions? How will these links be maintained?

Staffing Levels and User-base Issues

Cultural heritage institutions are unlikely to have staff already in place that will be capable of overseeing the introduction of such specialised technologies. The great majority will typically use external organisations for building the technological infrastructure, with a dedicated member of staff on hand to cope with any questions or problems.

The most demanding role would probably be that of content provision and organisation. Information delivery will have to be prepared for users. The information model will need

to respond to different profiles and needs. Ready-made solutions for this simply do not exist. From a psychological point of view, the skills required will change along with the rapid development of the technology. This is perhaps the greatest challenge to the designers and content providers in terms of harnessing the power of mobile devices at any given time, while simultaneously ensuring as far as possible that the solutions proposed are not so tied to a particular software or hardware solution that they will quickly become obsolete.

A study completed in 2002 into how wireless computing is perceived in the museum setting stressed that issues related to interfaces and location-sensitive applications are considered most important by museum patrons and wireless systems designers alike.[176] Museum professionals considered the administrative functions of the technology to be most important. Given the differing concerns of the three groups involved, this is not overly surprising. Since the introduction of new technologies inevitably precedes a solid understanding of the tools currently on offer (and their specific features), it will take time and an increase in the number of organisations offering wireless access in order to reach a consensus. The flexible nature of the technology means that it should be able to meet both requirements.

176 Gay, G., Spinazze, A. and Stefanone, M. (2002), "Handscape: Exploring potential use scenarios for mobile computing in museums" in *Cultivate Interactive*, Issue 8, November 2002: http://www.cultivate-int.org/issue8/handscape/

Rights Management and Payment Technologies

Executive Summary

The heritage sector has tremendous financial potential bound up in its collections. This potential is largely untapped. The Lund Principles, which were adopted by the EU Member States in 2001, stressed that public access to this material should be free of charge.[177] There is, however, widespread recognition that commercial exploitation of cultural services is essential if we are to ensure their long-term sustainability. As the public sector financial climate becomes increasingly constrained and competitive in Europe, heritage institutions must increasingly fight for a share of revenue funding and demonstrate their ability to generate income for themselves. The income-generating potential of the assets in the care of heritage institutions needs to maximised.

Licensing others to use their assets will provide an increasingly significant income stream. Deals will be made over the Web in an ever more automated environment. The publishing, broadcasting and advertising sectors appear to be making increasing use of images from cultural heritage institutions. Cultural heritage organisations lag behind commercial image libraries – such as **Getty**, **Bridgeman** and **Alinari**[178] – in offering services that provide rapid turn-around, are customer focused, and are reliable. While public sector institutions are unlikely to be able to compete with commercial enterprises, newer business models might provide opportunities for them to increase their revenue income and reduce the costs associated with generating that revenue. There are significant risks involved in the licensing of cultural heritage assets. Many of these risks are created by the flexible way in which the Internet enables content to be copied and distributed. Many institutions recognising the risks posed by piracy, including loss of income and control of their content, have shied away from making their content available on the networks. The lack of technological awareness in many institutions combined with limited resources to create, maintain, and exploit the necessary information and technological infrastructure means the cultural heritage sector is not benefiting as effectively as it might from the rise of digital opportunities.

Digital Rights Management (DRM) and related security technologies streamline and simplify the process of granting and gaining licences for the distribution of protected content. They allow organisations to define and represent access rights and conditions, ensure that these are adhered to, and facilitate the collection of licensing charges for the use of resources. Rights management software and automated payment systems will be crucial to the cultural heritage sector if it is to become and

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177 http://www.cordis.lu/ist/ka3/digicult/lund_principles.htm (April 2001)
178 http://www.getty.edu/art/; http://www.bridgeman.co.uk; http://www.alinari.com

remain competitive in comparison with commercial picture libraries and other comparable content providers. The sector should aim to become the natural source of high-quality cultural content, the first place users think of when they want their image, expertise and other content needs met professionally. This can only happen if potential users can identify possible material easily, negotiate the rights to use it efficiently, and have it delivered to them in a timely manner.

The case studies featured in this section describe in detail the issues involved in thinking about the distribution of content (e.g. **EMII-DCF**), as well as the need to simplify and streamline the various rights management processes in practice, making them as user-friendly and intuitive as possible (e.g. **AMICITIA**). The scenarios suggest other mechanisms to support online sales and digital rights management. This section – more than any other in this Technology Watch Report – covers a broad and eclectic range of technologies, standards and approaches. It raises a number of critical questions that institutions could usefully consider before embarking on creating an online shop-window.

Introduction

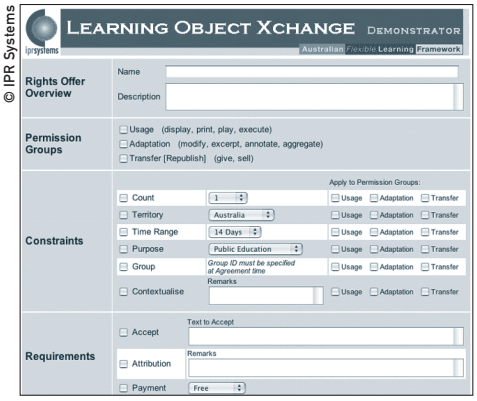
The Ever-changing Field of Play

Rapid developments in the fields of telecommunications and commerce have contributed to the growth of the intellectual property market during the past decade. The increased use of digital storage, networks, productivity applications, and online payment systems has made intellectual asset management more efficient and responsive to customer needs. This market has undergone two significant periods of development in the past fifteen years. The first phase, characterised by *naïveté* and a natural unfamiliarity with the risks to rights posed by the online environment and a poverty of imagination of the commercial opportunities it created, ran from the early 1990s until around the end of 1997. To begin with, the transfer of digital objects was regulated, when it was, by mechanisms and processes that had been effective in the traditional print publication or record industries. There was initially no control over the storage, transfer, manipulation, and duplication of information. This led to widespread and, seemingly, uncontrollable copyright infringements. The most widely known of these was the case of **Napster**, the file-sharing service that allowed users to swap near CD-quality MP3 versions of their favourite songs.[179] Copyright and intellectual property rights infringement became common practice, and – with good cause – record companies began to worry about their future revenue streams. They moved to put an end to the practice. In the cultural heritage sector, images and text were increasingly made freely available, and much copyrighted material was put online in a downloadable format, often by individuals who did not own the rights in either the original material or digital representations of it. Clearly this was an unsuitable state of affairs for the owners of intellectual property who wished to safeguard its financial potential.[180]

179 http://www.napster.com/. Users are no longer able to swap files so freely without fear of reprisal. See the section on *Collaborative Mechanisms and Technologies*, below, for more on the rise, fall and current controversies of popular file-sharing systems such as Napster and Kazaa.

180 For a more in-depth analysis of the issues raised by online music piracy, see Kostas Kasaras, "Music in the Age of Free Distribution: MP3 and Society" in *First Monday*, vol. 7, no.1, January 2002: http://www.firstmonday.dk/issues/issue7_1/kasaras/index.html

The second phase began in the late 1990s. At this time, the Internet was starting to play an increasingly central part in all areas of business, and organisations focused on strategic development of e-commerce opportunities. Early 'digital libraries' called into question the current standards on the control and enforcement of intellectual property rights (IPRs), and a number of companies began development of technologies to control digital rights. A number of countries introduced legislation in an attempt to slow the dissemination of unauthorised digital content around the Web. It is difficult to say whether or not the new technologies and legal frameworks are containing the flow.



© IPR Systems

IPR Systems' *Learning Object Xchange* - entry screen for educational learning content

Digital Rights Management: An Introduction

The principles of rights management have evolved over several centuries. From the outset the laws aimed to protect the rights of creators to exploit the economic potential of their creative acts. It was, and is, a widely held belief that these laws ensured that there was an economic motivation to underpin and foster creativity. From pirate copies of books in the 18th and 19th centuries to illicitly recorded music and film in the 20th century there have always been individuals prepared to infringe the rights of creators or their agents (e.g. publishers). Likewise, there have always been individuals prepared to buy or use illegally produced copies. The digital technologies and the Internet in particular have made infringement easier and, in the case of audio recordings and increasingly film, the impact on the income streams of artists, studios and distributors has caused increasing concern. Intellectual property rights issues are now widely discussed, and companies in Europe and North America are actively working on developing technologies that will enable organisations to stop the infringement of their rights and those of the creators they represent. Content owners are turning to the criminal and civil courts, who could protect their rights 'by making examples' of small numbers of individuals. An increasing number of vocal activists are pressing the argument that all human knowledge is in the public domain.[181] In fact, much cultural heritage content *is* in the public domain, having been bought and paid for by taxpayers or gifted to public institutions for the benefit of the citizens. Public institutions often restrict visitors from photographing material on display by claiming that this poses security and conservation risks. This can cause a certain amount of friction. It is important to protect the taxpayer's rights as well as those of a work's custodians; the case study on **AMICITIA**, below, examines this in more depth.

181 Rights management systems come under a significant amount of criticism, with accusations of privacy infringements and many of the larger corporations adopting a seemingly Orwellian approach to their jealously guarded content. In his book of interviews, *The Job*, William Burroughs writes that 'All knowledge all discoveries belong to everybody. All knowledge all discoveries belong to you by right. It is time to demand what belongs to you.' This has been adopted as the motto of the **Copyleft** movement, http://www.dsl.org/copyleft/. Burroughs' argument is carried on most prominently and most eloquently today by campaigner John Perry Barlow.

Digital Rights Management software is fundamentally concerned with the automated management and assertion of intellectual property rights, and the secure delivery of digital content.[182] A DRM system should meet the following seven tests:

1. Prevent or inhibit unauthorised use of content without unnecessarily constraining authorised use;
2. Describe (or represent) the rights that the user has acquired in the content (e.g. to print, to copy, to exchange) in ways that make it possible for software and hardware applications to use the information to manage access;
3. Detail whether or when a licence in the content expires;
4. Make the barriers to use as transparent to the consumer as possible and certainly only invoke restriction of use when conditions are not met;
5. Work effectively with different types of content;
6. Support different business models (e.g. pay per view, subscription);
7. Continue to allow 'reasonable use' of content (e.g. for educational or personal use).

DRM developers regard it as a rule of thumb that applications must be able to express rights in secure, machine-interpretable ways.

While DRM has the potential to be restrictive in the extreme, content providers should remember that the delivery of content is their *raison d'être*, and that consumers will quickly go elsewhere if they feel they are being treated as suspects rather than as valued users. Indeed, Digital Video Express (DiVX) failed because it made it too cumbersome for consumers to access the content for which they had paid. As Mairéad Martin of the **University of Wisconsin**[183] notes, 'the needs of universities and libraries are different from those of the business community, and the Internet's potential to enhance education will be inhibited if current DRM plans and legislation do not take the needs of this sector into consideration.'[184]

Although DRM is the primary technology covered here, the reader should be aware that there are other technologies currently in use that protect content in different ways. These include *visible and invisible watermarking* and *steganography*. In the former case, marks are embedded in digital objects that can be used to demonstrate ownership and, in the latter, bits are embedded containing information, algorithms or transformations. We aim to cover these technologies in a series of short pieces in the *DigiCULT.Info Newsletter* in 2004.

© MediaSec Technologies

MediaSec watermark embedding

182 The increasing globalisation of content and transactions has led to the complication of digital rights management. See Kim Nayyer, "Globalization of Information: Intellectual Property Law Implications" in *First Monday*, vol. 7, no.1, January 2002: http://www.firstmonday.dk/issues/issue7_1/nayyer/index.html

183 http://www.wisc.edu

184 Mairéad Martin, "Digital Rights Management in Research & Education" (2001): http://www.doit.wisc.edu/architecture/drm/DRM-WISC.ppt.

Automated Payment Systems: A Brief Introduction

The words 'automated payment' may strike panic into the hearts of many readers. Despite the rapid growth of online shopping many people fear that unauthorised withdrawals will be made from their bank accounts if they divulge credit card numbers, even over 'secure' servers. 'Never give out your password or credit card number in an instant message conversation' is the message at the top of any *MSN Messenger* window, and people understandably think that, if Bill Gates can't make the Internet safe, then who in the world can?

However, automated payment systems can take many forms, and must always begin with an explicit agreement preceding any transaction. Users should be assured of the fact that payments will only ever be made with their prior consent, and that legal precautions and other appropriate safety nets have been put in place to foil would-be fraudsters. A generalised outline of the automated payment process can be found in the following section.

How the Technologies Work

Digital Rights Management

The practice of rights management can be as simple as preventing users from altering, adapting or reproducing content without permission. A format such as Adobe PDF meets these needs while at the same time allowing unlimited distribution, duplication, storage, and printing rights. Of course, there are more in-depth strategies that may be pursued. Rights, permissions, obligations and constraints can be expressed through a Rights Expression Language (REL).

RELs are themselves frequently expressed as XML-compatible specifications. *The Extensible Rights Management Language* (XrML) is the best known of these specifications.[185] XrML enables companies to use an open standard of cross-platform specification for the accurate description of content, simultaneously validating the conditions of use of the digital product. The use of XrML defines a transparent, comprehensible and uniform structure of the rights pertaining to the digital product, regardless of its format or specifics. This facilitates interaction and ensures the compatibility of DRM systems across different organisational structures and technical platforms.

The *Extensible Business Reporting Language* (XBRL) is an XML-based standard for 'identifying and better communicating the complex financial information in corporate business reports.'[186] The aim of XBRL is to make the analysis and exchange of corporate financial information easier and more reliable. While XBRL may be more heavyweight than most cultural heritage organisations require, its suitability as a way to represent, exchange, and enable the integration and analysis of financial information makes it especially viable as a platform for organisations that need to make financial data accessible as part of openness and financial accountability. Another XML-related exchange architec-

185 http://www.xrml.org
186 http://www.xbrl.org

ture is *ebXML* (Electronic Business using XML),[187] a freely available format which supports the interoperable exchange of business information in a secure and consistent manner. This specification is aimed specifically at small to medium-sized enterprises (SMEs) that have not yet implemented a data interchange standard such as *Electronic Data Interchange* (EDI).[188] Organisations with existing experience using EDI are likely to find ebXML less expensive and easier to implement than their current set-up was.

Trusted Systems & Business Rules

Trusted systems are based on the principle of confidence between participants in an exchange, with the understanding that all parties concerned will adhere to certain rules. These rules tend to be concerned primarily with usage rights, such as the formats and the purposes for which the content may be used.

The rules should make explicit the costs that may be incurred on the part of the consumer. Software which identifies and enforces these rules is becoming more common. Recent upgrades of **Microsoft**'s *Windows Media Player*[189] (and similar media access programs) carry this functionality as a standard feature. The concept of 'trust' can even be built into hardware, with printers 'examining' the files sent to them to check that the content owner is prepared to grant permission to the end-user to produce a hard copy of their work.

Another XML-based standard, the *Business Rules Markup Language* (BRML),[190] supports the encoding, exchange, interpretation, and applications of business rules. Business rules are formal statements of policy related to pricing, access, usage, delivery, service, and decision-making guidelines. BRML was developed by **IBM**[191] for use with their *CommonRules* framework. CommonRules provides a way to communicate 'executable business rules between enterprises using heterogeneous rule systems, and enables incremental specification of executable business rules by non-programmer business domain experts'.[192] By codifying business rules, organisations are able to decentralise, and often automate, business processes while maintaining core control.

Licences[193]

Most orthodox rights management solutions are founded on frameworks for requesting and granting of licences. Licences can be acquired in one of four ways – *silent* (no user interaction), *non-silent* (user is required to do something), *predelivered* (licence acquired at time of purchase), and *non-predelivered* (licence acquired after purchase has been made) – with each approach having its strengths and weaknesses. Licences may be granted *gratis* or they may attract a financial charge. They may be perpetual, allowing the user to access the material for an unlimited period of time, or limited by specified timeframes. Licences

187 http://www.ebxml.org
188 http://www.xmledi.com
189 http://www.microsoft.com/windows/windowsmedia/default.aspx
190 http://xml.coverpages.org/brml.html
191 http://www.ibm.com
192 Cf. http://www.research.ibm.com/rules/commonrules-overview.html; http://www.alphaworks.ibm.com/tech/commonrules
193 The variance between Standard and American English in the spelling of 'license' can be problematic, particularly when searching for Web resources. The Standard and American spellings ('licence' and 'license' respectively) are often used interchangeably and, to complicate matters further, 'license' in Standard English is used as a verb.

may be further limited by media type, geographical distribution, size of production run or, in the digital environment, number of downloads, and quality.

A typical licence acquisition process will follow these lines:

1. The user attempts to access a protected/encrypted file.
2. A licence is requested, and metadata (usually comprising a unique ID and a set of attributes) are sent to the licence issuer.
3. The licence server retrieves the appropriate licence from a database using the metadata.
4. A licence is sent to the user, allowing access to the file.

A number of media viewers handle the licence acquisition process automatically, with messages being exchanged when a user attempts to view, listen to, or otherwise access protected content.

Self Protecting Documents and the Digital Object Identifier

Special file or object *formats* offer an alternative way of protecting content. The *Self Protecting Document* (SPD) format was initially developed by **Xerox**, and is now owned by **ContentGuard Inc**.[194] An SPD is a document that preserves its own confidentiality and integrity, and enforces the rights assigned to it. Documents created in PDF, Word or HTML format can be converted into SPD, with integrated metadata asserting the creator's preferences and enforcing conditions of use.[195]

Images can be protected in similar ways. Image-server technologies, for example, present zoomable images that cannot be downloaded or duplicated. **Digimarc**[196] and **MediaSec**[197] are companies that provide secure watermarking solutions. There are unsophisticated ways around this. It remains possible to take a screenshot of the image and paste this into **Adobe** *Photoshop* or **Macromedia** *Fireworks*.[198] The resulting quality, however, will not be good enough for any purpose beyond primitive Web display. For further protection, images can be tiled so that would-be pirates need to 'stitch' numerous files together to recreate the full image.

The *Digital Object Identifier* (DOI) is a system for 'identifying and exchanging intellectual property in the digital environment'.[199] The DOI identifier framework is 'media-neutral', and can be applied to both physical and digital objects whether they are documents, film, images, or sound files. Given its emphasis on persistence, interoperability and extensibility, the use of DOIs can be helpful in building automated services and assisted transactions in e-commerce, particularly in the communications required between different organisations running different copyright licensing systems.

194 http://www.xerox.com; http://www.contentguard.com
195 There are an increasing number of products in this area. For instance, Homepage Content Guard is a tool for securing the textual content of Web sites. While it enables viewing, it can be used to make printing and copying impossible. http://www.softcome.com
196 http://www.digimarc.com
197 http://www.mediasec.com/html/en/index.htm
198 http://www.adobe.com/products/photoshop/main.html; http://www.macromedia.com/software/fireworks/
199 http://www.doi.org/. Issue 4 of the *DigiCULT.Info Newsletter* carried a brief introduction to DOIs and pointed to other key sources of information. The September 2003 issue of Ester Dyson's monthly report *Release 1.0* (vol. 21, no. 8) focused on "Online Registries: The DNS and Beyond". In this she put DOIs into a broader context of persistent handle systems, see http://www.handle.net/.

Automated Payment Systems

The phrase 'automated payment system' is not entirely accurate because the process of purchasing goods over the Internet is not truly *automated*; rather it is *assisted*. Many Internet users will have some experience of online purchasing.[200] While numerous vendors provide automated payment services they all use very similar mechanisms. In many ways the online automated payment process is similar to the purchase transaction that takes place in a conventional shop except that in a shop where a credit or debit card is used the card is physically presented and the clerk usually reads its magnetic strip automatically.

The automated payment process is likely to take the following shape:

1. The customer browses or searches the seller's Web site and, once a product has been selected for purchase, proceeds to initiate payment.
2. The seller's Web site then collects some information about the customer to enable them to verify (or track) the customer's identity.
3. The seller's Web site passes the customer to a secure payment gateway which enables the customer to enter her credit or debit card details.
4. The Payment Gateway requests authorisation from the customer's bank or credit card. If funds are available the transaction is approved and if not it is declined. Confirmation of the outcome only is passed back through the Payment Gateway to the seller's server.
5. If the seller's server receives a positive response, then the transaction is approved and the seller releases the goods, whether this involves a physical shipment or a virtual one (e.g. an airline reservation number is sent as an e-mail, or an ID and password needed to open a file or site are passed to the consumer).

In transactions where the credit card is not present, the costs of fraudulent purchases are met by the selling party. Vendors must ensure that the card is not stolen (via a verification process using a home address or similar information) before agreeing to honour the transaction. This is a service that the Payment Gateway provider should perform as standard, and organisations should ensure that the provider they select routinely carries out this verification. Major suppliers of Payment Gateway services and systems include **VeriSign**, **Rodopi Payment Gateway**, **Authorize.Net**, and **eWAY**.[201]

Micropayments

One automatic payment system in which there is growing interest is *micropayments*, very small charges incurred each time a chargeable Web page is viewed or interacted with. These payments – perhaps in the region of a fraction of a cent – are too small to be

200 See **Indie Film Spot** (http://www.striketheset.com/), which allows users to download for a fee independently made movies in the format of their choice, for a good example of a site which achieves a balance between cultural worthiness and economic realism.

201 http://www.verisign.com/; http://www.r-p-g.com/; http://www.authorizenet.com/; http://www.eway.com.au/

treated in the same way as credit card transactions. Payments are made to Internet wallets, and are collected in bulk at agreed intervals. The Internet wallet was a concept touted by **IBM** in the early days of eCommerce, but eventually discontinued as confidence in online shopping grew. The resurrection of this concept owes much to the smaller amounts involved in increasingly frequent transactions. Micropayment systems can be used as an alternative to off-putting subscription charging methods, and may also act as a better revenue-generating mechanism than online advertising.

Another micropayment framework is to charge users randomly, so that, for example, every 500th user of a site pays a nominal fee. Payments should even out over time, with frequent visitors paying more often and casual visitors likely to be able to browse without cost.

A micropayment agreement may be difficult to establish with individual users, and micropayments are most useful when the agreement is between two organisations that need to use each other's online content on a daily basis. An alternative is for a number of sites to sign up with a central collections group such as **Peppercoin**,[202] who will facilitate the collection of payments from users and their transfer to service or content providers. Micropayments have not yet been widely adopted, and it is unlikely they will be until standards have been established in this area.[203]

A Unified Approach to Business

Online access is transforming the reach of heritage institutions. For instance, 'The NLC also provided an illustrative example of the tremendous potential for online digital products. The NLC [National Library Canada] noted that it currently averages roughly 29,000 online download requests per month on its *Virtual Gramophone* Web site. In contrast, on-site users make only 300 requests per year for the same collection of sound recordings, a usage difference of over 1000-fold.'[204] The large number of emerging technologies that appear to offer heritage institutions ways to represent, make accessible, and generate income from their content is bewildering. At the outset it is essential to define a strategic approach to content generation and exploitation. Technologies can then be chosen to make that strategy a reality.

If heritage institutions are to find their place in the digital environment then they need to move their content creation work from grant funding and other soft money to revenue-funded lines, as Carrie Bickner of New York Public Library Visual Archives noted at the April 2003 NINCH Symposium on "The Price of Digitisation".[205] Her statements echoed the findings of thirty-six interviews which the Humanities Advanced Technology and Information Institute (HATII) conducted in 2000 and 2001 as part of its research for *The NINCH Guide to Good Practice in the Digital Representation & Management of Cultural Heritage Materials* (2002). These showed that few projects had planned for the long-term sustainability of the resources they were creating in digital form.[206] Planning

202 http://www.peppercoin.com
203 For more on the obstacles to implementing micropayments, see Win Treese, "Putting it together: Where are the micropayments?" in *netWorker*, Volume 7, Issue 3, September 2003 http://delivery.acm.org/10.1145/950000/940840/p15-treese.pdf?key1=940840&key2=2014630701&coll=Portal&dl=ACM&CFID=14624569&CFTOKEN=19937062
204 http://www.pch.gc.ca/progs/pcce-ccop/reana/model-study.pdf, (2002), page 43
205 Report by Lorna Hughes at http://www.ninch.org/forum/price.report.html
206 See the reports of the interviews conducted by the staff at HATII on behalf of NINCH, http://www.nyu.edu/its/humanities/ninchguide/interviews/index.html

sustainability and developing revenue streams are essential for heritage institutions if they are to position themselves to take maximum advantage of the digital environment. Business models for sustaining the availability and funding of cultural heritage projects are gaining an increasingly high profile. Much work remains ongoing in this area. **Wall Communications Inc.**'s "A Study of Business Models Sustaining the Development of Cultural Content,"[207] prepared for the Department of Canadian Heritage, investigates business models in detail.

Business Technologies and the Heritage Sector

Brief Background

The cultural heritage sector has, until recently, been less concerned with the assertion of intellectual property rights than with the protection and preservation of the objects themselves. It is increasingly self-evident that the unchecked exchange of information across networks, and the unauthorised use of intellectual property in digital form will have an impact on the control and revenue streams of many larger cultural heritage institutions. Evidence from other sectors, and especially picture libraries, demonstrates how effective management of online digital assets can be used to create substantial revenue streams.

© AMICITIA
Video archive

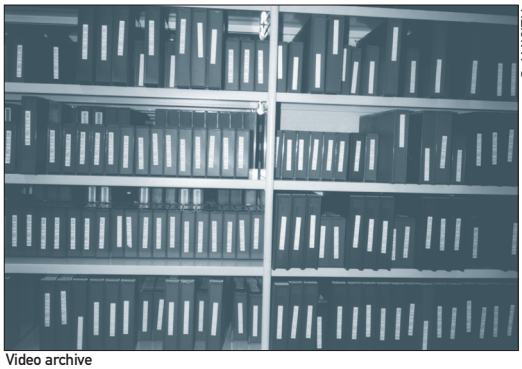
The case studies that follow demonstrate some of the ways in which rights can be safeguarded and transactions between organisations simplified. From EMII-DCF's recommendations for cultural organisations undertaking digitisation projects to AMICITIA's dedicated asset and rights management system for broadcast media, they show some of the effects of new business approaches on heritage organisations.

The scenarios suggest first steps that cultural organisations might take if they wished to test the possibilities of online resource delivery. We should stress the utopian nature of these scenarios. They are all implicitly successful, and perhaps underplay the tenacity and shrewdness that will undoubtedly be required to make a success in this environment.

207 Accessible online at http://www.pch.gc.ca/progs/pcce-ccop/reana/model-study.pdf (2002)

Case Studies

AMICITIA[208]


© AMICITIA
Video archive

The **AMICITIA** project (Asset Management Integration of Cultural heritage In The Interexchange between Archives), which began in October 2000 and finished in February 2003, involved major broadcasting companies and technology partners from across Europe. Some 342 person-months were invested in the project which cost around €3M, of which €1M in funding came from the European Commission's Fifth Framework Programme. The use of content is wholly dependent on rights negotiations, and determining the rights situation for a given piece of content can be among the most time-consuming of tasks in media production. The primary objective of AMICITIA was to link broadcasters' digital video archives together to enable the efficient exchange of video footage. The project succeeded in establishing a peer-to-peer (P2P)[209] network within which the participating partners can search and retrieve video content (and view the results) from remote archives as well as from their own. As a result the complex relationships between contracts and content were made transparent and flexible, and the rights negotiation process was simplified and speeded up.

The AMICITIA consortium comprised four major European broadcasters and national archives – the **BBC** (UK), **ORF** (Austria), **Beeld en Geluid** (Netherlands) and **SWR** (Germany)[210], and two technology partners – **Joanneum Research** (Austria) and **tecmath AG** (Germany).[211] During the course of the project the consortium was expanded by the introduction of a new partner, **Neurosoft S.A.** from Poland.[212] A Digital Rights Management component was included from the very beginning, but before designing the system the consortium sought advice from other broadcasters and archives, mainly via international bodies such as the **Fédération Internationale des Archives de Télévision/International Federation of Television Archives** (FIAT/IFTA) and the **European Broadcasting Union** (EBU).[213] The broadcasting partners liaised with their respective rights and business departments, and benefited from the experiences of other EC-funded projects.[214]

One area where the consortium anticipated potential problems was the process of establishing a common licensing agreement between licence holders. The project had the

208 This case study is based on an e-mail questionnaire completed by Dr Stephan Schneider of tecmath AG in June 2003, and on materials available via the AMICITIA Web site, http://www.amicitia-project.de/.
209 For more on P2P, see the section on *Collaborative Mechanisms and Technologies* below.
210 http://www.bbc.co.uk; http://www.orf.at/; http://www.beeldengeluid.nl; http://www.swr.de
211 http://www.joanneum.ac.at; http://www.tecmath.de
212 http://www.neurosoft.pl
213 http://www.fiatifta.org; http://www.ebu.ch
214 *Cf.* First EU-DL All Projects Concertation meeting, February 2001: http://delos-noe.iei.pi.cnr.it/activities/internationalforum/All-Projects/eu-dl1.html?content=eu-dl1_c.html

major advantage that the issues concerning rights management are well understood among the broadcasting community, since the processes of selling and granting rights is an everyday activity. Broadcasters are already embedded into the network of producers, artists, freelancers, news and advertising agencies, and there is a proven track record for content licensing and the granting of bilateral and multilateral licences. Clauses defining the rules for content exchange during the project's lifetime were included in the Consortium Agreement. In most cases the broadcasters involved in the project are themselves content creators, users, and suppliers. The participants struck a middle ground between the needs and concerns of all parties. In general, the negotiations over rights clearance were carried out via fax and phone.[215]

Project management and technology choices were strongly user-driven, and oriented towards commonly accepted standards. The user partners investigated their needs and set out the initial requirements for the DRM system, and then the technology partners suggested a technological solution to fulfil as many of these requirements as possible. In the course of this work the content owning and using partners analysed their workflow and considered how the new digital, DRM-assisted workflow could streamline it. ORF reviewed the DRM systems that have been developed in other European-funded projects (and elsewhere), and undertook a market analysis of commercially available DRM software and systems.[216]

Candidate technologies were assessed with regard to currently existing standards, as well as on the grounds of user-friendliness and ease of operation.

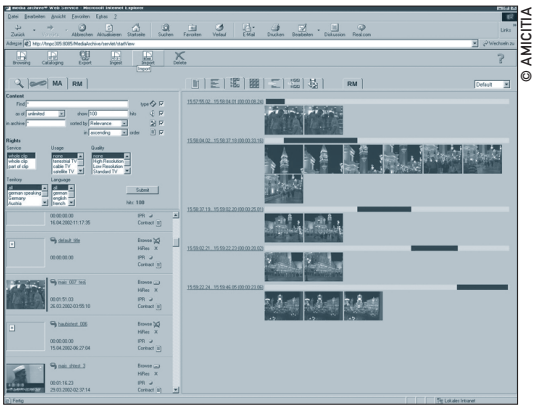
After discussion, the broadcasters found that all of their current usage rights were (or could be) ruled by contracts, therefore the consortium agreed to develop a DRM system based on inter-party contracts. As the contracts are composed of exclusively textual data, the technology partners adopted XML to encode their textual data.[217] That XML standards for rights management already exist, such as XrML and the *Open Digital Rights Language* (ODRL[218]), and that XML-coded text can be displayed using a standard Web browser were two major advantages of this solution. Once the mechanism for representing the contracts had been defined, the project needed to find a way to store them. They opted for a content management system based around a relational database, a full-text search engine, and a Web-based search interface. The application supported annotation of metadata at segment level, i.e. down to the level of single frames of the video content. Contracts could be linked to an item of content (e.g. a film of a sports event) or segments of an item (e.g. a single javelin throw). Another requirement was the need for multilingual access, and a multilingual thesaurus was implemented to interpret the rights contracts in the respective languages of the user partners. These constraints allowed the contract-based DRM system to be part of a multilingual, distributed rights management system that was both granular and flexible.

215 There remain certain obstacles to frictionless electronic transactions between businesses. See the European Commission's Open Consultation report on "Trust barriers for B2B e-marketplaces" at http://www.europa.eu.int/comm/enterprise/ict/policy/b2b-consultation/b2b-trust-cons-sum.pdf for a dedicated analysis of these problems.

216 At the **Institut für Technikfolgen-Abschätzung**'s International Symposium in Vienna on 7 December 2001 ("Access to and Ownership of Public Sector Information"), ORF's Peter Dusek and Martin Szerencsi gave a talk with the title "Digitisation and digital rights management: experiences at ORF". Slides from the presentation can be found at http://www.oeaw.ac.at/ita/access/szerencsi.pdf

217 The strengths of XML are outlined in the section of this report on this topic.

218 http://odrl.net/. ODRL is an open and freely available specification 'for the expression of terms and conditions over any content including permissions, constraints, obligations, conditions, and offers and agreements with rights holders'.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AMICITIA rights retrieval screen

To reduce the risks associated with software development and integration the Consortium agreed to implement the DRM system on a step-by-step basis, beginning with a local rights management system with only local contract capabilities and no multilingual access. Multilingual support was added. Finally, distributed access and a distributed rights management system with full multilingual thesaurus support were added. The consortium had to address a number of interface issues as they integrated their rights management system with digital video archives. The base digital video archive relies on a *CORBA* middleware framework within which the DRM system had to be embedded.[219] The database storing the contracts had to be embedded in the overall storage and *JDBC*-based interface architecture of the system,[220] and the user interfaces of the DRM system also had to work with the existing Web-based search and retrieval interface. The user interfaces of the overall system have been delivered as Web services. This development strategy supported rapid programming and independent module testing. The deployment of Web services has turned out to be an excellent choice for integrating the user interfaces and functionalities of the various partners: the technology has proved to be very reliable. The structure of the project reflected its strong user orientation, and the broadcasting and archive partners were heavily involved in defining the requirements of the system, in providing the content, and in evaluating the systems. Future work on AMICITIA will replace the multilingual thesaurus with a multilingual ontology dealing with the rights negotiation and legal terms. At present the contracts describing rights have to be encoded manually in XML. In future the ontology should help in editing contracts, or better still it should interpret contracts that are written in natural (legal) language. If the application were extended with billing and accounting components it would be possible to use it to enable broader purchase of services and content.

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AMICITIA: evaluating usability

The DRM system was built to support the exchange of content between media professionals such as journalists, editors, and footage cutters. These people form a trusted community where all transactions are covered by contracts. The peer-to-peer content exchange network, protected by technical means such as passwords and virtual private

219 http://www.corba.org/. Since the provider of the base digital video archive also programmed the DRM software, the integration of the DRM system caused no significant problems.
220 http://java.sun.com/products/jdbc/

networks (VPNs), supports this closed community. However, all of the broadcasters and archive partners are public or state-funded bodies, so there is at the same time a public interest in making the archival content available to all. For this reason the project has also developed a public Web access to allow non-profit access to all citizens who – it must be borne in mind – have paid for much of the content indirectly. The DRM system was introduced for profit and for professionals, while at the same time the general public gains or retains Web-based access to the materials for non-profit use.

Despite the clear advantages that DRM technologies may offer the cultural heritage sector, there are certain caveats and potential risks that seem inextricably linked with the introduction of use-restriction software. **Tecmath AG**'s Dr Stephan Schneider explained, 'Collections and archives of cultural heritage often lack the money to fund their everyday tasks such as restoration and conservation. DRM technologies could offer a way to make money out of their treasures and improve the funding situation greatly. However, the DRM technology should not be used to hide cultural heritage and to prevent it from being watched or used. The general public – who is the owner in most cases – must have at least a non-profit access to it.'

EMII-DCF (European Museums' Information Institute – Distributed Content Framework)[221]

The **European Museums' Information Institute** (EMII) is a network launched in 1998 to meet a perceived need for representation in the museum sector. Museums tend to be relegated to a secondary position in collaborative technical projects and the initiative hopes to redress this situation. EMII is a *virtual* network. It is managed by a steering committee and a secretariat. They work to bring collections together and act in a general advisory role for the sector. EMII's *Distributed Content Framework* (DCF) programme, an FP5-funded IST Accompanying Measure, ran from January 2002 to November 2003. It aimed to create a framework that will assist organisations or projects involved in the digitisation of cultural heritage content. The project produced three main outcomes:

1. A needs analysis which identified the current and future uses of digital cultural heritage content;
2. A legal report highlighting copyright and other legal issues, as well as template licence agreements designed for use by museum sector professionals and other collection administrators; and,
3. A set of standards for governing the planning and execution of digitisation projects.

This case study focuses on the second of these strands and in particular the rights management issues, although work done as part of the first strand (e.g. the survey of organisations such as SCRAN and CHIN[222]) influenced work on strand two. As well as covering key areas such as Intellectual Property Rights (IPR), Data Protection and Human Rights issues, the DCF outlines solutions for a range of problems likely to arise when digitised content is made available online. Other issues examined include the

221 http://www.emii-dcf.org/. This case study is the result of two telephone interviews, the first with EMII British Co-ordinator Rosa Botterill, and the second with Naomi Korn, Copyright Officer at Tate. The interviews took place on 07/05/2003 and 14/05/2003 respectively.

222 http://www.scran.ac.uk; http://www.chin.gc.ca

prevention of unauthorised content duplication and dissemination, rights management standards, and best practice guidance. The project addressed financial, technical and social issues.

The project consortium comprises partner organisations from across the European Community – three from the UK[223] and one partner from Denmark, Finland, France, the Netherlands, Portugal, and Sweden.[224] Given their extensive field experience, the partner organisations had much to contribute to the formulation of the framework. For example, solicitors from Tate and the Danish National Cultural Heritage Agency reached decisions on legal and licensing agreements. Tate Copyright Officer Naomi Korn led the investigation of the copyright issues. It was considered imperative that the DCF incorporate a facility to record information about licensing arrangements, and to handle concurrent licensing agreements for different organisations with different priorities and approaches towards the same material. Model licensing agreements usually serve as a starting point for negotiations, but these must be flexible enough to meet the needs of individual organisations.[225] Permissions are likely to vary between delivery and distribution methods (e.g. print or Web), and where in the past licences may have been granted for use in single publications, licenses are increasingly granted for limited periods of time. Periods of one to three years are common. The differences between the licensing-out to third parties of rights belonging to museums and the licensing-in of rights for use by a museum were made explicit. The complexities of the two-way relationships between consumers and providers were mapped out.

Metadata are at the heart of rights management systems. In constructing the DCF, consideration was given to how metadata should be created, linked to specific digital objects, and stored. The system had to be flexible enough to respond to the variation between infrastructures, policies, and sizes of institutions. EMII believes that it has created a framework that is flexible enough to remain applicable to all sizes and types of organisation. EMII hopes that DCF will be adopted as a European standard for distributed cultural content. In planning how to manage digital rights its model has much to recommend itself to European heritage institutions.

eBook Library[226]

eBooks Corporation Limited is an Australian unlisted public company founded in 1997, and backed by investors in the United States, the United Kingdom, and Australia. The project receives funding from the Australian Government for its research and development activities, and has long-standing and close working relationships with **Adobe**, **Microsoft**, **Palm**,[227] and other stakeholders in the burgeoning ebook industry. eBooks Corporation launched its retail ebook store, www.ebooks.com, in September 2000 and

223 mda, http://www.mda.org.uk; Illuminations Television, http://www.illumin.co.uk; Tate, http://www.tate.org.uk

224 The National Cultural Heritage Agency, Kulturarvsstyrelsen, Denmark (http://www.kuas.dk); the National Board of Antiquities, Museovirasto, Finland (http://www.nba.fi); Ministry of Culture and Communication – Mission de la recherche et de la technologie, France (http://www.culture.gouv.fr/culture/mrt.htm); Adlib Information Systems BV, Netherlands (http://www.adlibsoft.com); Instituto Português de Museus, Museu Nacional do Azulejo, Portugal (http://www.ipmuseus.pt); National Council of Cultural Affairs, Statens Kulturråd, Sweden (http://www.kur.se)

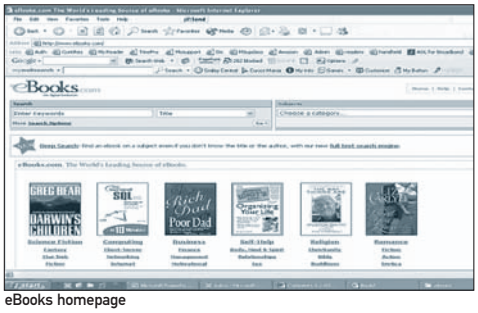
225 Model licensing agreements are available at http://www.emii-dcf.org/default.asp?id=2

226 http://ebl.ebooks.com/. This case study is based on an e-mail questionnaire completed by eBooks Product Manager Kari Paulson in December 2003.

227 http://www.adobe.com; http://www.microsoft.com; http://www.palm.com

achieved profitability in January 2003. Since its launch the technology has been refined extensively. The eBooks' Web site was relaunched in August 2003. When eBooks.com first launched, it had agreements with forty-five publishers and offered 350 titles. At the time of its relaunch 140 publishers had come on board and over 25,000 titles were available.

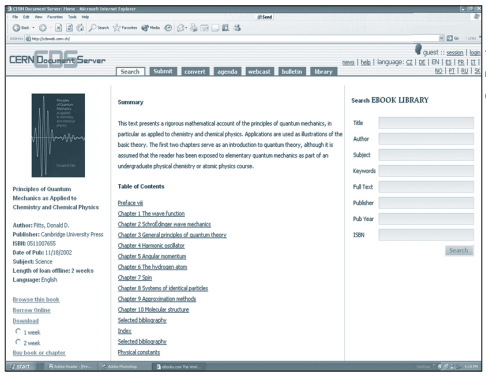
In collaboration with leading university and research libraries and major academic publishers, eBooks Corporation is developing **eBook Library** (EBL), which will deliver an expanding catalogue of ebooks to academic and research libraries. Libraries face significant challenges in the new digital publishing environment, and the growth of electronic journals and ebook databases has both transformed and complicated the acquisition and servicing of library materials. Supported in part by a research and development grant from the Australian government, EBL aims to extend current digital lending capabilities, enable greater availability of books, and deliver real cost savings and convenience to libraries and book publishers.



© eBooks.com
eBooks homepage

Publishers need to secure their business viability by ensuring that electronic content cannot be easily replicated and re-distributed. DRM has been a standard component of ebook delivery at eBooks.com. eBooks Corporation's contract with publishers establishes that ebook content will only be distributed through industry accepted and trusted DRM protected formats. In developing a DRM-driven lending model a balance had to be reached between the use of DRM to manage access and fair use; the digital medium needs to be used to increase accessibility to content, while at the same time ensuring that this accessibility does not compromise copyright or fair compensation to the creator or publisher for the use of their materials.

In constructing the eBook Library the team has gained extensive expertise in the acquisition, creation, protection, management, and distribution of digital books. They found three aspects of DRMs crucial:



© eBooks.com
The eBook Library interface and document server

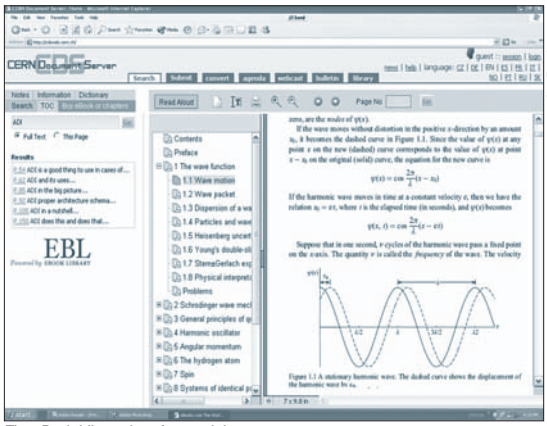
- the contract or licensing of content with the publishers;
- the licensing of the platform and content to libraries, which determines how the books can be lent (guided by the distribution licences secured from the publishers); and
- the rules which control how the end-user can interact with and use the content.

In reaching a decision on the technologies used for the final system, the team investigated all the available ebook formats and eventually elected to utilise a combination of a bespoke DRM system with an encrypted browser for online access. Access to the ebooks

will be possible via the encrypted online browser, and they are downloadable and readable via *Adobe Acrobat Reader*, and encrypted through *Adobe Content Server*. While Adobe's encryption has been chosen to protect the content of the book in the downloaded distribution model, the rules of distribution are being kept separate from Adobe's proprietary rules in order to facilitate EBL's non-linear lending model.[228]

The eBooks team realises that ebook technology is still in its infancy. They have adopted an information architecture which they believe will allow EBL to accommodate the changing technologies without having to be continually reinvented. For example, it should be possible to change particular rules easily in response to the changing needs of publishers and libraries and the changing technologies available. EBL should accommodate ebooks in different formats, which use different ebook reader technologies or different encryption measures. In its role as content aggregator and distributor, a real challenge for EBL lies in finding a middle ground between the content providers (the publishers) and the content users (the libraries). Defining the lending model has been an iterative process of input and feedback between the libraries and publishers. The lending model was about ninety-five per cent complete in December 2003, although a few additional changes will be made to incorporate different types of content (e.g. textbook, monograph, and reference books). Many librarians have felt that the DRM specifications imposed by existing ebook lending platforms are too restrictive, raising questions such as 'Why should an electronic book ever be unavailable?' and 'Why should copy and paste or read aloud functionality be disabled?' To date, most library systems impose the linear lending model of print books. For the technology to be successful it must extend accessibility of ebooks and do so in a way that is cost effective for libraries. The eBooks team believes that the digital format has the possibility of enabling services which meet the needs of visually impaired readers in ways that had not been possible in the past. Publishers have varying levels of understanding of the implications of ebook functionality such as 'read aloud', and there is a fine balance to be struck between 'read aloud' and audio books. eBooks' contract with publishers enables them to provide 'read aloud' functionality. A beta version of EBL is due to be tested in March 2004 with participants including the **Curtin University of Technology** (Australia), **CERN** (Switzerland), and **North Carolina State University** and **Yale University** (both USA).[229]

What eBooks has done with publishers could equally well be done with groups of heritage institutions and provide them with access to a distribution platform to ensure that their content was made accessible to a broader range of institutional and individual users in ways that ensure appropriate income streams were developed and their rights of ownership protected.



© eBooks.com

The eBook Library interface and document server

228 'Non-Linear Lending™ limits the total number of lending days per year per title but enables multiple concurrent access.' From "EBL Overview", eBooks Corporation, November 2003.

229 http://www.curtin.edu.au; http://www.cern.ch; http://www.ncsu.edu; http://www.yale.edu

Scenarios

A Railway Archive – Registration and Micropayments

A specialist archive holds a unique collection of railway paraphernalia, including architectural blueprints, engineering documents, and old photographs. Metadata about these documents are stored in a database which is searchable online via the archive's Web site. The Web site receives a high proportion of traffic directed from other archives, libraries, and museums holding related collections. An analysis of Web statistics shows that many users starting their searches from other institutions follow up their interest by browsing this archive's online catalogue.

The archive receives frequent requests from individuals seeking high-quality digital and print copies of the items it holds. However, much of this interest comes from overseas. Postal charges make it expensive to provide quality printouts to these customers. Another difficulty is that only a small proportion of the collection currently exists in digital form, which means that to deliver the material new imaging work must be carried out

The archivist recognises the financial potential of the collection, and sees the demand for access to content as a way of raising new funds that could potentially be used to digitise other items. He decides that it would be worthwhile to make both low- and high-quality digital copies of some objects available online.

Informally, he contacts some of the individuals and organisations that make frequent use of the online catalogue to measure their enthusiasm for enhanced access to the collection, and in particular to establish how willing they would be to pay for high-quality digital copies of items. Most of the users would be happy to pay a small amount for this access, but do not have sufficient budget to purchase individual digitised items. The archivist decides that an ideal solution would be to link small, low-resolution images of each item in the collection to the catalogue, enabling users to browse the digital objects online. If a user is particularly interested in an item, s/he has the option to purchase a digital copy of that item. If a document has not yet been digitised, the archivist can arrange this for an additional fee. The archivist discusses his idea with peers and technical contacts, one of whom mentions using a micropayments system for downloading multimedia from the Internet. After investigating various companies who facilitate micropayments, the archivist chooses a solution that will enable him to charge a very small amount of money each time a low-quality version of an item is accessed, while at the same time allowing the setting of higher rates for the purchase of high-quality reproductions or specialised services.

The archivist is aware of the importance of safeguarding the valuable images against unauthorised downloading and reproduction, and he must be convinced that the rights governing the collection are also protected. In order to preserve security for the high-quality images, the archive purchases specialised encoding software from the micropayments system vendor; this allows any virtual visitor to download the encoded file, but only users who 'buy' the item are given a key to decode it.

Browsing the collection requires the user to register with the micropayments provider, therefore the archivist spends some time encouraging both his customers and organisations with similar collections to register. He organises e-mail publicity, and traditional print press releases to promote the new service. Once an institution has registered, all of its users can browse the catalogue under a generic username. However, if an individual

wishes to purchase a high-quality digital item, he or she must register individually.

The archivist does not want to exclude users who are not registered, and therefore decides to maintain three levels of functionality: the existing free access to a text-only catalogue for all users, micropayment-enabled access to low-quality versions for library/archive/museum users, and direct purchase of high-quality objects through the digital payment system for individually registered users. He outsources the Web work, and adapts the pages to reflect this new structure. Utilities to guide users through the buying process are added. The archivist is confident that money coming in from this new source will enable him to digitise and sell more and more digital items online.[230]

An Art Gallery – Rights and Digital Collections

A medium-sized civic art gallery holds a number of original paintings and photographs, dating from the Renaissance to modern times. The gallery is usually fairly busy, and guests often include specialists who are interested in one particular item or collection. The gallery also maintains a café and gift shop.

The gallery's Web site has been up and running for eight years, but it has only recently started to present online details of the collections, including images of some of the more famous or iconic items. The gallery's administrator keeps a logbook of telephone and e-mail enquiries that cannot be quickly and easily resolved or answered. She notices that the number of requests to use particular pictures in adverts and promotions has increased significantly since details of the collections went online. After discussion with the gallery manager, she decides to run a needs analysis to ascertain whether the gallery should update its copyright licensing policy. The survey examines the needs of organisations and individuals on local, national and international levels. It identifies the services the gallery can offer which produce the greatest financial return and maximise public awareness of the collection and its content.

The results of the survey indicate that the process of licensing reproductions from the gallery's collections needs to be simplified and that there is a demand for early photographs which is not currently being met as effectively as it might be. A significant amount of interest is shown from overseas companies and institutions, simultaneously complicating the rights issues problem and opening up potential new markets for business.

The gallery holds transparencies of many of the more popular paintings that could be lent to licensees to enable them to reproduce the images. However, the gallery manager would like to reduce the risks of damage and loss involved with transporting these transparencies. She would also like to exploit the international market for these images more fully, and therefore decides to offer images in a digital format, on CD or delivered over the Internet.

The customer survey also indicated that there was a general lack of knowledge about the issues surrounding the management and licensing of rights. The gallery manager realises that a new, full-time member of staff is required to monitor and enforce copyright. His duties will include:

- Producing digital copies of the collections, beginning with the more popular paintings and photograph collections;

230 For a potentially more lucrative scenario, see *The DigiCULT Report: Technological Landscapes for Tomorrow's Cultural Economy*, pp. 162-174, "Turning Archival Databases into Goldmines: The Genealogy Case".

- Managing the licensing of these digital objects;
- Offering advice to potential clients about the images most suitable for their needs;
- Advising customers about further copyright issues when the painter or photographer is still alive or has not been dead for over seventy years. For an extra fee he may help with the administrative work involved in clearing copyright in these situations;
- Updating the gallery's Web site to include thumbnails of new items as they become available;
- Keeping records of customers and their accounts.

While the gallery would like to automate the process it recognises that, because its charges depend upon a wide range of factors – from the cost of reproducing an image to the length of the licence, the scale of distribution, the size of the image, how it is to be used, to by whom it is to be used – a substantial amount of staff time will be occupied costing licences on a case-by-case basis.

After some time, the digital collection has become a representative sample of the gallery's most popular items, and the manager decides to use these items to help publicise and promote both the image service and the gallery itself. She employs a company to produce a DVD to be given away free to potential customers. After discussing design details, it is decided that this will have the capabilities to:

- Search for thumbnail images by keyword, genre, year, artist/photographer, and technical data;
- View specific collections dynamically, e.g. Impressionists, or 1920s photos from Pompeii;
- View items in a certain part of the gallery as a virtual tour, perhaps implemented in *QuickTime*;
- Display a random selection of images, e.g. as a screen saver;
- Select an image and complete a form to order a licence. The form can either be e-mailed or printed and faxed to the organisation.

Two thousand DVDs are printed initially and distributed to existing customers, magazine publishing houses, and advertising agencies. The ease with which the DVD can be used leads to an increase in orders for images from the collection. The DVDs are also made available for sale in the gallery shop, and offered as bonus prizes in an online competition.[231]

A Local Museum – Setting up an Online Shop

Concerned that rivals are cornering the market in local souvenirs, particularly mail order gifts bought by Antipodean and North American tourists, a small town museum decides to set up its own online shop. Given the numbers of emigrants who made their way to the New World from the town, the distance-selling market is indeed a lucrative one, and the museum plans to capitalise on this. A difficulty is that the available funds are limited.

231 It should be borne in mind that licensing images can be hard work, and both the technological and organisational barriers are high. For a contemporary account of the state of play in this area, see *The DigiCULT Report: Technological Landscapes for Tomorrow's Cultural Economy*, pp. 150-154, "Institution to Business Markets for Cultural Heritage Collections".

The museum's curator explores the possibilities of outsourcing this work, but at first glance the costs appear to be prohibitively high, and the technologies involved seem very confusing. However, a friend and fellow curator has heard of open-source solutions to such problems, and the curator decides to investigate this further. By employing a recent IT graduate who has practical experience of PHP and HTML on a short-term freelance basis, the museum's Web site undergoes a complete rebirth.

Working from home on a part-time basis, the graduate takes two months to construct the online shop and link it to the museum's existing, modest Web site. The curator takes digital photographs of the existing souvenirs that the museum shop sells, and uploads these to a *MySQL* database via a PHP-driven submission form. The curator has initial concerns about the shop's potential for scalability, but the programmer assures her that his work has been well documented, and that it caters for a larger range of items than the museum currently carries. The system can be expanded with relatively little difficulty. The customer mailing details submitted may also (with the customer's permission) be used to build a mailing list with special offers, and discounts.

The most difficult aspect of the process is likely to be the credit card verification and payment collection procedures, which must be outsourced to a dedicated third party. The curator and programmer together canvass potential suppliers, eventually selecting a payment gateway with a record of working with small companies. A merchant account is set up with the museum's bank, and the payment system provider will then organise the information and credit flow parameters. As business grows, the curator looks at new opportunities. A local craftsman is employed to produce handmade souvenirs to be sold online, thus further boosting the local economy.[232]

A Digital Library – Initial Questions

In a recent article, Howard Besser analyses the stages in the transition between experimental, standalone digital collections and interoperable digital libraries.[233] The head librarian of a small university has read this article, and is keen to embrace the new digital age, while at the same time being concerned about some of the issues that this may entail. The librarian reflects that, rather than purchasing, the library now rents the majority of its serials. This shift has reduced the expenses involved in maintaining the physical objects, but leads to new questions with regard to preservation of the digital content. How can this be ensured? How can possible losses be *insured against*? What impact will this have on future costs?

The librarian remembers that she recently read that the US **Library of Congress**[234] receives over two million requests a day for digital files, and around two million requests per year for physical items to be delivered to readers in its rooms.[235] With digital libraries still in their infancy, how are they to cope with a growing demand for the supply of distributed digital content, already more than 300 times more popular than physical documents?

232 For some short case studies on real-life museum retailing initiatives, see *The DigiCULT Report: Technological Landscapes for Tomorrow's Cultural Economy*, pp. 142-143, "Developing and Selling Products: eRetailing".
233 Howard Besser, "The Next Stage: Moving from Isolated Digital Collections to Interoperable Digital Libraries", in *FirstMonday*, June 2002: http://www.firstmonday.dk/issues/issue7_6/besser/index.html
234 http://www.loc.gov
235 Peter D. Kaufman (Innodata), NINCH Symposium, New York City, 8 April 2003. Report by Lorna Hughes, New York University, available at http://www.ninch.org/forum/price.report.html

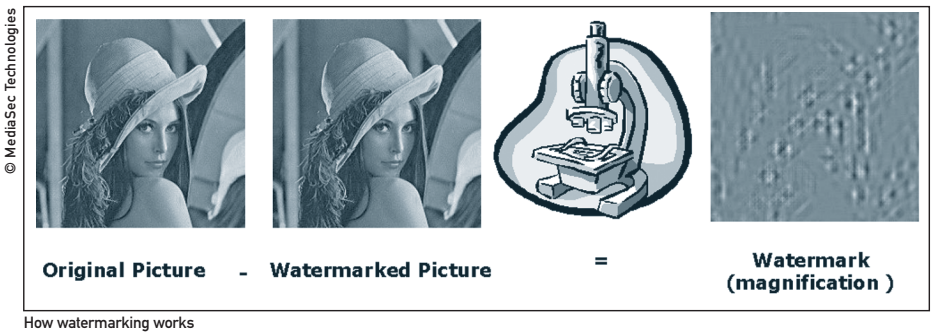
She also wonders whether or not it will be possible to make this shift without compromising the services offered to existing patrons. To a certain extent, libraries are social spaces as well as information storage repositories, and this role should not be undermined. The librarian has monitored the progress of experimental digital repositories such as *DAEDALUS* and *RoMEO*,[236] which allow the self-archiving of materials. It would be interesting, she thinks, to allow library users to self-submit their experiences of life at the university in a standard format, treating this as a pilot project which could lay the foundation for a larger, and eventually interoperable and remotely searchable repository for academic papers. This would be a valuable addition, both to the library and to the university community as a whole.

Naturally the moderation of such a project is something which is of concern, and the librarian is determined that the project should not become merely an opportunity for 'e-graffiti'. Other issues that concern her are the costs and practicalities of ongoing staff training, data backup, and the cost of equipment and expertise. Only through proper costing of these areas will the library be able to meet the digital age on its own terms, while at the same time broadening the range of services it offers to users. What is absolutely certain is that the digital library concept can no longer be ignored.[237]

Advantages and Disadvantages

Introduction and Ethical Considerations

Although much has been written about the potential benefits of DRM technologies, there remain some serious issues attached to rights management software, and its potential implications for the heritage and educational sectors in particular. If abused, DRM policies may threaten the privacy of the user, and the continued 'fair use' of materials for legitimate educational purposes may be put at risk.[238] This is something that will be of particular concern for all involved in the heritage sector, given the prominence with



© MediaSec Technologies

How watermarking works

236 http://www.lib.gla.ac.uk/daedalus/; http://www.lboro.ac.uk/departments/ls/disresearch/romeo

237 For further advice and real-life examples, see *The DigiCULT Report: Technological Landscapes for Tomorrow's Cultural Economy*, pp. 156-161, "Exploitation of Library Services". See also the special 'Economic Factors of Digital Libraries' issue of the *Journal of Digital Information Management*, available online at: http://jodi.ecs.soton.ac.uk/?vol=4&iss=2; *Digital Library Development Review*, National Library of New Zealand (Wellington, 2003), http://www.natlib.govt.nz/files/ross_report.pdf

238 See Mairéad Martin, "Digital Rights Management in Research & Education" (2001): www.doit.wisc.edu/architecture/drm/DRM-WISC.ppt and Christopher May, "Digital rights management and the breakdown of social norms" in *First Monday*, vol. 8, no.11, November 2003: http://www.firstmonday.dk/issues/issue8_11/may/index.html

which educational purposes have been traditionally privileged there. An alternative and less flexible approach to content protection would be a type of watermarking which allows content owners to track stolen images, while simultaneously acting as a visible deterrent. It should be borne in mind, of course, that many users have access to image manipulation programs that make the removal of visible watermarks feasible. EMII-DCF has compiled a set of guidelines for digitisation that will soon be available from their Web site. These include recommendations on the physical size of images made available on the Web, and the maximum and minimum resolutions at which they should be displayed. If these guidelines are adhered to, the images should be of only very limited functionality to unauthorised users, as they will pixelate when scaled up.

Advantages

Protection – DRM systems provide an unrivalled way of guarding IPR against unauthorised use or abuse. The automation of this facility acts as a deterrent as well as a guard.

Customer Responsiveness – one reason commercial content creators, such as magazine publishers, turn to commercial image libraries is that they have extremely rapid turn-around times, which is essential in a deadline-driven arena. Before the advent of digital technologies and online services heritage institutions could not compete in this sector. Now the simplicity of the technologies, their ubiquity, and their reach mean that all content holding institutions can compete relatively inexpensively with the commercial players.

Financial – Automating rights and licence management is by far the quickest and most secure way of maximising revenues from existing collections and materials. In addition to this, museums and other content holding institutions should learn to use the Internet to sell souvenirs and other merchandise.

Ease of use – Customers are showing increasing confidence in online shopping, and many see it as a straightforward and reliable way to purchase materials that were previously unavailable, or difficult to get hold of.

Disadvantages

User approval – Users are likely to object to being treated as potential criminals, and subtlety will be of paramount importance in pursuing rights management goals.

Fraud – Online purchases appear to be more susceptible to fraudulent practices than shop-based transactions.

Complexity – The complexity of legal issues associated with IPR and the definition of digital rights management guidelines require access to expertise.

Introducing the Technologies

Selecting a Specification and Development Environment

Only the largest of cultural heritage institutions will be in a position to build their own rights management solution from scratch. Standard, small-scale commercial packages are still fairly thin on the ground. Off-the-shelf digital asset management (DAM) packages are beginning to include DRM components, or allow them to be added on.[239] The legal and technical issues involved demand a high degree of expertise, and substantial financial investment. Collaborations between similarly sized and equally focused organisations may offer a way forward for some institutions.[240] Shared portals may be the most effective solution for the cultural heritage sector, and the use of Application Service Providers (ASPs) should be investigated, as well as the potential of distributed, XML-compatible databases.[241]

Technological Infrastructure Issues

None of the technologies featured here require massive hardware investment for their implementation. Most organisations will be able to run DRM software on their existing systems. The difficulty is much more likely to be in selecting and implementing the application solution for the task. Decision-makers must consider factors such as the *scale* of their organisation, exactly what they wish to do with the new system, and the *personnel* and *finances* that will be required to implement and maintain the application. These are questions that can only be addressed on an individual basis, and advice should be sought broadly.

Staff and Policy Issues

The use of Digital Rights Management technology is inextricably linked with the formulation of policy and best-practice approaches. The first DigiCULT report, *Technological Landscapes for Tomorrow's Cultural Economy*, highlighted the fears held by managers of cultural heritage organisations that the expenses incurred in the introduction and maintenance of a dedicated rights management strategy might outweigh the benefits. There is not enough evidence from institutions that have adopted this technology to say either way. It can be hoped that, once a DRM solution is in place, it will remain functional (and even profitable) for many years, although it is likely it will require some maintenance.

In terms of interfacing, it should be borne in mind that the organisation is selling two things: the licences to use protected content, and the system with which potential

239 *DigiCULT Technology Watch Report 1* features a section dedicated to Digital Asset Management software. Readers are also invited to see the Artesia white paper (2001) at http://www.artesia.com/pdf/DRMwp.pdf for more technical information on the relationship between DAM and DRM.

240 See Manchester's *Museums United*, http://www.museumsunited.org.uk, for an example of such a venture.

241 See the section on the *Application Service Model* for a full analysis of the potential benefits of this approach for the cultural and scientific heritage sectors.

customers interact. If this system is overly complex or intimidating, customers will go elsewhere. If the system is not sufficiently stringent, it will be open to abuse and content will leak. This is a fine line which decision-makers must tread with care if the dormant financial potential in their cultural collections is to be (legitimately) unlocked and not compromised

Finally, it is worth bearing in mind that the material that a cultural heritage organisation places online should fulfil a variety of purposes, not least of which is encouraging potential visitors to make the physical journey to visit the institution in person. Turning virtual visitors into physical visitors is as important a process in the digital age as finding new ways to use digital representations of holdings to generate income streams.

Collaborative Mechanisms and Technologies

Executive Summary

It is axiomatic to say that information technologies have broken down distance and enable new kinds of interactions between people whether they are in the same building or continents apart. Asynchronous mechanisms such as Email, bulletin boards, and mailing lists support the passing of messages and information. Synchronous tools make possible dynamic, active, and engaging communication of both a personal and professional nature. Peer-to-peer technologies have enabled the possibilities for the effective and efficient sharing of resources (using the computers of community members rather than servers) to be explored and exploited.

These developments have opened new possibilities for the cultural and scientific heritage sectors. The first of these is the increased ability for attracting a global audience to study or present cultural heritage artefacts through more intense, more varied, lower cost, and simpler communication mechanisms. They have also created new possibilities for building consortia and partnerships between cultural/scientific organisations and their existing and new audiences. They provide the basis for both formal and informal interactions, and platforms for enabling professional development. This section is not about virtual communities themselves, but about the technologies that can be used to underpin them. The development of virtual communities has been considered in DigiCULT Thematic Issue 5.

Whether fully technology-driven or simply technology-assisted, electronic collaboration is working its way steadily into all areas of human activity and interaction. This section's case studies demonstrate a wide range of these approaches, and depict the variety of purposes to which they can be put. The eMarCon project gives a technology-driven solution to a straightforward logistical problem: how can (physically) huge artefacts be experienced in context with each other when their real-world locations are far apart? Another approach is that taken by VRoma, whose innovative approach to historical and scholarly work allows geographically separated users to access and discuss material in a shared virtual space. This shows how collaborative resources can be deployed for multiple purposes, particularly as a medium for structured and unstructured learning. An examination of eStage provides insight into the process of building a shared, community-specific portal, from planning to execution, and on to potential future commercialisation. The MIRROR community of practice gives perhaps the fullest account of the benefits of these new approaches, with the goal of creating both a virtual, pan-European group of natural science museums and new methodologies for learning. The variety of technologies and approaches involved here highlight the growing importance of interoperability between collaborative systems. Taken together these

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studies show how improvements in the ease of sharing materials and experiences enable links between disparate spheres and disciplines to be forged and, given time, strengthened.

After reading the case studies and the scenarios, the changes that will be needed for heritage institutions to take advantage of these developments should be clear. The main problem is that the increased availability of resources does not necessarily mean *better* resources, and better mechanisms of communication do not necessarily result in better communications. Increased communication in a virtual world does not necessarily boost the emotional or intellectual impact of artefacts or information, and may even enhance a sense of alienation from the real world. The understanding of these issues will become increasingly the responsibility of communication specialists, and organisations from the cultural and scientific heritage sector must consider their options carefully in providing resources of the best possible quality for these emerging and developing communities.

An Introduction to the Technology

In his book *Being Digital*, Nicholas Negroponte, founding director of the Media Laboratory at the Massachusetts Institute of Technology, claimes that: 'Computing is not about computers anymore. It's about living'. Communication between individuals and groups has been transformed by the developments of new technologies. The emerging technologies are changing how we communicate, who we communicate with, and what we can exchange as part of our communications. The growth of dynamic, immersive, and interactive virtual communities are one manifestation of the take-up of these collaborative technologies. The term 'virtual community'[242] is defined here as a network of individuals/organisations using digital technology to create, share, and exploit experiences and knowledge. Often we tend to think of virtual communities in the context of popular uses of online spaces for social interaction. The term 'virtual community informatics' denotes the design and application of ICT to support community processes. A special area of concern within community informatics are practices causing the potential isolation of large groups of people, also known as 'the digital divide' between those who have real access to ICT and are able to use it effectively, and those who do not.[243] This Technology Watch Report focuses on how the heritage sector can use collaborative technologies to create heritage environments that enable professionals and the public to interact on different levels, share experiences, and develop communities of action and practice.

Communities tend to be built around two different 'spheres' of purpose: *knowledge*, and *feelings/emotions*. Shared knowledge in these communities encompasses know-how, learning materials, opinions (which may be contradictory), information on where to find resources, and interconnections between information. Most participants have a willingness to share the resources they bring to the community and a desire to use the community to enrich their understanding. These groups engage people from distributed and often distant locations (e.g. paper conservators or individuals with a interest in 16th century

242 Sometimes the term 'online community' is used with a similar meaning. However, 'virtual' and 'online' emphasise on different aspects – presence in the real world and mode of getting together. In both cases the idea beneath is that the community consists of members present in different places, and the connection is done using computer networks.

243 See the *DigiCULT Thematic Issue 5* on Virtual Communities, http://www.digicult.info/pages/Themiss.php

Persian tiles). While institutions can promote the development of virtual communities, informal study of those currently in use on the Internet does not suggest that this is the common or the necessary way they come about. A second type of community is formed around the ability of net-based communication to create social spaces and bring together actors with an emotional need to fulfil. The emergence and refinement of Internet technologies has boosted the development of various modes of computer-supported communication. These days, as the popularity and participation in online communities continues to grow rapidly new technologies are being created to meet their needs.

Four main categories of technologies support VCs:

1. *Asynchronous communications*, including email, mailing lists, bulletin boards and news groups;
2. *Synchronous communications*, such as chat rooms and internet relay chat (IRC);
3. *Peer-to-peer networks*, for example, **Napster** and **Kazaa**, add distributed resources to communication channels;[244]
4. *Virtual worlds*, where participants interact via the Internet to develop VCs. Typical of these are Multi-User Domains (MUDs)[245] and MUDs Object Orientated (MOOs).

Each of these communication mechanisms has a different kind of influence on the communities which result from their use. For instance, asynchronous communications are useful for distributing information, but do not give the sense of immediate response, engagement, and excitement which synchronous communication can offer. Peer-to-peer networks are ideal for collecting enormous amounts of distributed information from various sources and although so far widely used for illegal purposes (exchange of music) they have many legitimate uses. Participants in MOOs and MUDs gain a sense of belonging to a community with a special ambience or setting and as a result their immersion can become quite real and tangible.[246] These technologies pose their own specific problems. For example, peer-to-peer networks, seem inextricably linked in the minds of many people with copyright infringement, i.e. exchange of files between users who do not have the rights to share the files. Another typical problem is the distraction of people from their real work, with IRC often being blamed as a timewaster, and a number of organisations now prohibiting its use in the workplace.

Viable and effective communities will be built around a central topic, group of topics, or activity. Successful knowledge-oriented communities create social circuits. These provide an environment where participants can build on existing knowledge in innovative ways to generate new knowledge from previously untapped sources. All virtual communities need not be information or resource led; some are centred around more basic needs of humans to communicate and engage (e.g. play) at a personal level. These, while not the focus of the discussion here, can also evolve using the same technologies. That said, there certainly is a role for communities of interest that engage in gossip about people, issues, and generally share experiences and ideas, much as we might in a conventional environment at the coffee machine, over lunch, or in the lift.

244 http://www.napster.com; http://www.kazaa.com

245 Even abbreviations are ambiguous in the virtual world. Other expansions include *Multi-User Dimension* and *Multi-User Dungeon*.

246 In many ways, this is similar to the construction of virtual worlds, as discussed in *DigiCULT Technology Watch Report 1*. The specific issues associated with MUDs and MOOs are the subject of many detail psychological, sociological and anthropological studies which readers may find illuminating.

Virtual communities exist mainly online, but this need not be the only environment in which they exist. For example, we can use mobile devices to create ad hoc virtual communities of visitors to heritage institutions and archaeological sites.

Participation in communities allows individuals to exchange opinions, share experiences, and participate in immersive environments. The development of a community in fact creates a social circle. These virtual communities need not remain virtual and they can also engage in real world activity, although this is less common. This is closely connected to the purposes underlying the development of the community. If an online community serves all of a user's emotional needs, could these (virtually-created) ties be developed further in the real world? If the virtual world serves knowledge acquisition needs adequately, is a shift to the real world necessary? Can *every* user's emotional and knowledge components be separated neatly?

Opinion is split regarding the influence VCs are likely to have over human lives. Enthusiasts believe that a new communication model which does not take factors such as gender, race, location, and age into account will lead to an improvement in communication, and help people with communication problems to find their place more easily. The potential for accessing data and software resources enables the development of human knowledge. On the other hand, some psychologists and sociologists are concerned that while communicating virtually, many individuals are losing their personal face-to-face communication skills and use the environment to establish alternative personalities (e.g. adopting different personalities or even genders in the virtual world). In the former case, a kind of gradually deepening alienation from the real world has been heralded and in the latter issues of trust, authenticity, and disjuncture between reality and imagination arise.

Types of organisations interested in virtual communities

Technologies that enable the development of virtual communities are of value to:

- *Governments* – as a way to promote the growth, take-up and participation in e-government by the citizen;
- *Educational institutions* – as part of an e-learning strategy;
- *Corporations* (both profit and not-for-profit) – as ways of communicating better with potential and actual customers;
- *Professional associations* – as a way to advertise and promote their activities.

Cultural heritage institutions could also benefit from these technologies as the sections that follow demonstrate.

Influences of virtual communities on organisational behaviour

Developing the role of cultural heritage institutions as resource providers

Technology, commitment, interactivity, and engagement in conjunction with a topic or activity of interest to a group of individuals are the key ingredients that lie at the heart of virtual communities. VCs could provide opportunities for heritage institutions to engage communities of interested players in discussion, virtual use of, and learning about the heritage. Increased accessibility of the collections in virtual form can play a role in promoting communication about heritage issues. Participants in VCs need not be local, but can come from widely dispersed locations and backgrounds. This diversity brings a richness of perspective and knowledge to discussions – engineers with an interest in pottery production could be engaged with archaeologists, enabling examination of issues related to the process of and social organisation of pottery production which might have been conducted occasionally on a local level, but not often on a global scale. The growth of virtual communities has already led to a new level of commitment to cultural heritage institutions in terms of making information on their collections more readily accessible, particularly when linked with the resources of other institutions. The majority of digital libraries still follow something similar to the traditional library model, but development in this area should lead to changes to views on the organisation of and access to cultural heritage material.[247]

eMarCon (Electronic Maritime Cultural Content)[248], an EU-supported project has worked to create a platform to enable geographically distant European museums and their visitors to arrange and subsequently experience common virtual exhibitions via the Internet. Four maritime museums are sharing knowledge about their artefacts as part of a distributed, but virtual collection. In this way eMarCon engages and serves the needs of a variety of distributed audiences. Such endeavours are likely to change organisational behaviour in the cultural heritage sector by shifting the focus away from activities within the organisation which were previously considered most important, i.e. taking care of holdings, providing (physical) access to them, attracting more interest in them, and so on. Supplementing these now are concerns of how best to present collections for the new media, and how this can be interfaced with the resources provided by other institutions.

Support for communities from the educational sphere

Community building technologies can be drawn on to establish effectively synergies between educational centres and cultural heritage institutions. As a result of collaborations of this kind, the work of cultural heritage institution can provide the foundation for learning communities. A good example of this type of activity is the partnership

247 One example of work in this direction is *Gabriel* (Gateway to Europe's National Libraries) (http://portico.bl.uk/gabriel/), which provides access to a variety of online services, including *OPAC* (Online Public Access Catalogues), *National Bibliographies, National Union Catalogues*, and digital collections. Gabriel also features *Bibliotheca Universalis*, which aims 'to put major works of worldwide cultural and scientific heritage comprising text, images and sound, at the disposal of the general public using communication and information technology' (http://portico.bl.uk/gabriel/bibliotheca-universalis/en/bibliotheca_universalis_accueil.htm).

248 http://www.emarcon.net

launched in 1995 between the **Bellingham public schools** (USA) and the **Whatcom County Museum of History and Art**.[249] This collaboration resulted in the creation of a virtual museum devoted to local nineteenth century history.[250] Educational institutions are building cultural heritage virtual communities; an example of these is the **VRoma** (Virtual Roma, A Virtual Community for Teaching and Learning Classics) project (see below).[251] Experts in knowledge acquisition and collaboration with those who can supply knowledge provide a key ingredient in the construction of virtual communities. In a report on the **National Museum of Science and Technology Leonardo Da Vinci's**[252] (Milan) investigation of the influence of e-mail, discussion lists, and real-time communication on the development of a community of museum visitors. Giuliano Gaia argued that "[i]n Italy most museums are focused more on conservation than on communication. This reflects the situation of the whole culture, often seen as a separate kingdom, far from the ordinary life of people. Museums are the temples of this 'high' culture."[253]

Finding a balance between conservation of the heritage and access and understanding of it is challenging. Memory institutions can use the new technologies to improve how they engage users. Gaia's report, 'Towards a Virtual Community' outlines the steps taken by his museum in order to become more open and communicative with its patrons, both virtual and real.[254]

Influences of virtual communities on human experiences

While technology makes virtual communities possible by providing an interactive environment with a sensation of immediacy, the communities themselves are inextricably related to the personal experiences in which they engage the participants. For the heritage sector, VCs for professionals offer an efficient and fast way to distribute recent news and developments using weblogs (blogs) and/or specialised chat networks. This new form of organising knowledge has already attracted considerable interest from the professional community, and the number of weblogs on library topics is already over the one hundred mark.[255] While these methods of communication do not constitute communities themselves they lay the foundation building them.

When VC technologies are used in parallel with mobile devices, they could serve for sharing visiting experiences. For example, an electronic guidebook called *Sotto Voce*[256] was implemented on **Compaq**[257] PDAs allowing pairs of museum visitors to follow a museum tour simultaneously.[258] Experiments with the system were conducted at the **Filoli**[259]

249 http://www.whatcommuseum.org
250 J. McKenzie, 1997, "Building a Virtual Museum Community", *Museums and the Web Conference*, Los Angeles, CA., http://www.fno.org/museum/museweb.html
251 http://www.vroma.org/index.html
252 http://www.museoscienza.org
253 http://www.archimuse.com/mw2001/papers/gaia/gaia.html
254 See also Derek W. Keats, Maria Beebe, and Gunnar Kullenberg, "Using the Internet to enable developing country universities to meet the challenges of globalization through collaborative virtual programmes" in *First Monday*, vol. 8, no. 10, October 2003: http://www.firstmonday.dk/issues/issue8_10/keats/index.html
255 Details of some of the larger library blogs are listed in the References section.
265 http://www2.parc.com/csl/projects/guidebooks/
257 http://www.compaq.com
258 R.E. Grinter, et al, 2002, "Revisiting the Visit: Understanding How Technology Can Shape the Museum Visit" in *Proceedings of the ACM Conference on Computer Supported Cooperative Work*, (New Orleans), http://www2.parc.com/csl/projects/guidebooks/publications/cscw02.pdf
259 http://www.filoli.org

museum near San Francisco. Visitors to the museum could use the device in four ways: shared listening, independent use, following, and checking-in. Shared listening, also known as 'eavesdropping', allowed partners to hear audio clips being played for other visitors, thereby sharing what their partner was studying, examining, or experiencing at any given moment.

Problems the Technology Addresses

These technologies can change how we communicate and who we communicate with. Knowledge and intellectual effort is widely distributed and collaborative approaches make it feasible to bring them together virtually. It is difficult to gauge empirically the knowledge that exists *within* a community since this changes so frequently and so rapidly. Conversely, it may be that the knowledge held by a community's core may become *more* stable (and certainly more mature) as a result of the peripheral communications orbiting it. Thus the basic influences that VCs hold are in intensifying the act of communication and changing its nature from face-to-face to remote, and the creation of new knowledge compendia which because of their dynamic nature are not as a rule being preserved.[260]

The technology can be used to address the following sorts of challenges:

- The wide distribution of individuals interested and knowledgeable about the heritage generally and specific subjects (e.g. natural history studies of butterflies);
- The development of communities of activity about topics in an environment where it is increasingly difficult for people to meet physically because of time constraints;
- The sharing of access to virtual representations of objects, recordings, or data that can form the basis of discussions (e.g. using P2P technologies) and engaging discussions surrounding them;
- The integration of professional and popular discussions by communities of interest;
- The need to break down social barriers to the heritage. Virtual communities can be more inclusive than real communities, although in this the digital divide created by the costs of access can be a barrier;
- To generate excitement through immersive and interactive communication; and
- To engage individuals in communities.

How Collaborative Technologies Work

Types of Community

Virtual communities may be broadly classified into three basic types: *communities of practice*, *informational communities*, and *social communities*. Communities of practice,[261] as the name suggests, are formed among individuals to enable them to share knowledge and

260 Of course, it is possible to record the development of dynamic content; the question is who will do this, and how do we decide what is and what is not worth keeping? Issues of appraisal of these kinds of material remain a substantial research area.

261 Sometimes they are referred to as 'practical communities'.

information on specific tasks, professional activities, and practices. A key aim might be to assist participants to develop skills or have access to sources of guidance. Informational communities encompass company and customer service sites, information resources, and weblogs. The distinction between communities of practice and information communities can easily blur; the reason the community was formed provides the primary focal point – does the community exist purely to supply information, or does it aim to engage members in shared development? The third type – social communities – includes open networks like **Yahoo** and **MSN**[262] which offer chat, e-mail and topical group building facilities. Here we could also include networks targeted at relationship building such as date.com and match.com, and business networking communities, such as the **Ryze Business Networking Community**.[263] Before joining any kind of virtual community, participants must first agree to abide by the rules and behaviours which the members have established. In some environments users who behave improperly can be barred. The word 'netizen' appeared in 1994, as a blend of net and citizen, to refer to an active participant in on-line community of the Internet; this term encapsulates the real world concept of citizenship and the duties and rights incumbent on a citizen with the concept of virtual communities.

Technologies

Email and discussion lists

Professionals will already be familiar with email and discussion lists. Discussion lists have been used in the cultural heritage sector to promote both professional and popular discussions. They play a role in maintaining the exchange of information on particular topics (e.g. conservation and preservation) and a mechanism for engaging those with an interest in heritage institutions in discussion.[264] By the end of the 1990s there were thousands of public lists and many more closed ones. Many of these lists are moderated, although not all. Moderation ensures control of membership and content is maintained. It has the downside that it can be used to stifle discussion; in general, though, moderated lists are the more effective communication spaces.

Bulletin board systems

Bulletin boards (BBs), which were commonly used in the 1980s, were one of the first tools to promote synchronous communication. BBs allowed users to check the notices on the board and to post their own messages. To do this users had to dial-in and log on to a remote computer. In many instances it was possible to exchange messages in real time with other users who were logged on simultaneously. BBs offered users a sense of control and interactivity – unlike discussion lists where they received every message BBs supported choice, selectivity and topical threads. Participants had access to all the available information, but they could choose what they wanted. The features of BBs supported communication mechanism which formed the basis of chat systems.

262 http://www.yahoo.com/; http://www.msn.com
264 http://new.ryze.com
264 G. Gaia, 2001, 'Towards a Virtual Community', *Museums and the Web 2001*: http://www.archimuse.com/mw2001/papers/gaia/gaia.html

Text chat

Text chat, more commonly known as *instant messaging*, provides instantaneous synchronicity. The most popular non-commercial system is *Internet Relay Chat* (IRC).[265] To use instant messaging it is first necessary to install a client program which connects to one of a number of interconnected servers. Chat systems support virtual environments which can be configured to establish chat rooms (also called channels) around particular topics, interests, or real and virtual groups. Chat systems can be compared to analogue CB radio.[266] In 2003-4 the most popular IRC clients are *mIRC*[267] for *Windows* and *Ircle* for *MacOS*. While the chat clients may be different, the networks to which they connect are the same.

Designated community websites

The development of Web technologies has transplanted many BBS or IRC-type activities onto standard community Web sites, which allow people to make new connections and expand their personal networks. Ryze, for instance, was built with the special purpose of helping to create and extend business networks. The site includes private messaging facilities, an events calendar, a message board, home pages and profiles, and a contact management system. Ryze supports over 150 networks with very different sizes and communication intensities; and while some networks have hundreds of posts in a week, others have none. For example, an average of just over two posted messages per network member were published in one week within Ryze's 500 *Citizens of the World* network, while for other networks the ratio was more like one message per twenty members.

Weblogs (Blogs)

A blog is a Web page containing short and frequently updated posts arranged in chronological order, and which appears similar to a diary or journal. As with bulletin boards, the topics and purposes vary according to the blogger's aims. Blogs have become popular for various professional groups exchanging messages. They can offer news and software demonstrations. The Northern California **DigiBarn Computer Museum** uses a blog to post computer-related announcements and questions/answers.[268] The basic advantage of a blog is that it allows all interested parties to keep abreast of what is going on. Some groups use blogs as a place for posting questions and collecting feedback from the user community, while others post newsworthy articles or links, or a mixture of both approaches.

To create a weblog, one can use the **Blogger** Web site, which provides a way of automating and speeding up the publishing process without the need to write specialised code or install server software or scripts.[269] The process of posting messages is achieved by

265 An IRC help page can be found at http://www.irchelp.org
266 A two way, person-to-person licence-free communication system allowed for use in non-commercial communications when distances are limited.
267 http://www.mirc.com/mirc.html
268 http://www.digibarn.com; blog http://www.digibarn.com/weblog/blogger1.html.
269 http://www.blogger.com/. Of course, primitive blogs can be hand coded in HTML, but this is very time-consuming and potentially error-prone.

submitting forms via the Blogger site. The service is currently free of charge.

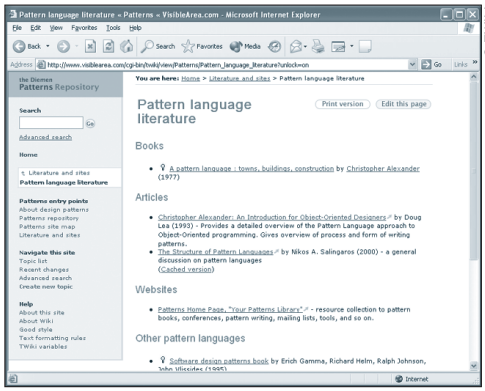
MUDs and MOOs

A MUD is an environment where multiple logged-in users are provided with interaction tools, and MUDs have their roots in role-playing games of the *Dungeons and Dragons* variety.[270] In these games players identified themselves with a virtual character and went on a quest involving combat and lateral thinking. The action and communication was took place as text commands which were entered by the user and textual response that appeared on their machine. There are now hundreds of MUDs 'live' on the Internet, some of which are even used for educational purposes.

Pavel Curtis, the creator of the first MOO (*LambdaMOO*[271]), defines a MUD as 'a network-accessible, multi-participant, user-extensible virtual reality whose user interface is entirely textual.' MOOs (MUD Object Oriented) enhances the MUD concept by providing participants with access to a built-in object-oriented programming language allowing players to create new objects. Players can create new virtual settings. While MUDs employ plain text to communicate with the users, MOOs can support textual, visual, and other communication metaphors. Similarly to the channels of IRC, MUDs and MOOs also organise the groups of users along the lines of a spatial metaphor, with users placed within virtual 'rooms'. One example of a MOO for educational purposes is *LinguaMOO: An Academic Virtual Community*, which was founded in 1995 by Cynthia Haynes of the University of Texas in Dallas and Jan Rune Holmevik of the University of Bergen, Norway, and which serves as a learning environment for students from both universities.[272]

Wikis[273]

A wiki[274] is defined as 'the simplest online database that could possibly work', and takes the form of a collaboratively edited Web site which can be altered by any user. 'WikiZens', as they are known, contribute to the development of the content wikis by adding to or editing the work of their fellow authors.[275] While it is surprisingly rare to hear of WikiZens destroying the work of others, most wikis have a roll-back system which allows the recovery of maliciously deleted material, and

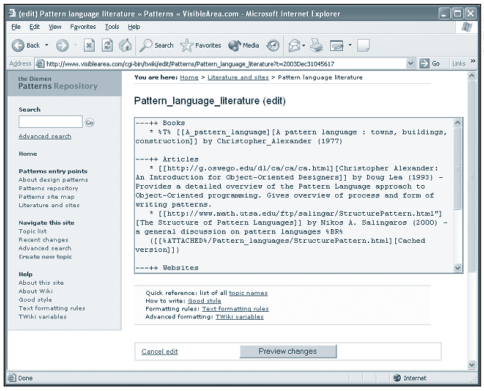


© TWiki

TWiki in View mode

270 See *DigiCULT Technology Watch Report 1*, in particular the section on Games Technology.
271 http://www.lambdamoo.info
272 http://lingua.utdallas.edu
273 A long list of wikis can be found at http://esw.w3.org/topic/InterWiki. This list is hosted by **ESW Wiki**, a wiki dedicated to discussion of the Semantic Web. See the *DigiCULT Thematic Issue 3: Towards a Semantic Web for Heritage Resources*, May 2003, http://www.digicult.info/pages/Themiss.php, for more on this topic.
274 The name comes from the Hawaiian word wiki wiki, meaning quick.
275 They are also sometimes viewed as anarchic publishing tools, but in the interests of succinctness.

facilities for blocking the IP addresses of repeat offenders. It should be stressed that true wikis are open to everyone[276], and thereby operate on a trust basis – if you are worried about what other people might do to your content, wikis are not the answer. If, however, you want your users to be able to contribute their own knowledge to your work, and to work in a genuinely democratic, collaborative environment, wikis may be worth looking into.[277]



© TWiki
TWiki in Edit mode

Every wiki has its own distinct culture, dependent on the interests and aspirations of its core user community. The **Urban Tapestries** team, for example, used a **twiki**[278] wiki to facilitate group working. As the case study on this project shows they found that the online collaboration and information space allowed team members to share research findings, refer to and update project schedules, and collaborate on documentation.[279]

In comparison with other means of publishing, wikis have a unique set of attributes which make them suitable for certain modes of content, and eminently unsuitable for others. 'Wiki has an *attention economy* based on publishing. Its function is to direct others' attention to a subject (or person) you like…The Web is not an interactive medium, so conflict and conflict resolution (whether competitive or cooperative) are mostly absent. The Usenet is a different matter. Usenet posts are fleeting and the medium is impermanent.'[280] 'Wiki,' on the other hand, 'is interactive. It offers whole areas of interaction for conflict to flourish, as well as conflict resolution. Wiki is also persistent. When we (re)direct attention, we play a high stakes game.'[281]

The first wiki on the Web – the **Portland Pattern Repository** – was started in 1995, and now holds thousands of pages[282]. The largest current wiki is **Wikipedia**, a multilingual project aimed at creating a complete and accurate free content encyclopaedia. Started in January 2001, the English version alone now contains 173,826 articles, and continues to grow.[283] 'Knowledge through consensus' would seem to be its tacit motto, and others seem to agree – Wikipedia was quoted as a source in a major newspaper for the first time in June 2003.[284]

276 Although they can be 'walled' by the use of registration and passwords.
277 Another form of 'attribution-free' Web resources is detailed in Steve Mann, "Cyborg logs and collective stream of (de)consciousness capture for producing attribution-free informatic content such as cyborglogs", *First Monday*, vol. 8, no. 2, February 2003: http://www.firstmonday.dk/issues/issue8_2/mann/index.html
278 http://twiki.org/
279 For more on the Urban Tapestries project, please see their case study in *Mobile Access to Cultural Information Resources*, above.
280 http://c2.com/cgi/wiki?WikiAsAnarchy
281 Ibid.
282 http://c2.com/ppr/
283 Correct on November 17th 2003, although likely to be higher at the time of reading.
284 http://www.theglobeandmail.com/servlet/ArticleNews/TPStory/LAC/20030620/UBRITM/TPInternational/TopStories

From client/server technology to peer-to-peer

All of the technologies presented so far use a server to host the community resources. An alternative approach to this is the formation of a peer-to-peer (P2P) network. In a P2P network the participants make resources available to members of the community. The term peer-to-peer means 'equal-to-equal'. The members of such a community can both provide or consume available resources. This method was popularised by *Napster*, a utility created in 1999 in order to facilitate the sharing of MP3 music files. The idea was to combine three key functionalities: *direct file sharing* (without a centralised server), a *search engine* (which would search users' machines for MP3 files alone), and a standard *IRC client*, allowing instant messages to be passed between MP3 users.

Participation in a P2P network is relatively simple; the utilities needed can be downloaded from the web and the shared folder accessible by remote users easily set up. The simplicity of joining a P2P network when combined with highly popular content leads to rapid growth of like-minded communities. Witness, for example, how fast Napster gained popularity.[285] The concept and technology, which was used to support the illegal copying and distribution of copyrighted music can be used to support the sharing of other information resources.

Since the Napster boom, numerous other similar utilities and Web sites have appeared, many of which do not limit file sharing to just MP3s alone. File sharing networks such as **Gnutella** and **Kazaa**[286] allow the sharing of a wide-range of digital object types from movies, to images, to software. Sharing of resources need not be limited to the exchange of files: CPU resources and services can also be offered to fellow community members. Since the peer-to-peer approach can be applied to all devices in the network, it is necessary to define how resources will be published and located. Publishing usually means saving data into a designated (shared) folder, while location involves the creation of directory mechanisms which can be consulted by users looking for a specific file or group of files. Even these communities have rules to which participants must adhere if they are to take part.

Collaborative Technologies and the Heritage Sector

Brief Background

Collaborative technologies provide the heritage sector with mechanisms to engage distributed communities in their work and to provide them with focal points for discussion and activity. The deployment of these technologies to create virtual communities has so far been limited. The technologies can be employed to create communities of shared resource development, online learning, collaborative exhibitions, and knowledge. **eStage**

285 This debate continues to rage over bulletin words and mailing lists across the world. Beginning September 2003, the Recording Industry Association of America (RIAA) took legal action against individuals whom it had evidence of downloading music illegally, among them a twelve year-old girl. See http://212.100.234.54/content/6/32740.html and many other news pages for the full story. In the US music shipments fell 26% between 1999 and 2002.

286 http://www.gnutella.com/; http://www.kazaa.com

examines the development of a virtual community in the puppetry domain. The **VRoma** project provides a multi-user networked environment built upon the spatial and cultural metaphor of ancient Rome to support sharing of resources and learning. **eMarCon** demonstrates the potential of the technology for creating virtual exhibitions that represent collaborations of institutions and experiences for visitors. Sharing knowledge is a central objective of these newer online social spaces and the **MIRROR** project has shown how this could be done in the context of natural science museums, in conjunction with providing a learning space. The scenarios that complement the case studies demonstrate the ways in which these technologies can foster communication and collaborative practices based on evidence from other domains. The pervasive nature of the technologies and the ease with which it can be deployed make it actually quite low cost.

Case Studies

eStage[287]

© eStage

The eStage search facility

eStage, an experimental project which ran for twelve months with a budget of €164,000, aimed to provide a puppetry portal. eStage encourages participants to contribute to the creation of a cross-language and cross-cultural Internet stage for puppetry. It began its work by testing the feasibility of establishing a new information service for puppetry based on the technology created by an earlier EC-funded RTD project, IRAIA.[288]

The eStage consortium consisted of **LemonLabs** (Munich), the **IRIT Lab** (Toulouse) and **DIW**.[289] DIW, the German Institute for Economic Research, had co-ordinated IRAIA, a service provider platform designed, in particular, for large and complex information spaces.[290] The key element of the IRAIA system that was of value to eStage is the system's capability to lead the user in a small number of steps to a concise but comprehensive

287 This case study is based on the answers to an email questionnaire completed by Kurt Englmeier of **LemonLabs GmbH** in July 2003, and on material available from the eStage Web site, http://www.epuppetry.com/.

288 IRAIA - Getting Orientation in Complex Information Spaces as an Emergent Behaviour of Autonomous Information Agents (IST-1999-10602). Further information on the project is available at http://inf2.pira.co.uk/mmctprojects/iraia.htm.

289 Initially, eStage had another partner, Germany's **Waidspeicher** puppet theatre. Unfortunately Waidspeicher had to withdraw from the project soon after the project start-up because of difficulties in recruiting the necessary personnel, leaving eStage without a partner who could offer an in-depth knowledge of puppetry.

290 The test data used for IRAIA's first application area came from national statistical and economic research institutions, typically constituting large and complex datasets.

fraction of the information space containing the data necessary to meet a particular need. The interface provides the users with semantic elements that help to describe concisely the things they expect to find while exploring information spaces/repositories. A semantic coordinate system equips users with a minimal but sufficient vocabulary. Hierarchically arranged and grouped along major content facets, this vocabulary acts as a stable coordinate system which is at the same time easy to comprehend and memorise. Users find localising themselves easy and quick. Successfully searching and navigating now means guided travelling from information to information by changing the semantic coordinates, i.e. by pointing to relevant concepts. To foster collaboration among puppeteers (both professional and amateur), puppet theatres, and authors of different kinds of puppetry-related literature, eStage provides puppeteers with a platform for exchanging their work, their artefacts, and their ideas. The project team hoped that in this way eStage would become a catalyst for inspiration. The corresponding collaboration platform is manifested through an Internet portal which allows uploads and downloads of a variety of media types including plays, videos, textual/descriptive data, and still images. This approach was dubbed 'intecreation' by the project partners, and defined as the interactive development of a collaborative workspace.

eStage put a strong emphasis on user involvement in terms of participatory design applied to the software development, and this is an approach that all projects aiming to create collaborative or virtual communities could usefully adopt. Throughout the project, but particularly in the early stages, the partners carried out a number of interviews with puppeteers and puppet theatres. Among the institutions which contributed to the shaping of the design were the **State Collection of Puppetry of Saxony**, the puppetry department of the **City Museum of Munich**, as well as **Union Internationale de la Marionnette** (UNIMA) and **Association Nationale des théâtres de Marionnettes et des Arts Associés** (THEMAA), both international associations of puppetry.[291] According to Kurt Englmeier of LemonLabs, the success of the project reflected direct contact with the puppetry community. Consideration was given to reports of user needs in the design. The team considered what kinds of information puppeteers are likely to be looking for. The following is a good example of the types of queries that puppeteers make:

> We were looking for a new play for children that should have some educational effect through a certain level of cruelty as it occurs likewise in many of Grimm's fairy tales. We looked for children's books in libraries, bookshops and even toy shops and run into a book in English telling the story of a mother and cannibal looking for a child to eat (*The Female Cannibal* by Valerie Dayre). The design idea for the necessary puppet came from a picture in a festival announcement showing a puppet representing a fierce devil. (Theater Waidspeicher, May 2000[292])

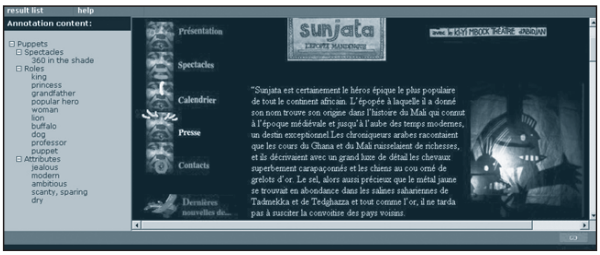
User interaction is a fundamental cornerstone of the eStage venture and experience. eStage was designed around the kinds of user interactions it was expected to meet:

- The access to a digital archive must enable creative talents to go directly to the material they are looking for while bypassing the vast majority of the collection;

291 http://ww.unima.org; http://www.themaa.com.
292 A description of the play can be found at http://www.waidspeicher.de/cgi-local/pagemaker.pl?mf*rep.

- The interaction mode must be able to cope with users arriving at the site with only a vague idea of what they are looking for. Therefore the structure of guidance provided by the system must be sensitive enough to let the users keep their vague idea as the steering element;
- There is no such thing as a precise answer to a vague query. Anything that relates to it can be useful, and thus any kind of information found by chance or good fortune should be welcomed.

The characteristics of eStage's interaction mode demonstrate the expectations of a user community requiring a platform that actively supports their work, i.e. expectations that determine the rationale of an information platform in the specific context of fostering creative talents. These users clearly do not want a portal which simply offers a virtual tour through a puppetry museum. Visitors to a museum (whether real or virtual) expect an overview of the virtual collections they are encountering, to be guided through these collections, and to have learned something by the end of the tour. Due to differing user expectations, eStage did not align its user interaction mode with the museum metaphor; instead a hybrid structure was tested which links documents/records in the same way traditional textbooks and guidebooks do. Integrated into a retrieval environment like eStage, this can be helpful in guiding users towards deeper explanations or further details on a specific topic. Users can broaden the scope of a certain topic, or even compensate for missing knowledge by adding explanations to the pages they visit. Vague concepts give space for a number of development directions that become concrete in the reflection of the material encountered, and this kind of retrieval rationale responds to a desire for serendipity in the discovery process.



© eStage
The eStage search facility

Semantic mapping – the annotation of documents and associating documents to concept hierarchies – depends in eStage on automatic text analysis. Contributions are accepted in HTML format only, and these texts are then annotated automatically. eStage employs a 'vector voting' strategy to assign textual documents to concept hierarchies. Put simply, the more votes a concept receives, the stronger the link becomes between the text and concept. Classification in eStage generates an XML header and associates the header to its corresponding document. The header consists of the annotated concepts of the concept hierarchies (CHs), but the concepts themselves are represented by pointers to their corresponding CH nodes, not mentioned explicitly.[293]

© eStage
The eStage search facility

293 The use of XML comes into its own here too, with the possibilities it brings for multiple simultaneous links and richer multidirectional linking.

This system of indirect referencing is indispensable in eStage because of the parallel use of CH in different languages. Underpinning automatic text analysis and association using the vector voting method bypassed a number of compatibility problems usually encountered in heterogeneous databases.

Englmeier recommends the use of platform-independent Java applets for features that are usually found in traditional client-server applications, and are therefore different from 'traditional' text and graphic presentations. For a higher level of interaction it may even be justifiable to forsake a complete readiness and availability on the client side and to resort to a Web application that is installed and runs independently. This option should be investigated if the user audience is willing and in the position to install and run an application.

Significant interactivity is the key to an advanced level of communication, permitting the two-way communication essential for highly interactive information environments. There remains a major difficulty with the Web's suitability for delivering highly interactive units, particularly evident in the shortcomings of HTML. In terms of user group size, the level at which the eStage community becomes truly useful is about fifty contributors and around 400 contributions. Below this threshold an information space will have problems attracting a significant user group. The estimated optimal size is 500 contributors and 7500 contributions. This size would ensure that eStage covers almost all ramifications of modern puppet theatre, including a substantial representation of cultural heritage content. These conclusions provide pointers to other groups wishing to establish similar interactive communities of information and actors. The project also concluded that there were other areas that could be developed once the project had achieved a critical mass of contributions and participants. The education possibilities could be further investigated; structuring the eStage information space along pedagogical issues can lead to an instrument that demonstrates certain behaviours through puppet plays. There might even be possibilities for developing an electronic marketplace of puppetry allowing the community to commercialise their artefacts.

VRoma[294]

VRoma is an online community for the teaching and learning of Latin and ancient Roman culture. The VRoma community exists in a virtual 'place', a multi-user networked environment (MOO/Web server) built upon the spatial and cultural metaphor of ancient Rome. Here teachers and students can meet in real time, interact, collaborate, hold classes, and access databases, texts, images and teaching materials. The project provides access to online classical resources, ranging from archives of digital images relating to classical antiquity, to Web pages on Latin language and Roman literature, history, and culture.

© VRoma
Stone figures 'looking' at computer monitor

The purpose of the project is to facilitate the teaching and learning of Classics and to promote more broadly interest in ancient Roman civiliza-

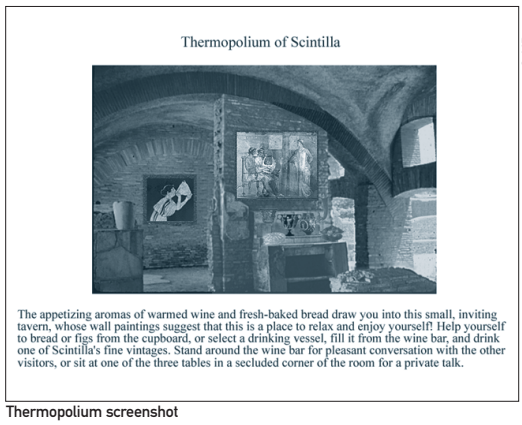
294 This case study is based on email communications between Barbara McManus of VRoma and Daisy Abbott of DigiCULT, taking place during August 2003.

tion. The approach taken by the project could be equally well applied to many other cultural heritage domains.

The development of VRoma began in 1997 when the **National Endowment for the Humanities** (NEH)[295] granted **Miami University** $190,000 (€ 154,000) for a three year period under their Teaching with Technology scheme. **Rhodes College** in Memphis provided the first server for the VRoma project, and the **Associated Colleges of the South** provide and house the current VRoma server at the ACS Technology Center at **Southwestern University** in Georgetown, Texas. During the grant period (1997-1999), the project had five directors representing different institutions: Michael Arnush, (**Skidmore College**), Suzanne Bonefas (Associated Colleges of the South), Barbara McManus (**The College of New Rochelle**), Kenneth Morrell (**Rhodes College**), and Stephen Nimis (**Miami University**). The NEH funding was used to run three national workshops for pre-college and college Classics teachers, involving technological training, creation of on-line resources, and discussion of pedagogical uses of the materials. Ranging from seven to ten days each, the workshops were designed to create a small community of scholars and teachers and to share technical expertise in order to give the project its initial motivation. All workshops were held in academic computer labs with Internet access, and the primary technological skills taught involved MOO skills, Web authoring, and digital image processing. Key to creating the virtual community itself were face-to-face meetings.

The planning team's decision to create a virtual community using a MOO was prompted by the fact that despite the many excellent classical resources available on the Web the team felt that there was very little understanding among college and pre-college teachers about how to use these resources effectively. The team felt that a 'virtual field trip' might provide students of Latin with an experience of context in which the language was used that would improve their learning and their contextual knowledge. This community or 'critical mass of learners' would greatly benefit more isolated Latin students (e.g. those in small programmes). The planning team concluded that the spatial metaphor on which MOOs are based was ideal for their purposes and suggested the concept of a virtual re-creation of ancient Rome.

After considering the various options available, it was decided that the *BioGate MOO core*[296], a system developed for **BioMOO**, a virtual community of biologists (subsequently closed in 2002) with the *Cup o' Mud* java interface[297] was the most appropriate technology for VRoma purposes. A MOO is a database (stored as a very large ASCII text file) which is read into memory when the MOO server is started. Every MOO object (users, rooms, exits, bots,



© VRoma

Thermopolium screenshot

295 http://www.neh.fed.us
296 http://bioinformatics.weizmann.ac.il/BioMOO/BioGate/
297 http://www.du.org/java/CupOmud/

items and so on) has a unique ID number and belongs to a class which has attached properties and features. The objects are controlled by an object-oriented programming language executed by the MOO server (in VRoma's case, *LambdaMOO*)[298] which defines the ways in which the objects interact. For example, a 'room' object can contain 'user' objects that can interact both with each other and with any 'item' objects in that room. Some of the objects in the BioGate MOO core had to be adapted to better suit VRoma's needs. After several years, the creators of the BioGate MOO database stopped developing it, and connectivity problems with newer browsers began to develop. The VRoma project team responded by moving their work to the *enCore MOO* database (which was specifically developed for use in colleges and universities) with the *XPress* Web client[299] and the *MOOca* java interface.[300] Most of the VRoma rooms had to be reformatted to work with XPress. While this work was done the original MOO was kept open and functioning. VRoma's *MOO/Web*[301] interface combines two different technologies to create the virtual world. A pure MOO is completely text based, however VRoma includes a Web window that is interlocked with the Telnet connection in order to display images, multimedia objects, and support other Web functions. This integrated Web-based MOO client, *enCore XPress*, uses Web standards and technologies such as HTML, Java, and JavaScript. Users type what they want to say or do in the Input Window; when they press the Enter key, their dialogue or actions appear in the Output Window, where anyone else who is currently connected and located in the same 'room' can see what has been said or done and respond (if they wish). This interface fits well with VRoma's initial goal of making the technology as transparent and user friendly as possible. It enables visitors to access VRoma and enjoy its resources without requiring access to specialised hardware.

© VRoma

The Colosseum - line drawing

In order to build the virtual city, it was decided that two distinct sections were required: the historically accurate reconstruction of Rome, and a non-historical section which would contain virtual offices of VRoma core staff and student projects. To virtually recreate the vast and complicated city of ancient Rome and to provide user-friendly navigation, the VRoma team used divisions created by the emperor Augustus. These split the city into fourteen regions. The first historic room is simply called 'Rome' and has a clickable map of the fourteen regions as well as an entrance to each of the regions. Some of the regions have clickable maps which take the user directly to major monuments in that region. With

© VRoma

The Colosseum - photograph

298 http://www.lambdamoo.info
299 http://lingua.utdallas.edu/encore/
300 http://www.zanid.com/mooca/
301 Webbed MOOs are sometimes called WOO's.

the exception of these shortcuts, the topography of Rome is strictly adhered to; all entrances and exits must be physically possible and are based on scholarly maps of the ancient city. Use of images was emphasised in order to give students a sense of immediacy and connection to the ancient world. The VRoma Image Archive was created by digitising photographs (many contributed by VRoma staff and Classics teachers) and has now grown to more than 2000 images. The Image Archive is one of the most widely used of all VRoma resources, and has inspired much interest from makers of television documentaries. Image sources do not have to be ancient; models, reconstructions and modern paintings of classical subjects are also used, as well as images scanned from books within the public domain and a number of photographs taken specifically for the project.

VRoma's Web server has directories assigned to individual photographers where they can upload the images and HTML files which link to them and contain metadata: a brief description of the subject; dating of the subject (if known); location and date of photo; and useful keywords. The images are stored as jpegs (or occasionally gifs). The Image Archive uses the *Glimpse* search engine[302], which queries the text in the HTML files, although this process is not standardised beyond the minimum metadata specified.[303]

The building of VRoma began in the initial workshops by core staff who chose particular sites based on their research interests and expertise. Building was largely collaborative, with workshop participants making suggestions and constructive criticism. Building continued after the workshops' conclusion, and several more advanced MOO-building workshops were organised to allow staff to work together once again in an intensive collaborative setting. Building privileges are granted by the VRoma administrator, who gives characters a gateway room which they 'own', usually in the non-historic section of VRoma.

The project has a core staff, primarily recruited through the initial workshops, of whom some have built various sites in the MOO. Continued collaboration has been achieved through a listserv, email, and synchronous communication within the MOO itself. The VRoma Core Faculty listserv comprises sixty-one members. The nature of the collaboration primarily involves the creation of online resources both in the MOO and through Web sites, although staff at different institutions have also collaborated on courses, students from different schools have worked together on projects, and both have participated in discussions within the MOO. The VRoma MOO currently has 679 registered users. Most regular users are from the US, and there are many international users who visit more sporadically. Due to the varying visiting patterns and usages of VRoma resources, the technology can accommodate many more users. Users are stored as objects in the VRoma database. If a user has building privileges he can designate one of the rooms he owns as 'home' and the character enters the MOO from this location. Characters who cannot 'own' MOO rooms are stored in a MOO object called Limbo and enter VRoma through the Prima Porta VRomana. Characters can be customised, users choose a name, a password, from ten different genders (which determines which pronouns are used), and can change their icon and description. As an educational MOO,

302 http://webglimpse.org

303 Since VRoma has been continually developing and evolving, the directors decided that ongoing assessment by individuals actively participating in the project and using the MOO for teaching would be used to evaluate the system. The assessment of various aspects of the project, and results of that assessment, as well as more information about VRoma collaboration and project outcomes, can be found in the Final Report to the NEH, at http://www.vroma.org/~bmcmanus/finalreport.html

VRoma does not support automatic character creation; potential users must apply for a character[304] who is created with a unique name and object ID number. There are roughly twenty-five 'guest' character objects which can be slightly customised for a casual visit. Character avatars wear colour-coded tunics to represent their status. Players wear aqua tunics, guests wear green, characters created for a VRoma workshop or class building project and other characters with builder privileges wear brown, programmers wear gold, wizards wear purple and bots wear blue.[305]

Since VRoma is an educational project, there can be no doubt that activities involving learning and using knowledge are the first priority; the MOO and other resources are intended to promote knowledge and understanding of the Latin language and ancient Roman literature, history, culture, and civilization. However, the pedagogical approach to education in this form was partly based on the belief that the best way to spark interest and increase knowledge is to involve the users emotionally, to create a sense of imaginative engagement in the ancient world. It was this methodological approach to active teaching and learning which led to the creation of the virtual city, complete with its tour guide, bots (some of whom speak only Latin), linked visuals, accurate yet amusing details, games, and so on. Users are encouraged to adopt Roman names and personae and to use their knowledge of Latin to interact with the bots and objects within the MOO.

The MIRROR Community of Practice[306]

© MIRROR

The MIRROR message board

The MIRROR project was begun with the intention of creating 'a collection of components and tools for a distributed knowledge management system that will support physical and social interactions.' This goal was to be achieved by establishing a pan-European community of practice for natural science museums, while at the same time developing a novel learning methodology using state-of-the-art tools, systems, and techniques. The MIRROR community currently boasts ten member museums. At the last European Collaborative for Science, Industry and Technology Exhibitions (ECSITE) conference[307], the consortium gave a presentation as well as had a computer booth for demonstrations in order to attract new members.

The project's methodology is based on the principles of Etienne Wenger's model of *Communities of Practice* (CoP). These are defined as 'groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise

304 Using a form found at http://www.vroma.org/volunteer.html

305 A 'wizard' is a MUD term for a character with administrative privileges.

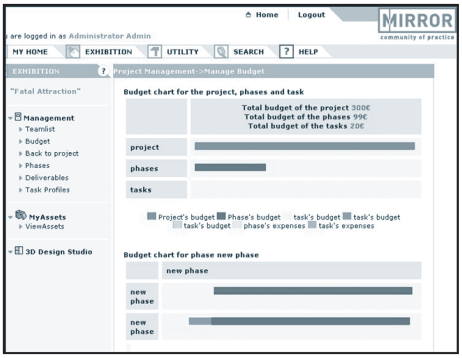
306 MIRROR (http://www.mirror-project.net/) is a twenty-six month €2 million project co-funded by the European Commission under the Information Society Technologies Programme (IST-2001-32504). The project consortium consists of IT companies (**UMA Information Technology AG** of Austria, and project coordinators **Syntax Information Technology** Inc of Greece) and universities (the Manchester Visualisation Centre, at the **University of Manchester** in England, the Museum Studies Department at the **University of Leicester** in England, the **Royal Belgian Institute of Natural Science**, and the School of Education at the **University of Athens** in Greece), as well as representatives from the museum community. This questionnaire was answered in October 2003 by the following members of the MIRROR consortium: Yannis Avrithis, Andreas Generalis and Varvara Kiouki, Syntax Information Technology Inc, Athens, Greece; Daniel Doegl and Aleksandar Golubovic, UMA Information Technology AG, Vienna, Austria; Theano Moussouri, Museum Studies Department, University of Leicester, England.

307 http://ecsite.ballou.be/new/meeting_mun_2003.asp. Held at the Deutsches Museum, Munich, Germany, on November 27-29 2003.

in this area by interacting on an ongoing basis'.[308] Such communities combine a 'domain of knowledge, which defines a set of issues; a community of people who care about this domain; and the shared practice that they are developing to be effective in their domain'.[309] However, in order to function effectively and grow, such communities need a 'shared workplace' or 'conversation space' where they can define and reinforce their domain, together with tools that can facilitate the exchange of shared knowledge and the development of relationships among its members. The *MIRROR Knowledge Management System* (MKMS) is a tool that provides this required space, and a means for holding 'conversations' to support communities of geographically-distributed exhibition development teams. It caters for all aspects of collaborative exhibition development and helps teams manage both tacit and explicit knowledge produced at different phases of their work. Furthermore, the MKMS can also be used as a virtual meeting place where specialist organisational knowledge can be maintained and exchanged.

MIRROR is a Web-based application supporting and enhancing interaction and synchronous/asynchronous communication between users. It does this through:

- *An Exhibition Design Studio*, a multi-user design studio environment which assists collaborative visualisation and exchange of 3D scenes and models and ideas for individual exhibits, as well as exhibition areas and the exhibition as a whole;
- *Forum and Conference facilities*, allowing for immediate exchange and feedback (similar to IRC chat);
- *Collecting and sharing digital content*. A library gives the ability to collect and share digital content, and to use it as a resource and knowledge-expanding tool in day-to-day work;
- *Project Management*, which facilitates the organisation and management of everyday teamwork.



© MIRROR

MIRROR project management

In technical terms, MIRROR is a distributed platform which enables its subsystems to communicate through specific network protocols. MIRROR subsystems do not need to be installed in the same geographical location; in fact the system could be geographically distributed on the server side between different sites that communicate using different protocols. The real goal was to have a centralised system management and repository for all MIRROR components, while at the same time maintaining a common protocol through which all applications would be able to communicate and exchange data. Interoperability is supported using a Web Services framework, and MIRROR also enables real-time distribution and sharing that facilitate functions such as instant chat and scene sharing.

308 E. Wenger, R. McDermott, W. M. Snyder, *Cultivating Communities of Practice* (Harvard Business School Press, 2002), p. 4.
309 Ibid, p. 27.

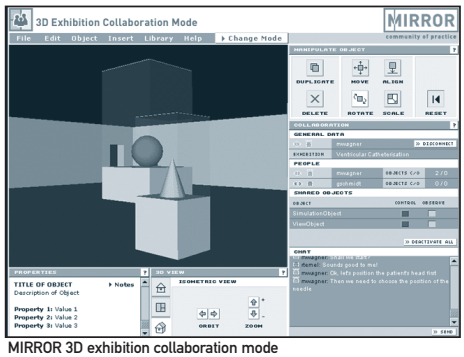
The project's main technologies and subsystems are as follows:

- *The Control subsystem* implements methods for information exchange utilising open standards and mechanisms such as Web services and XML message exchange. This standardises the way each MIRROR subsystem provides its internal services. Technologies used include a Web Services framework based on *SOAP, UDDI, J2EE, .NET* and *WSDL*;
- *A DeepMatrix*[310] *server*, running a Web virtual environment system that enables development of systems incorporating virtual worlds. The server supports the creation and management of complex 3D environments and the distribution of shared 3D or VRML objects between MIRROR members, based on the client-server architecture. Technologies used include Java, TCP and HTTP protocols;
- *The Conference Server*, which assists collaborative work between different users by implementing conference session management. It is built on top of the DeepMatrix API, and is extended on demand by the use of external plug-ins that provide advanced collaboration services. The technologies used include DeepMatrix API, Java, plugin framework, and XML configurations;
- *A 3D Conference Client* provides the presentation infrastructure for building and sharing 3D resources, and improves the use of the system between MIRROR members by simulating real world interactions. Technologies used include Java applets, the DeepMatrix API, and VRML;
- *Exhibition and Conference Management subsystems* enable the creation and management of exhibitions and conferences. They also provide the framework for initialisation and set-up of the subsystems, as well as allowing access to internal MIRROR resources. Technologies used include Struts, Java, Web Services, JSP+ custom tag libraries, and XML configurations;
- *A Project Management subsystem* enables the organisation and management of everyday teamwork. It also provides permission handling for specific access areas. Technologies used include .NET Application Framework, Web Services and COM+ application components;
- *A User Management subsystem* provides the ability for user manipulation, new member creation and role handling. The user management is built on .NET Framework and Web Services, which can be accessible via the different system components;
- *An Asset Management subsystem* enables the sharing of digital content. Digital content can be divided into several categories and some specific content can be edited on-line. Asset Management enables category and file manipulation, metadata assignments over categories and files as well as document versioning controls. It is implemented using .NET framework and COM+ components;
- *The Search subsystem* encapsulates searching methodologies among users and assets. It is implemented with .NET Framework Components using additional technologies such as Indexing Service. The Search subsystem provides multiple options for searching among users, user roles and assets.

MIRROR is a heterogeneous system with individual elements based on different frameworks. The two main platforms used are J2EE and .NET. This fact demanded the deployment of technology that enables efficient cross-platform collaboration. Many tech-

310 http://www.geometrek.com/products/deepmatrix.html

nologies claim to ensure such interoperability (e.g. CORBA), but recent developments in Web Services seemed to the MIRROR team to offer the most convincing and suitable solution for their system. A complete, platform-independent Web Services framework is based on the HTTP protocol and XML specifications, and also enables definition of the interfaces (using WSDL) that are easily used by other platforms, thus encapsulating the business logic behind them. This was one of the most important requirements for the system.



© Mirror

MIRROR 3D exhibition collaboration mode

Some of the subsystems, notably DeepMatrix, are already in use and very well proven in other projects, so these were adopted and extended for the needs of MIRROR. Some upper layer subsystems (such as Exhibition Management and Conference Management) were implemented using *Struts*[311], which implements an advanced Model-View-Controller (MVC) pattern. This is a proven framework that encapsulates different parts of the Web applications (model, view and control), thus enabling separation and assignment of different tasks to the experts. It also provides advanced tools for session management in combination with the view component (JSP, custom tag libraries, resource files and so on).

The main theoretical impetus behind the project was to explore the 'mirroring' of the learning interactions of individuals within communities of practice through the application of new technology. The specific context explored within the project is that of natural history museums, and – in order to provide sufficient focus for the size and duration of the project – specifically those exhibition teams and communities engaged in the production of collaborative exhibitions. Social theories of learning view it as a social activity, inasmuch as people learn through their participation in a number of communities. Communities of practice tend to be relatively coherent groups which share common endeavours, whose members may work, live or share leisure time together, and who derive a sense of meaning and learning in the world from their membership of the community.

MIRROR constitutes a multi-disciplinary approach to the concept of knowledge management. Its main short-term goal has been to combine the strength of recent technological advances with the sound theoretical infrastructure of pedagogical and learning disciplines, in order to create a powerful and worthwhile system. It is apparent that this attempt led to the formation of a consortium that is essentially based on complementary expertise, know-how, and scientific backgrounds. Future additions to the project will bring it towards a fuller system of information and means of communication, such as online encyclopaedias and other reference tools.

311 http://jakarta.apache.org/struts

eMarCon – Electronic Maritime Cultural Content for Virtual Exhibitions[312]

© eMarCon

An eMarCon virtual exhibition

The promotion, dissemination, and accessibility of European history, for a general audience as well as for the scientific community are important tasks for the European society. The field of preservation and presentation of maritime cultural heritage makes a particularly suitable test case for interregional knowledge sharing and virtual cooperation. Its European socioeconomic dimension is obvious, and a number of specific problems exist which complicate and may hinder cooperation between institutions. Many important artefacts such as historical warships cannot be moved, either because of their sheer size and weight, or due to the immense transportation and insurance costs of doing so. In the past these problems have complicated efforts at giving common presentations of scattered maritime artefacts within a European framework. In the words of Andreas Kammler of the **Deutsches Schiffahrtsmuseum**, 'such common presentations would be highly desirable, as they may remind us of our common European roots, but additionally can highlight the regional cultural differences of the contributing countries.'

eMarCon (Electronic Maritime Cultural Content) is a two-year project with part of its € 2.5 million euro budget coming from the European Commission's eContent Programme; Bremerhavener Gesellschaft für Investitionsförderung und Stadtentwicklung mbH is providing additional funding. The eMarCon partners comprise nine institutions from seven European countries (including Poland), with four maritime museums[313] and a broad cross-section of the academic, regional and informatics/communication technologies organisations in Europe.

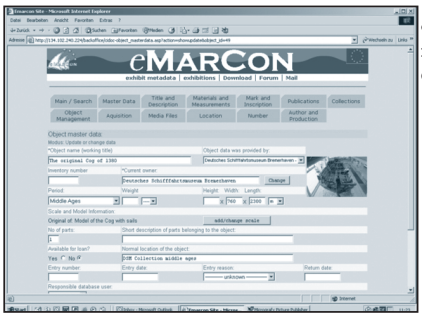
The objective of eMarCon has been the creation and implementation of a tool for maritime museums to improve cooperation in areas such as presentation, publication, education and teaching. The project is user-centred, and its main focus is on allowing geographically distant European museums (and their visitors) to arrange and publish common virtual exhibitions on the Web. The project also had to provide the possibilities for storing and presenting the content in several languages, and was geared towards different user groups, in order to reach the largest possible audience across Europe and beyond.

The different groups of users (e.g. virtual visitors, scientists, teachers and pupils, parents and children) are able to visit the virtual presentations and interact with them at an appropriate level. The incorporation of interactive and historical games and simulations will simultaneously educate and stimulate the users as they experience the virtual artefacts. The presentations will take the visitors' profiles (age, educational level, skills, interest, language, etc) into consideration when explaining the exhibits, and the resulting distributed exhibitions will allow forums for discussing the exhibits and arrangements that the

312 This case study is based on a paper provided by Andreas Kammler of the **Deutsches Schiffahrtsmuseum** (German Maritime Museum, http://www.dsm.de) and Robert Huber of **Universität Bremen** (http://www.uni-bremen.de) in October 2003. The eMarCon Web site was also consulted: http://www.emarcon.net/.

313 **Deutsches Schiffahrtsmuseum**, Bremerhaven, Germany; **Centralne Muzeum Morskie**, Gdansk, Poland; **Museu de Marinha**, Lisboa, Portugal; **Museo Maritimo Ría de Bilbao**, Bilbao, Spain.

museums have configured. According to the eMarCon Web site, the project's main goals are:



© eMarCon
The eMarCon 'back office'

- To adapt a set of tools which not only communicates the experience of visiting a virtual exhibition, but which communicates the experience itself via an interactive process;
- To allow co-operating museums to arrange common virtual collections in a simple online environment;
- To encourage the sustainable development of Europe-wide distributed digital repositories;
- To simplify user access through high-tech navigation tools applied to museum objects;
- To provide access to distributed exhibitions, tailored to specific user profiles (multi-lingual, age, education, etc);
- To promote cutting-edge virtual/multimedia access to museum exhibits and distributed collections;
- To contribute to pan-European standardisation on the digital representation and delivery of museum objects;
- To open new channels of finance for museums through eCommerce, via an online shop, and the licensing of eMarCon software for establishing virtual exhibitions to other museums.[314]

From a technological point of view, the eMarCon project consists of a database-driven content management system (CMS) which allows museum experts to combine explanatory exhibition information – arranged in virtual rooms – with artefact information derived from a CIDOC-standard based object database and multimedia content, one of the most widespread standards for the description of museum items. Pre-exhibition cooperation and communication is supported by a commercial groupware solution, *Basic Support for Collaborative Work* (BSCW[315]). Additional system modules include feedback mechanisms and discussion boards for the visitors, as well as configurable download sections. An integrated e-shop solution enables the museums to create additional income as well as to attract visitors by shopping possibilities of unique products.

The server software is divided into six distinct parts, or modules:

1. *The museum co-operation module* facilitates the co-operation of participating museums in setting up exhibitions via the Internet;
2. *Exhibits and metadata input*, allowing participating museums to enter exhibits and metadata into the museum database;
3. *Visitor guidance*, helping users keep track of their tour through the virtual exhibitions. Each exhibition can be experienced taking different routes;

314 List adapted from http://www.emarcon.net/objectives.html
315 http://bscw.gmd.de

4. *A personalisation module* for acquiring and recalling visitor-related information in the form of a visitor profile, including factors such as age and education, preferences, payment details, and so on;
5. *A security and virtual shop module*, protecting the system and the data held within it from being compromised, erased or stolen;
6. *An exhibition creator*, enabling Web designers and museum experts to create the layout of an exhibition.

Prior to the design and implementation phases, the project team performed an identification of the requirements of both the participating museums and the expected visitors, together with hardware requirements and standards for the future tool. Coupled with a critical analysis of the existing tools, this meant the team had a solid foundation and shared perception on which to build. The four maritime museums created a dedicated museum group to develop and conduct an exchange mechanism to identify best practice, exploit the project results, and reach out to other similar museums. During the project, the museum group used the eMarCon system to create a common demonstration exhibition entitled 'Ships from Wood, Ships from Steel', illustrating some of the interesting aspects of the history and tradition of European shipbuilding. A number of exhibits, including many original scale ships, were presented publicly here for the first time in a common context.

One of the most important tasks of the project was the initial workpackage 'system requirements' and 'system architecture'. Over the course of these two workpackages, the detailed functionality of the system was specified and the appropriate tools and technologies were evaluated and decided upon. Some of these decisions were based on what the partners had already. **Sybase** *Adaptive Server*[316], for example, was selected because this database was already in use at eMarCon project partner Marum, and the staff there were comfortable and competent with it.

© eMarCon
A record from an eMarCon virtual exhibition

However, the system design is open, and test installations on **Microsoft** *SQL Server* worked without any problems. It uses Active Server Pages to create the user front-ends. This was based on the fact that most partners defined themselves as being 'Microsoft orientated', thus, the skills of the people involved influenced the technology decisions. The compromise towards an open, OS-independent system was embodies in the choice of **Chilisoft** (now part of **Sun Microsystems**[317]) for the ASP platform. The system currently runs on a Sun server, but will also work in a Windows environment.

With the project now up and running, the eMarCon museum group considers itself to be the core of a larger future community of maritime museums, and plans outreach strategies to encourage other, small and often volunteer-run organisations to cooperate. By using the eMarCon tools, museums can open their archives, some of which contain huge amount of exhibits, to the general public, thus boosting the profile of maritime heritage across the greater cultural heritage community. By doing this, eMarCon aims to

316 http://www.sybase.com/products/databaseservers/ase
317 http://wwws.sun.com/software/chilisoft/index.html

constitute the nucleus for a European database of maritime cultural heritage which will continue to grow, and thus allow scientists to present and compare artefacts in a European – and perhaps eventually global – dimension.

Scenarios

Copper Mining in Norway – A MUD as a Learning Resource[318]

A former mining town in the Norwegian mountains is preserved in a state of 'arrested decay', i.e. some years after the town was finally abandoned, efforts were made to prevent any further dilapidation to those buildings that remained. The town is registered as a national site of historical significance, and welcomes thousands of visitors each year.

The local tourist office receives a large number of enquiries about the town, especially from schools whose pupils are studying Scandinavia's industrial heritage and who would like to run field trips to the town. However, most of these potential visitors do not go through with the proposed trip, and the tourism manager fears that the town's potential is not being maximised as a result of its geographical isolation and difficult driving conditions. This assumption is confirmed by some of the entries in the town's guestbook, such as teachers who visit privately bemoaning the fact that it is impractical to arrange a trip for their students.

Industry and mining forms a significant part of schoolchildren's historical education, and the area tourist board would like to increase accessibility to the resources of information held within the town, from information about the formation and mining of copper itself, to life in the town, its people, society, and the technologies at use. While the Web site promoting the town already provides some of this information, it does not recreate the feel of a visit to this historical site, nor the 'investigative' learning process undertaken by visitors to the town.

For these reasons, the tourism board decide to create the opportunity for 'virtual visits' to the town, including many of the aspects of a real visit, such as:

- Learning by exploration – at the visitor's own pace, in the areas of most interest to them;
- Investigation of objects (buildings, items, paper records, etc) preserved within the town to learn more about life there in days gone by;
- A sense of history, emphasised by the preserved state of the town;
- Scholarly presentation the history of the town, e.g. explanatory notices for visitors in some of the buildings, video showings.

It is decided that recreating the town as an online MUD (Multi User Domain) will enable a truly interactive exploration of the town, and will give virtual visitors a chance to experience a similar emotional response to the town as a real visitor. The users of the MUD will be encouraged to visit in groups, just as if they were on a real field trip, thus creating a community of users who can discover, discuss and share information together. The MUD would also be a valuable resource for people who have actually visited the

318 For an example of such a town (albeit without its own MUD) please see the mining town of Røros: http://www.miljostatus.no/templates/PageWithRightListing.aspx?id=2417

town, enhancing their memories and potentially enabling them to find out more than they did during the visit itself.

The board members prepare a budget, research a number of existing MUDs, and begin to examine methods of achieving their goal. They negotiate the funding for the project, and seek a local IT company to outsource the programming contract to. With the assistance of volunteers, the board members begin to prepare the learning functionality of the MUD: mapping the town into squares, writing textual descriptions of all buildings and areas, deciding which objects are most important as learning tools and producing textual descriptions of them. From the existing tour offered in the town, they prepare a virtual tour taken by a *bot* (a computer program which is presented as a human being) who conducts the tour with much of the same information as his human counterpart. With the help of the programming team, they also produce a tutorial which introduces users both to the virtual town and to the commands that are used to explore it.

During this period, it becomes apparent that the historical learning potential can not only be replicated, it can also be greatly enhanced by such a community. The board members soon come up with several more ideas to maximise engagement with the information, including:

- Allowing MUD users to enter areas which are forbidden in real life due to safety or preservation reasons, such as the mines themselves. Each area is described true to life, complete with safety hazards;
- Incorporating a 'treasure hunt' feature aimed at students aged from eleven to sixteen years of age. The game follows a real historical figure through his life in the town, and clues lead the players to discover the man's house and various objects which belonged to him, from the pickaxe he left in the mines, to the old-style bottles he might have drank from in the inn, to the register book which recorded his death. Each object, once examined, reveals a URI which points to an image of that object in context, hidden somewhere on the town's Web site;
- A time machine which takes the user back to the town in the 1700s. Users are 'dressed' in clothing appropriate to the time, and each area is bustling with activity. The town is populated by bots (all based on actual historical people, ranging from the mine's founder to ordinary miners) who provide emotive information by interacting with visitors. The MUD building team ensures that the experience is as historically accurate as possible, with a barman asking users for their age and then throwing them out of the bar if they are underage. Through bot characters in this setting, users are encouraged to continue their visits to the MUD and to interact with each other;
- The time machine feature may also offer users a glimpse into the geological information available. For example, the long-term formation of copper deposits in the hills can be described as if it was happening at high speed in front of the user's eyes.

Once the MUD's basic functionality is complete, the tourism board publicise it in schools and educational facilities, in MUD listings, and on the Internet. The extra functionality is added piece by piece, and although use of the virtual community is initially low outside school hours, users tend to log on in groups of ten or more, hence there is almost always someone online to interact with. The tourism board cooperates with educational establishments to produce worksheets for a number of different age groups, thereby integrating the information contained within the MUD into the curriculum.

After a few years, usage has increased due to teachers repeatedly visiting with different classes of students, and also through word of mouth: there are even a number of schools from overseas who use the MUD for teaching purposes. The number of adult users has also grown with specialists in that area of research using the MUD as an informal meeting place and discussion zone.

A Virtual Museum Community

A virtual museum is a prearranged collection of electronic artefacts and information resources, which can comprise anything that can be digitised. As there are no barriers towards amalgamating dispersed collections in the virtual space, a virtual museum's collection can include different resources around the world which are related to the museum's main objectives, regardless of their real, physical location.

Virtual museums tend to have the following characteristics:

- The collection is significantly large, and potentially limitless;
- The home page (the entrance) of the virtual museum is both attractive, and easy to access and navigate;
- It will necessitate multiple visits in order to explore anything approaching the whole collection of the museum. The homepage should therefore be dynamic and retain the interest of the returning user;
- Different learning tools may be offered to answer the needs of different age groups, audiences, and educational approaches;
- The lack of geographical restrictions leads to a diverse and dispersed visiting community.

Virtual museums link the activities of museums, universities, and other cultural heritage institutions which can be physically situated all over the world. The online environment was created by collaboration between individuals and organisations, and is itself a virtual community, encouraging (indeed, demanding if the collection is non-static) the further collaboration of Web page content providers, experts, and visitors.

Visitors to the virtual museum can range between casual browsers and dedicated enthusiasts, experts and schoolchildren, one-off visitors and regulars. Participants in this community are able to perform integrated learning in different ways, including research and the remote 'manipulation' of museum artefacts. Students thereby acquire knowledge and develop an understanding of a culture itself, while at the same time gaining the skills necessary to explore content and make informed judgments. Visitors can often also contribute experiences or knowledge back to the community. One of the standard roles of a museum is as a place for learning and interpretation that is not restricted to traditional educational scenery. The virtual museum community makes museums available to people who are unable to access physical buildings, and technology enables both curators and users to restructure virtual exhibits in a variety of different ways.

With the introduction of Web-based communities and collaborative exploration, users are empowered to interact with an object even from distance, and to explore it from different approaches and perspectives. They can develop an interest by using the virtual museum's resources and access to curators, collection managers or subject specialists is also possible, allowing multiple points of entry to access of the object. Very successful virtual museums communities do not attempt to replace the physical visit, but use ICT to produce

complementary activities, discourses and presentations of the cultural or heritage artefacts.

Examples of valuable community activities which occur within a virtual museum environment include:

- 'Ask a specialist'. Email enquiries can be answered at a curator's convenience;
- Users can 'play' with a digital surrogate of an artefact in hitherto impossible ways. This deeper engagement is not only an advantage in itself, but allows features such as 'Create your own…' where a visitor can 'use' the object (for example, an antique musical instrument), and save their interaction with it (e.g. a tune);
- Encouraging visitors from non-traditional museum audiences, and dispelling any negative preconceptions about museum visiting;
- Using the digital artefacts as part of social interactions, for example, sending an e-Card of a painting in the collection;
- Personalisation such as 'My Museum' features. This could include 'matching' functionality, for example 'Other visitors who enjoyed that exhibit also enjoyed X';
- An increased likelihood of cross-pollination between disciplines and enhanced communication between scattered devotees and experts, leading to both increased knowledge and new degrees of interaction;
- The possibility of face-to-face communities developing as a result of online interactions.

Virtual museums should begin to use their online environments in more sophisticated ways as the potential of these new interactions between people, objects and environments becomes more fully understood. As the new modes of interaction, greater accessibility, and more widespread input make participation in VCs more exciting and valuable, more people will make use of it, leading to a greater number of knowledgeable, adept and fulfilled virtual communicators.[319]

Remote Collaboration for an Exhibition

An art gallery wishes to run a yearlong exhibition on the theme of immigration, and in particular the cultural value and diversity that immigrants have brought to their new country. The gallery plans to include works by both contemporary and historical artists, and would like to produce an introductory guide to the exhibition which will be presented on the gallery's Web site. The planner contacts a local museum which holds many important artworks by and of immigrants, as well as a small private gallery which holds a rich collection of the works of a famous contemporary artist. The gallery also contacts the national galleries of the countries of origin for a majority of immigrants, and after discussion with the managers there decides to include some of their works which depict colonisation and emigration.

The gallery does not currently have a member of staff whose job it is to design exhibitions, and as this exhibition combines works from many institutions they decide to seek opinions from the collaborators and more experienced peers. The project has not the budget to organise multiple face-to-face brainstorming and planning sessions, so in order to utilise the expertise of all the collaborators most fully the gallery staff begin to

319 *Cf.* Dominic Prosser & Susan Eddisford, "The Object of Learning: Virtual and Physical Cultural Heritage Interactions" in *DigiCULT.Info 5*, December 2003, http://www.digicult.info/pages/newsletter.php

research methods of collaboration via the Internet. It is important that the communication is synchronous, that the software is reliable, and that language differences do not lead to ambiguity when planning the best way to display the paintings and sculptures and their identifying and explanatory notices.

The staff at the gallery have heard a great deal about collaborative aids (such as **Microsoft**'s *NetMeeting*, **WebEx**'s *Meeting Center*, and **Centra**'s *Centra 7*)[320] which allow synchronous chat together with 'whiteboard' features, thus allowing distant users to see their co-collaborators' imaginations at work. The essential difference between this way of working and the alternative is that the creative process can be visualised and followed in real time. It also allows information to be date-stamped and saved to hard disk – an essential feature, allowing users to save and track changes and marker points.

Once the collaborators have installed the software, the gallery organises an initial brainstorming session with the museum, the foreign national gallery and the contemporary artist to decide on the themes connecting various works and the provisional list of works to be included. The session is a success, and the gallery gains a good deal of useful advice, as well as suggestions and offers of artworks to exhibit. The gallery then prepares a series of possible exhibition layouts with various combinations of works in the space available. In another meeting using the software, the layout options are presented and the gallery asks for opinions and suggestions which the other collaborators provide in a mixture of textual comments, by drawing on the diagrams and by drawing new ideas for layouts. The art gallery saves each picture to preserve the ideas, and these are returned to and modified between collaborative sessions.

In time the institutions finalise a list of works to be displayed, and prepare explanatory text for each artwork, connecting it with one or more of the exhibition's primary themes. This is especially useful as it allows the gallery to gain valuable information directly from the artist, as well as from experts at the other institutions. The gallery also discovers issues around the display of individual items (e.g. lighting, ideal hanging heights, etc), thus saving time and effort when planning the technical details of the exhibition. Comments and pictures from all three collaborators are used to produce a final exhibition design and publicity material. In a late meeting, the relevant notices and flyers are checked and cleared by all concerned. After borrowing the necessary works and preparing the space, the gallery begins to set up the exhibition.

As a side effect of this collaboration, the first museum decides to plan an exhibition of the contemporary artist's work for a couple of years later, and persuades the local authority to commission an installation piece from her. Additionally, as a result of creating such a successful working relationship, the different collaborative parties (in particular the galleries) manage to strengthen their working relationships: maintaining contact by email, swapping ideas, asking for advice, and commenting on each other's exhibitions.[321]

320 http://www.microsoft.com/windows/netmeeting/default.asp; http://www.webex.com/services_online-meetings.html; http://205.247.223.102/products/index.asp. Interestingly, *Centra 7* is also available on an ASP basis (see above).

321 For a much more advanced collaborative environment employing CAVEs, see **CAVERN - The CAVE Research Network** at http://www.evl.uic.edu/cavern/vrserver.html. CAVERN is an alliance of industrial and research institutions equipped with CAVEs, ImmersaDesks, and high-performance computing resources all interconnected by high-speed networks to support collaboration in design, training, scientific visualization, and computational steering, in virtual reality.

Advantages and Disadvantages

Introduction

Virtual communities can change the ways in which knowledge is organised, perceived, and used. Cultural and scientific heritage institutions can benefit from the presentation of their collections in innovative ways, and by engaging individuals online in discussions about the heritage virtual communities make resources, expertise, and social interaction accessible to people distributed across the globe. The **24 Hour Museum**[322] offers a good example of the benefits of simple community building for the memory sector.

In order to present their material for use among VCs, cultural and scientific heritage organisations can benefit from adopting consistent and shared data encoding standards. The development of VCs will boost standardisation, moving from in-house standards to standards which may be applied globally. A current risk which must be taken into account when creating such resources is the multiplicity of approaches for electronic data representation that are followed. The work of multiple partner institutions on the same collaborative environment must also be planned in advance and monitored closely.

An immediate benefit to be gained from the use of these technologies is that access to geographically scattered content is greatly improved. Then again, there are many such compendia on the Web which are available, and yet rarely consulted. The registration of resources with search engines and mutual linking with similar organisations are strongly recommended in order to overcome this difficulty.

Many VCs 'contain' knowledge which falls outside the formal hierarchies and documentation processes of the subject area. A positive feeling accompanies the freedom of expression and presentation of personal knowledge and thoughts that such communities make possible, but this can also lead to an increase in the circulation of incorrect and misleading information. The availability of newly emerging compendia of information can ease the learning curve. Of course, this depends on the quality of supplied content, and if care is not taken to offer good quality content, the results are more likely to be negative.

The more people who are attracted to the idea of contributing to informal communities, the better the utilisation of the intellectual capital, although it is not always obvious that the people who know most are the same people that are most willing to share. The availability of resources which are created in an immense amount with unknown quality in fact puts far *greater* demands on the analytic abilities of community members and those who consult its resources.

The freedom of developing communities means less control on public messages. This is generally seen as a positive thing, but it also means that no one can control malicious communities which harm an organisation's image or reputation, or which convey incorrect or heavily slanted content intentionally.

Communities have a clear influence on the emotions. On one hand, they provoke an increase in communication which is considered to be a positive tendency in a world that is increasingly alienated, while on the other hand the quality of this communication is

322 http://www.24hourmuseum.co.uk

difficult to measure. For the person involved in it, it may be completely satisfactory, while at the same time distracting him/her from the real world and withering the skills needed to build real relationships. In extreme cases this can lead to a form of addiction to life in the virtual world. In organisational terms, staff may be distracted from their work by ceaseless interaction with the Internet. This can be interpreted as a positive influence when in search of professional advice, but adversely it may distract and detach users from their routine work. However, VCs are by no means unique in this: distractions can always be found in the workplace if employees are prepared to look hard enough.

Advantages

User satisfaction – Collaborative technologies facilitate the assembly and presentation of virtual collections in an innovative and appealing way. Access is increased, and users may have an increased sense of participating in a 'shared experience', which can be valuable both in terms of learning and entertainment. Learning curves may also be reduced by such shared experiences.

Openness, understanding and informality – The 'open-access' approach to cultural discourse should help to remove the perception of memory institutions as 'ivory towers' for experts and the elite. Increased discussion and easier communication between different groups can only lead to an increased understanding between decision-makers and the general public in whose interest they are entrusted the custody of their artefacts.

Standardisation – Work on standards can only be helped by collaboration between representatives of all groups involved in a particular area. The utilisation of shared intellectual capital is thus made increasingly efficient. EMII's *Distributed Content Framework* is a good example of such a collaboration.

Disadvantages

Management – The collaboration of several organisations in providing joint resources might be difficult to manage. The traditional 'personal touch' may also be lost if all communication is handled online, and through a purely textual medium.

Standardisation – Problems may arise if collaborating organisations are working to different standards for their electronic resources. Blanket interoperability, although the goal, is still some distance from fruition.

Potential lack of rigor – In the past, the only people with a means of expressing a widely-heard opinion on cultural matters were the educated (and, it was assumed, trustworthy) experts. Allowing everyone to have a say may lead to a glut of misleading and incorrect information, and this in turn demands a greater deal of analytic work from community members.

Distraction – Online chat has the potential for becoming addictive, thus distracting staff from their work, and indeed their rest. Of course, this is no different from other potentially habit-forming technologies in the workplace, such as the telephone, Internet, coffee machine, games, and so on.

Introducing the Technology

Policy and Organisational Framework

Virtual communities follow lifecycles not unlike those seen in real world communities – they are born, grow, wither, and die. Sometimes they break up to form newer communities and at other times create offspring communities. The technology for VCs is fairly simple to implement and maintain. The richness of the interactive environment they can be used to offer has improved dramatically since the advent of the Web in the early 1990s. While heritage institutions can engage in planning to design communities, successful planned communities (as urban planners in the real world have found to their cost) are not that easy to create. Extensive analysis, planning and guidance through the process of defining community goals and best ways to achieve them combined with a strategy for seeding the community's start-up can help. Key to the growth of the community will be a strong alignment of personal and organisational goals and the encouragement of a high level of commitment from participants.

Organisations considering developing a virtual community might consider:

1. What is the primary goal of the venture?
   - Is it to create a community of shared interest and experience?
   - Is it to build on a real world community?
   - Is it to provide participants with access to knowledge which is otherwise not available?
   - Is it to attract more attention to a collection or set of collections?
   - Is it to support educational initiatives?
   - Is it to offer unique visiting experiences?
   - Is it to extend the circle of friends or patrons of the institution?
   - Is it to find ways of increasing the competence of the staff in their work?
2. What will attract individuals to join and actively participate in the virtual community?
3. Will the primary aim be realised in isolation, in collaboration with other institutions from the same sector, or with institutions from another sector?
4. Will the primary focus of the community be the exchange of information resources about the cultural heritage or heritage institutions and their activities? If so will this best be done with P2P technologies, the Web, or dynamic databases?
5. How will participants' contributions to the community be monitored and validated?
6. What kind of resources should the community use: peer-to-peer or server-based?
7. What expertise is available and what would need to be introduced?
8. Will the community be controlled in some way, e.g. by a moderator, owner or managing group?

9. How can communication between participants be increased/improved?
10. How can the system and resources be safeguarded against malicious use?
11. Should the community be built around synchronous or asynchronous technologies, or a combination of the two?

What Existing Technological Infrastructures are Needed?

How your organisation answers this question will depend upon the type of community that you aim to create. The technological infrastructures will depend very much on the sort of community that is to be created. In many cases, such as using networks for information exchange, weblogs or e-mail, a PC with an Internet connection will meet a wide range of needs. In the cases when the organisation considers development of resources, the placement on a server or using peer-to-peer technology has to be discussed, together with all the concomitant cost battles and staff issues to set up, maintain and develop the system.

Staffing Levels and User-base Issues

Some of the questions related to the building of communities concern the staff, their availability, and how much and what they will be willing or able to contribute. Basic concerns in this direction are:

1. Will the virtual community offer the possibility for real research? Many of the artefacts stored in a virtual museum may be generated by people who do research on the matter within their own community and the global community, thus potentially transforming the museum into a distributed learning workshop. What would be the proportion of staff and external community members who will take part in this process?
2. How will the virtual community improve the skills of the organisation's staff, or those of external participants?
3. How will the quality of teaching and learning be improved?
4. What intellectual and artistic collaborations will be necessary in order to build something really innovative?
5. What levels of institutional involvement does your organisation intend to commit? Will the investment comprise only content and occasional time, or does your organisation intend to be a more active participant in the collaborative activity and virtual community?

Annexes

Selected Glossary

Abbreviations

References

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Selected Glossary

Term	*Meaning*	*Used in chapter(s)*
Avatar	The representation of a human user or computer-generated actor in a virtual world.	Agents and Avatars, Mobile Access, Collaboration
Application Service Provider (ASP)	An organisation or third party providing software applications and services over the Internet.	ASP, Agents and Avatars, Collaboration
Bandwidth	The maximum rate at which data can be transmitted over a given channel (measured in bits per second).	ASP, Agents and Avatars, Mobile Access
Blog	See 'Weblog'.	Collaboration
Digitisation	The process of converting analogue representations into digital representations.	Agents and Avatars, Rights Management
Haptics	Physical devices employing force-feedback to give users the impression of actually touching/manipulating a virtual object.	Agents and Avatars
Infrared	Any device using wavelengths longer than visible light but shorter than radio waves.	Mobile Access
Intellectual Property Rights (IPR)	Rights governing patents, trademarks, copyrights, and designs.	Rights Management
Interoperability	The ability to exchange and use information across different applications, systems, or networks.	ASP, XML, Rights Management, Collaboration
Iterative	Repetitive, in a loop structure.	Mobile Access, Rights Management, Collaboration
Library Management System (LMS)	A system for automating and administering a library's technical and public services functions.	ASP
Markup	A means for making an interpretation of a text explicit.	ASP, XML
Metadata	'Data about data', often crucial background information to make primary data usable.	ASP, XML, Rights Management, Agents and Avatars, Mobile Access, Collaboration
Micropayment	Very small charges processed by e-commerce systems.	Rights Management

Term	*Meaning*	*Used in chapter(s)*
Mixed reality	A type of virtual reality that combines real and virtual images. Also known as 'augmented reality'.	Mobile Access
Netizen	An active participant in the Internet community.	Collaboration
Operating System (OS)	Software that sequences and controls the execution and operation of computer programs and peripherals.	Mobile Access, Collaboration
Piconet	A collection of Bluetooth-compatible devices arranged as a Personal Area Network.	Mobile Access
Pixelisation	The effect seen when a digital image is enlarged too much and its individual pixels become visible.	Rights Management
Peer-to-peer (P2P)	1) Decentralised computer network architecture, distributed across many machines with the role of peers, rather than clients centralised around a server; 2) A network software application supporting the exchange of resources in a peer-to-peer network.	Rights Management, Collaboration
Remote Procedure Call (RPC)	A means whereby a computer program running on one host can cause code to be executed on a remote host.	XML
Schema	An organisation or representation of concepts and components.	XML
Semantic	Relating to the meaning of data.	XML, ASP, Collaboration
Service Level Agreement (SLA)	A contract between an ASP and its customers which lays out the terms of agreement between the parties, how performance will be measured, and the processes by which lapses of service will be redressed.	Rights Management
Service Level Management (SLM)	Methodology for establishing, monitoring and improving different service levels.	Rights Management
Small-to-Medium Enterprise (SME)	A company which: a) employs fewer than 250 people; b) has a turnover of less than €40M per annum or net balance sheet assets of less than €27M; or c) must be less than 25% owned by a larger company/companies which do not qualify as an SME themselves.[323]	Rights Management

323 EC definition, http://www.europa.eu.int/comm/enterprise/enterprise_policy/sme_definition/index_en.htm

Term	*Meaning*	*Used in chapter(s)*
Smart labels	Thin, discret labels attached to items in order to track their whereabouts using Radio Frequency Identification (RFID) technology. Also known as 'smart tags' (see DigiCULT Watch Report 1, pp. 63-93.)	Mobile Access
Stylesheet	A file that specifies the presentation or appearance of a document (including Web pages).	XML, Agents and Avatars
Stylus	A pen-like device used to input data and make selections on the touchscreen of a PDA.	Mobile Access
Transcoding	The conversion from one digital encoding scheme (or format) to another.	Agents and Avatars
Tuple	A data object containing two or more components.	Mobile Access
Universal Resource Identifier (URI)	A unique ID (usually in the form of a Web address) used to differentiate between resources.	XML, Collaboration
Watermarking	Adding a distinguishing mark to a digital object during or after digitisation, often indicating proof of origin/ownership.	Rights Management
Weblog	A frequently-updated, collaborative Web site consisting of posts from registered users. Often used as online 'diaries', Weblogs are commonly and informally known as 'blogs'.	Collaboration
Wiki	A small, collaborative Web database wherein any user can edit any page.	Collaboration

Abbreviations

Abbreviation	*Stands For*	*Used in chapter(s)*
AC	Alternating Current (for electrical appliances)	Mobile Access
AMO	Application Maintenance Outsourcing	ASP
AMPS	Advanced Mobile Phone System	Mobile Access
API	Application Programmer Interface	XML, Collaboration
ASCII	American Standard Code for Information Interchange	XML, Collaboration
ASP	Application Service Provider	ASP, Rights Management, Collaboration
ASP(+)	Active Server Pages (Plus)	XML
BBS	Bulletin Board System	Collaboration
BRML	Business Rules Markup Language	Rights Management
CAVE	Cave Automatic Virtual Environment	Agents and Avatars
CB	Citizens Band (radio)	Collaboration
CD	Compact Disc	ASP, Rights Management, Mobile Access
CDMA	Code Division Multiple Access	Mobile Access
CGI	Computer Generated Imaging	Agents and Avatars
CoP	Community of Practice	Collaboration
CRM	Customer Relationship Management	ASP
CSS	Cascading Style Sheets	XML, Agents
DAM	Digital Asset Management	Rights Management
DBMS	Database Management System	XML
DOI	Digital Object Identifier	Rights Management
DOM	Document Object Model	XML
DRM	Digital Rights Management	DRM
DTD	Document Type Definition	XML
DV	Digital Video	ASP
DVD	Digital Versatile Disc	Agents, Rights Management, Mobile Access
EAD	Encoded Archival Description	XML
EDI	Electronic Data Interchange	XML, Rights Management
EEIG	European Economic Interest Grouping	Rights Management
EPG	Electronic Programming Guide	Agents and Avatars
ERP	Enterprise Resource Planning	ASP
FAQ	Frequently Asked Questions	XML
FDMA	Frequency Division Multiple Access	Mobile Access
GPRS	General Packet Radio Service	Mobile Access
GPS	Global Positioning System	Mobile Access
GSM	Global System for Mobile communications	Mobile Access
HCI	Human-Computer Interaction	Mobile Access

Abbreviation	*Stands for*	*Used in chapter(s)*
HLT	Human Language Technologies	ASP
HMS	Home Media Server	Agents and Avatars
HTML	Hypertext Markup Language	XML, Agents, Rights Management, Collaboration
HTTP	Hypertext Transfer Protocol	ASP, XML, Collaboration
ICT	Information and Communication Technologies	Rights Management, Collaboration
IEEE	Institute of Electrical and Electronics Engineers[324]	Mobile Access
IPR	Intellectual Property Rights	Rights Management
IRC	Internet Relay Chat	Agents, Mobile Access, Collaboration
ISO	International Organization for Standardization	ASP
IT	Information Technology	ASP, XML, Agents, Rights Management, Collaboration
JDBC	Java Database Connectivity	XML, Rights Management
JDOM	Java Document Object Model	XML
JSP(+)	JavaServer Pages (Plus)	XML, Collaboration
LAN	Local Area Network	ASP, Mobile Access
LCD	Liquid Crystal Display	Mobile Access
LMS	Library Management System	ASP
MARC	MAchine Readable Cataloguing	ASP, XML
MOO	MUD Object Orientated. See also 'MUD'	Collaboration
MSP	Management Service Provider	ASP
MTSO	Mobile Telephone Switching Office	Mobile Access
MUD	Multi User Domain	Collaboration
MPEG	Moving Pictures Experts Group	Mobile Access
ODRL	Open Digital Rights Language	Rights Management
OPAC	Online Public Access Catalogues	Collaboration
OS	Operating System	Mobile Access, Collaboration
P2P	Peer-to-Peer	Rights Management, Collaboration
PAN	Personal Area Network	Mobile Access
PC	Personal Computer	ASP, XML, Agents, Mobile Access, Collaboration
PDA	Personal Digital Assistant	XML, Mobile Access, Collaboration

324 http://www.ieee.org

Abbreviation	*Stands for*	*Used in chapter(s)*
PDF	Portable Document Format	ASP, XML, Rights Management
PHP	PHP (Personal Home Page) Hypertext Preprocessor	XML, Rights Management
PIM	Personal Information Management	Mobile Access
RPC	Remote Procedure Call	XML
RDF	Resource Description Framework	XML
REL	Rights Expression Language	Rights Management
RFID	Radio Frequency Identification	Mobile Access
RTD	Research & Technological Development	Collaboration
RTF	Rich Text Format	XML
SAX	Simple API for XML	XML
SCM	Supply Chain Management	ASP
SGML	Standard Generalised Markup Language	XML
SLA	Service Level Agreement	ASP
SME	Small-to-Medium Enterprise	Rights Management
SMIL	Synchronized Multimedia Integration Language	XML
SOAP	Simple Object Access Protocol	XML, Collaboration
SPD	Self Protecting Document	Rights Management
SQL	Structured Query Language	XML
SSP	Storage Service Provider	ASP
TCO	Total Cost of Ownership	ASP
TDMA	Time Division Multiple Access	Mobile Access
TEI	Text Encoding Initiative	XML
TTS	Text-to-Speech	Agents and Avatars
UDDI	Universal Description, Discovery and Integration	XML, Collaboration
URI	Universal Resource Identifier	XML, Collaboration
URL	Uniform Resource Locator (also Universal Resource Locator)	XML
VAT	Value Added Tax	Agents and Avatars
VC	Virtual Community	Collaboration
VE	Virtual Environment	Mobile Access
VHS	Video Home System	ASP
VoD	Video on Demand	Agents and Avatars
VPN	Virtual Private Network	Rights Management
VRML	Virtual Reality Modelling Language	Collaboration, Avatars
VTG	Virtual Tour Guide	Agents and Avatars
XBRL	Extensible Business Reporting Language	Rights Management
XHTML	Extensible Hypertext Markup Language	XML
XML	Extensible Markup Language	ASP, XML, Agents, Rights Management, Collaboration,
XQL	XML Query Language	XML

Abbreviation	*Stands for*	*Used in chapter(s)*
XrML	Extensible Rights Management Language	XML, Rights Management
XSL	Extensible Stylesheet Language	XML, Agents
XSLT	XSL Transformations	XML
xSP	A common abbreviation for different types of service providers	ASP
WAP	Wireless Application Protocol	XML, Mobile Access
WLAN	Wireless Local Area Network	Mobile Access
WML	Wireless Markup Language	XML
WPAN	Wireless Personal Area Network	Mobile Access
WWW	World Wide Web	XML

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ASP News – News and Analysis for Application and Web Services: http://www.aspnews.com

ASP Street (including ASP directory with 10,500 companies): http://www.aspstreet.com

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ASP Vendors

While there are thousands of companies offering some kind of ASP service, it is essential to match an organisation's needs to the niche market for which the ASP caters. These are some popular ASP's in the cultural heritage sector:

3M Library Systems: http://www.3m.com/library/
Auto-Graphics, Inc. (AUGR): http://www4.auto-graphics.com
Cyber Tools for Libraries: http://www.cybertoolsforlibraries.com
Eos International: http://www.eosintl.com
IONA - Vendors of the Orbix E2A Application Server Platform: http://www.iona.com
LibraryCom - A division of CASPR Library Systems: http://www.librarycom.com
NPower: http://www.npower.org
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XML.org: http://www.xml.org
XML Sucks, Big List of XML Technologies: http://xmlsucks.org/xml_technologies/

Vendors, products & specifications

ALTOVA *xmlspy 5*: http://www.xmlspy.com/products_ide.html
CIMI: http://www.cimi.org
COREL *XMetaL 4:* http://www.corel.com/servlet/Satellite?pagename=Corel/Products/productInfo&id=1042152754863
ebXML: http://www.ebxml.org
FIVESIGHT *XPath Tester*: http://www.fivesight.com/downloads/xpathtester.asp
TIBCO *TurboXML:* http://www.tibco.com/solutions/products/extensibility/turbo_xml.jsp
The Semantic Web Challenge: http://challenge.semanticweb.org
W3C XML: http://www.w3.org/XML/
WML: http://xml.coverpages.org/wap-wml.html
XBRL: http://www.xbrl.org
XMI: http://www.omg.org/technology/documents/formal/xmi.htm
XML-EDI: www.xmledi.com
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Vendors, products & specifications

Company	*URL*	*Activities and products*
Artificial Life	http://www.artificial-life.com	Develops intelligent agents and conversational smart bots
Avatar-Me	http://www.avatar-me.com	Development of photo-realistic avatars (more than 270,000)
DA Group	http://www.digital-animations.com	e-learning Mentors, Government Information Agents, Avatar Marketeers, Mobile Messengers, Customer Service Agents, Professional Services
Digimask	http://www.digimask.com	Talking Head software: LaunchPad creates digimask head from a couple of real person photographs
DigitalSpace Commons	http://www.digitalspace.com	Tools for communication, collaboration an visualisation
Geo-metricks	http://www.geo-metricks.com	Avatars, 3D worlds
Haptek	http://www.haptek.com	VirtualFriend® – photore-alistic emoting characters

Company	*URL*	*Activities and products*
Integrated Data Systems	http://www.ids-net.com	Sells a powerful VRML authoring system called V·Realm Builder 2.0.
Kiwilogic AG	http://www.kiwilogic.de	Offers software (Lingubot Creator) for development of conversational virtual agents
LifeFX	http://www.lifefx.com	Face Xpress Software and Stand-In Bundle authoring tools for development of photo-realistic avatars (stand-ins)
Microsoft	http://msdn.microsoft.com/ workshop/imedia/agent	Develops agents and bots (such as "Cleepit") to help Office users
MIT's Media Lab	http://gn.www.media.mit.edu	Offers BEAT(Behavior Expression Animation Toolkit), develops virtual real estate agents such as REA
NativeMinds, Inc. (now acquired by Verity)	http://www.nativeminds.com	Provider of integrated self-service solutions called virtual representatives or Vreps
Novomind	http://www.novomind.com	Develops chatbots and virtual sales assistants
Oddcast	http://www.oddcast.com	Offers Vhost – a Flash based platform to develop an online community
Pulse	http://pulse3d.com	Offers Veepers – software for development of photo-realistic avatars
Safe Work (Human Modeling Technology)	http://www.safeworkcom	Digital human modeling technology
Seestorm	http://www.seestorm.com	Offers software development kits for creation of photo-realistic avatars and a messenger involving talking head.
Sensory Inc.	http://www.sensoryinc.com	Speech technology tools, develops retail kiosks as service agents
Superscape	http://www.superscape.com	Develops interactive 3D applications for both Java and Native environments (Swerve Author and Swerve Client)

Company	*URL*	*Activities and products*
Sven Technologies Inc.	http://www.sven-tech.com	Offers Avatar Maker - an inexpensive program for creation of three-dimensional avatars.
TeleVirtual	http://www.televirtual.com	Virtual actors, including talking heads
Vapour Technology	http://www.vapourtech.com	Offers a stand-alone Win32 application to view, pose, animate, edit and export AvatarMe avatars
VICOMTech	http://www.vicomtech.es	ABATEUS, Basque speaking avatar
Virtual Clones	http://www.virtualclones.com	Lifelike avatars for multi-sector deployment
Virtual Personalities, Inc. (Conversive, Inc)	http://www.verbots.com http://www.conversive.com	Develops the Conversive Application Platform™: InstantAgent™, EmailAgent™, AnywhereAgent™ (agent creation tools)

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mGain - Mobile Entertainment Industry and Culture: http://www.mgain.org
The Mobile Computing and Communications Review: http://www.sigmobile.org/pubs/mc2r/
Mobile Info: http://www.mobileinfo.com/Default.asp
Mobile Village: http://www.mobilevillage.com
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Vendors, products & specifications

Bluetooth: http://www.bluetooth.com
Elo TouchSystems: http://www.elotouch.com
Emblaze wireless player: http://www.emblaze.com/serve/products/emblaze_player.asp
Impulsesoft iBTStack: http://www.impulsesoft.com
Openbrain: http://www.openbrain.co.kr
Widget: http://www.widget.com
WML: http://xml.coverpages.org/wap-wml.html

PDAs

PDA Model	*Provider*	*Operating system*	*Installed memory*	*Extras*	*Price (USD)*
Axim X5 (300 MHz) Personal Organiser	Dell	PocketPC	32 MB	Backlight Display	199
Clie PEG-NX80V Personal Organiser	Sony	Palm OS	64 MB	MP3 Player, Backlight Display	500-647
Clie PEG-SJ33 Personal Organiser	Sony	Palm OS	16 MB	MP3 Player, Backlight Display	169-275
iPAQ Pocket PC H1910 Personal Organiser	Hewlett Packard	PocketPC	48 MB	MP3 Player, Wireless modem	192-391
iPAQ Pocket PC H2215 Personal Organiser	Hewlett Packard	PocketPC	64 MB	Built-in wireless modem	355-400
m130 Personal Organiser	Palm	Palm OS	8 MB	Optional modem, Backlight Display	105-249
Treo 90 Personal Organiser	Handspring	Palm OS	16 MB	Optional modem	140-300
Tungsten C Personal Organiser	Palm	Palm OS	64 MB	Wireless modem	405-537
Tungsten T2 Personal Organiser	Palm	Palm OS	32 MB	Backlight Display	326-400
Zire 71 Personal Organiser	Palm	Palm OS	16 MB	MP3 Player, Wireless modem	247-300

Mobile Phones

Nokia: http://www.nokia.com
Bluetooth: http://www.bluetooth.com/tech/products.asp
Alcatel: http://www.alcatel.com
Azzurri Technology Ltd: http://www.azzurri.com
Broadcom: http://www.broadcom.com
CSR: http://www.csr.com
CTS: http://www.ctscorp.com
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LTX: http://www.ltx.com
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GPS

An extensive list with GPS Receiver Manufacturers, System Integrators, Equipment Suppliers, and Service Providers can be found at: http://gauss.gge.unb.ca/manufact.htm

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AIIM International - The Enterprise Content Management Association: http://www.aiim.org

Authorize.Net: http://www.authorizenet.com

BRML: http://xml.coverpages.org/brml.html

ContentGuard: http://www.contentguard.com

The Digital Object Identifier System: http://www.doi.org

ebXML: http://www.ebxml.org

eWAY: http://www.eway.com.au

iRights: http://www.ness-europe.com/Europe/Products/iRights/iRights_en.htm

Liberty Alliance: http://www.projectliberty.org

Microsoft Windows Media DRM: http://www.microsoft.com/windows/windowsmedia/drm.aspx

Open Digital Rights Language (ODRL): http://odrl.net

Peppercoin: http://www.peppercoin.com

Rodopi Payment Gateway: http://www.r-p-g.com

Verisign: http://www.verisign.com

XBRL: http://www.xbrl.org

XML-EDI: www.xmledi.com

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Centra Collaboration Solutions: http://www.centra.com
Microsoft NetMeeting: http://www.microsoft.com/windows/netmeeting/
Virtual Facilities Conference Center: http://www.communitytechnology.org/conference.html
Virtual Mail System collaboration tool: http://www.evl.uic.edu/timai/vMail/vmail.html
WebEx Meeting Center: http://www.webex.com

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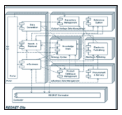

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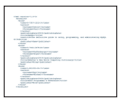

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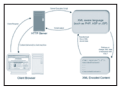

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