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What Must be Done to realise the Scenarios?

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1. Introduction

A revolution is underway. Major galleries and museums around the world are scanning in digital images of their collections and producing new products, some for sale (e.g. CD-ROMs, videos), some for the public good (e.g. Web sites). This digital process introduces enormous new possibilities. For typical tourists, digital collections permit post-cards and even sculptures on demand. Persons in remote places will be able to make preliminary virtual visits and will thus better appreciate the actual works when they eventually visit the museum. Visitors and everyone with access to the World Wide Web will, for the first time, be able to view those parts of collections which are in storage, which typically account for somewhere between 50% to 98% of the whole. In the physical world, paintings by a given artist are scattered in different museums. For instance, there are paintings by Botticelli in Florence (the Uffizi), Berlin (Dahlem), London (National Gallery) and elsewhere. In the past, attempts at publishing the complete works of such artists in the form of a catalogue raisonnée were frequently limited to producing only a few images in colour, with the rest appearing in black and white or even in thumbnail versions. In digital form, the complete works can be in full colour and potentially even in very high resolution. Instead of being limited to a random set chosen by a curator, users can buy posters of any particular painting which they find interesting.

With the advent of digital collections users will also be able to trace the evolution of topics such as the Life of Christ through various versions and discover connections between fresco cycles in churches and paintings now scattered in various museums. They will be able to do the same with mythological subjects, such as Venus, themes such as love, war, dance and play. They can study the evolution of a style and cultural trends, how different countries emphasise various sets of topics, or even completely different art forms: how, for instance, some focus on the performance arts (theatre, literature), while others focus on the visual arts. When students in schools can use these materials in their study of art, history and civilisation, there will be new insights into the richness of our cultural heritage and new appreciation of the complexity of cultural diversity. The result will be a whole, which is greater than the sum of its parts. Culturally, it will lead to new awareness of patterns in cultural development. Creatively, it will provide artists with new sources of inspiration as they gain new access to their cumulative heritage. Financially, it will lead to new products ranging from digital postcards to new sources for digital television, video and film.

These wonderful possibilities require certain conditions and are threatened by dangers. Museums must adopt common standards to scan their images, and to store them. Otherwise there will be no interoperability among the images in different collections and the potential of synthesis will be lost. This need for common standards is the more urgent because large museums such as the national galleries typically have more resources than small provincial and local town museums. There are also dangers. Precisely because digital museums and libraries pose a series of new market opportunities, some companies and even individuals have devised plans to dominate this domain as if the so called 'cultural industries' were merely another area which could be acquired through a series of clever take-overs and mergers. How can one prevent such rash hubris, and yet engage the major players to co-operate reasonably which will result in both financial and cultural gains for all the partners? This was one of the challenges which originally inspired the MoU.

This paper reviews some of the initiatives in the cultural domain which are already underway around the world. It proposes a new approach with centralised meta-data and distributed content. It lists the needs and challenges facing the MoU and outlines some steps to be taken in order to achieve the vision. At stake is something much more than a business opportunity. Access to our cultural heritage represents the collective memory of our civilisation. If we take shortcuts, or worse still, let others try to profit from short term, superficial solutions, we shall in the long term suffer from a cultural amnesia which no amount of money can buy back. The great number of cultural institutions and other stakeholders who have signed the MoU attest that there is serious interest in and hope for a successful outcome.

International Developments

There is world-wide activity in the realm of digital museums and libraries. In the United States, the AMICO project of the American Museum Network (AMN) offers one model for integrating information on museum events and shops. The (former)

Getty Art History Information Program, working with Archives and Museum Informatics, published a stimulating Research Agenda for Networked Cultural Heritage (1996). The new Getty Information Institute has pursued this and other initiatives such as the Art and Architectural Thesaurus (AAT) and compilations such as the Union List of Artist Names (ULAN), and their Thesaurus of Geographic Names, which are based on a compilation of eight of their databases. Co-operation with the Museum Computer Network (MCN) has led to a significant group, Computer Interchange of Museum Information (CIMI), which is actively engaged in extending the Z39.50 protocols from the library world to the realm of museums and galleries. The same protocol has been chosen for the Gateway to European National Libraries (GABRIEL). Meanwhile, the Library of Congress and the Research Library Group (RLG), through their Research Libraries Information Network (RLIN) have been expanding the scope of the Machine Readable Card (MARC) format to include archival, visual and museum materials. This network also includes over twenty of Europe's major research libraries and the MARC format is used internationally in Singapore, Australia and New Zealand. The United States has thus made a fundamental contribution by pointing to an integration of standards between the library and the museum worlds.

The American approach is focused on the short term and very pragmatic. For instance, the National Gallery in Washington is scanning in its 105,000 works of art at approximately 30 MB per image. This is in marked contrast to museums such as the Uffizi which are scanning in their images at 1.4 GB per square meter. The American approach is open to criticisms of being less thorough, more superficial and occasionally naive. For all this, it is inspired by a vision that the technology should be available universally to everyone at any time. This ideal of universal access, including those who are sensorially impaired (the blind and deaf), provides perhaps the most important lesson which America has to offer.

It is important to recall that significant models for integration of museum information also lie elsewhere. The first systematic museum network was the Canadian Heritage Information Network (CHIN), founded in 1972. The automation efforts of the Canadian Conservation Institute (CCI) helped inspire the Getty's Conservation Institute and its databases. A Canadian software company, Alis Technologies, has produced the best software (Tango Browser) for displaying texts in over ninety different languages. In Germany, the Marburg Archive became the second network of museum materials on a national scale. In Leipzig, the standard biographical dictionary for artists, the Allgemeine Künstler Lexikon of Thieme Becker, is now available in electronic form. In the Netherlands, the ICONCLASS classification for art (Leiden, now Utrecht) by Van der Waal is available in electronic form. At the international level, the International Committee on Museums (ICOM) has made pioneering efforts in co-ordinating awareness concerning various museum web sites around the world.

Meanwhile, all over the world there are important pilot projects in the realm of culture. Some of these have been identified by G7 Pilot Project 5: Multimedia Access to World Cultural Heritage. Others have been supported by the European

Commission. Some are being linked with UNESCO's Observatory of Cultural Communication Audiovisual Media for the Mediterranean area (OCCAM). South Africa is creating a network of African art. In France (University of Bordeaux), North African Roman sites are being reconstructed in virtual reality. In Egypt and Tunisia there are indigenous projects. In Australia, there is an emerging national network. In Singapore, mediaeval Chinese cityscapes are being reconstructed on computer. The challenge lies in creating a common framework for access to all these projects.

A New Model

At least since the Library at Alexandria there has been a dream that the best framework for access to materials was to collect them in a centralised library. In the nineteenth century this dream inspired Panizzi to combine the idea of a national library and national museum in the form of the British Museum, which soon became a model for the world. For all their value, the limits to growth of such centralised collections has become increasingly evident in the course of the past decades. The new building of the British Library will be too small before it is fully operational and even the mega-project of the Bibliothèque de la France will not house all its collections in a single complex.

The Internet offers a model at the opposite end of the spectrum with a fully distributed model for housing collections. This model is extremely attractive because it means that museums, galleries and other cultural institutions can remain in control of the databases and information pertaining to their own collections. The disadvantage is that there are already hundreds and there will soon be tens of thousands of individual repositories. If every user around the world has to visit all of these sites for any search they do, this approach will become hopelessly inefficient. If, for instance, a person is searching for Chinese art of the Han Dynasty, then it makes sense to go only to institutions and databases which contain Chinese art. It makes no sense to waste time going to sites with Aboriginal, Mayan, European, American, African or other kinds of art.

An alternative to these two extreme models foresees a centralised database of meta-data, which acts as a service centre to negotiate among distributed content sources. This centralised database has three basic functions. First, it serves as a master list of all names (*who?*), subjects (*what?*), places (*where?*), calendars, events (*when?*), processes (*how?*) and explanations (*why?*). This master list contains all typical variants and versions of a name, such that a person searching for Vinci, Da Vinci or Leonardo da Vinci, would be directed to the same individual. Second, this master list contains a high level conceptual map of the perimeters of all major databases in cultural and other institutions. Hence in the case mentioned above of the user searching for Chinese art of the Han dynasty, the master list will identify which databases are relevant. Third, this master list of names and subjects is linked to indexes of terms (classification systems), definitions (dictionaries), explanations (encyclopaedias), titles (bibliographies),

and partial contents (reviews, abstracts and citation indexes). Thus this centralised database effectively serves as a digital meta-reference room which links to distributed contents in libraries, museums, galleries and other institutions.

Needs and Challenges

While it is fashionable to assume that a fully unregulated market environment provides an optimal context for some business aspects of the Internet, to achieve this new model for cultural heritage will require cooperation among all the stakeholders: government, museums and industry. Telcos and computer companies are likely to provide a general infrastructure. Small and medium enterprises can then focus on applications within this infrastructure, while government should continue to ensure that everything is not reduced to minimalist market principles of what is cheapest to produce and what sells most. Standards must be established and quality maintained. Indeed government should help assure that at least nine ingredients are included, as follows:

I. Open Distributed Processing Environment

An open distributed processing environment is needed if the digital contents in museums, galleries, libraries and other cultural institutions are to be shared effectively. The major telecommunications, telephone, cable and computer companies should be constrained to produce interoperability within a basic infrastructure. Indeed the Telecommunications Information Networking Architecture (TINA) is aiming at such a synthesis. TINA includes at least five viewpoints:

1. Enterprise (capturing requirements)
2. Information (e.g. OMT)
3. Computational (interaction model for services)
4. Engineering
5. Technology.

Some feel that the TINA framework may be too cumbersome and that interim (or perhaps even long-term) alternatives can be offered through CORBA or DCOM architectures. TINA has the advantage that it has taken into account the various relationships (retailer, retailer to retailer, third party, broker, terminal connection etc.) which will be required in business models.

II. Demo Rooms and Prototype Service Centres

The TINA consortium foresees a Validation of Integrated Telecommunications Architecture for the Long Term (VITAL). This is crucial for a number of reasons. At a simple level it has to do with basic hardware. The emerging technologies entail a spectrum of solutions, each linked with different companies. For instance, in the case of image compression and image management, a popular solution is provided by Apple. A more advanced system is provided by Hewlett Packard (FlashPix) and a high end solution is offered by Silicon Graphics (e.g. the infinite resolution method developed by Infobyte

in Rome). The public needs examples of these alternatives and demonstrations of the extent to which these are interoperable on different platforms. Because all the major computer firms stand to gain if more of their machines are sold, it is fully in their interests to support this project in terms of hardware and software.

In terms of field trials, it is fine and well for an Italian, German and Canadian consortium to do their own trials for set top boxes linking computers and television sets. But at some point it is critically important to know if these systems can inter-operate. Else the materials produced in one country will not be transportable to other countries.

At the international level the same goals are shared by the G8 pilot projects. For example, pilot project 2 foresees interoperability. Pilot project 3 deals with education, pilot project 4 with libraries and pilot project 5 with Multimedia Access to World Cultural Heritage. Under discussion is the establishment of a series of open demo rooms in each of the eight countries: e.g. Rome, Paris, Berlin, London, Toronto, Washington, Tokyo, Washington and Moscow are linked by a high speed ATM connection. The mandates of this new kind of demo room coincide with the goals of the Trans European Networks (TEN) project for museums (MOSAIC), and other activities of the Commission such as the Research, Technological Development and Demonstration (RTD and D) projects (VISEUM, SICMA, AMUSE, MUSIST, BONAPARTE, AQUARELLE, MENHIR and INFOWIN), which has a specific mandate of broadening awareness. It is thus recommended that the TEN actions be linked explicitly with these projects. There are at least two other rationales for choosing a common venue to demonstrate the results of both the G8 and European pilot projects. One is practical: vendors will be more willing to make available equipment that serves a twofold purpose. Second, by having the best examples on these various projects in a single network, it will be easier to test and demonstrate principles of interoperability. These rooms will demonstrate best examples of projects for:

- a) politicians
- b) representatives of industry and
- c) members of the public.

Hence a person in Rome could, for instance, see examples of the latest developments at IMAX and Alias in Toronto, at Art+Comm in Berlin and new examples of HDTV in Tokyo. Similarly a person in Toronto could see the latest developments at Infobyte in Rome and elsewhere. This demo room would help everyone to understand better the relationship between first generation public access systems available on the regular Internet and second generation developments which will be more widely available in the next few years. The demo rooms will begin as 'sandboxes' for demonstrations and evolve into a series of prototypes for new cultural 'service centres'.

III. Toolboxes

The market is producing tools to perform a whole range of functions from simple word-processing to creation of hypermedia links and virtual museum spaces. Members of the MoU will be encouraged to recommend which tools are most suited to their needs. These will then be incorporated as plug-ins within integrating packages such as SUMS and SUMMA.

IV. Strategies for Digitising Museum Content

An immediate challenge lies in developing strategies for scanning in the materials in museums and libraries. Here members of the MoU, G7 and related consortia such as AMICO, with experience in scanning should post their practices for the benefit of the community, listing hardware and software used, scanning standards etc. This will prevent institutions (especially smaller ones) from constantly re-inventing the wheel, and save much money on duplication of efforts. It may prove useful to identify at least four levels of digitisation. Museums and galleries have traditionally made arrangements with local photographers to handle requests for images of paintings and other works in their collections. A first step might be to have these photographers take digital images, with a copy for the museum in each case, such that every external request for a photograph adds to the digital repertoire of the museum. A second step can negotiate with publishers to digitise images used in the books which they publish. In the past most art books were limited to black and white photographs. In future classics in the field can be retrospectively updated with colour images. A third step can include photo campaigns in terms of all the works by a given painter (e.g. Leonardo), or on a given theme, which can then generate specialised publications as well as posters and post-cards on demand. This level can again involve publishers. A fourth level would involve local, regional and even national governments because culture relates to tourism, and ultimately the roots of a nation's identity. This level might provide museums and galleries with funds to digitise parts of their collections provided that they adhere to acknowledged standards.

V. Library Connections

Once the collections have been digitised, it is important that the databases used to store records and images comply with those of the library world in order to produce cross-references between textual sources and visual images. This can be accomplished at a number of levels. Initially one can combine some aspects of G7 pilot project 4 (libraries) with G7 pilot project 5 (museums). It will also be useful to promote closer links between existing international bodies in both the museum world (ICOM) and the library world.

VI. Applications to Education

It is very important that these new resources be integrated within the new school environment. To this end the initiatives of G7 pilot projects 3-5 (education, libraries, museums) can be combined. The Pegasus Foundation's Schools *Adopt a Monument* project also provides a useful prototype for such initiatives.

VII. Meta Data Reference

As suggested above, a centralised source of meta-data could coordinate a distributed network of databases organised by museums, galleries and libraries. The idea behind such a meta-data reference "room" is closely related to the Alice Grant discussion of "common knowledge" which is properly authenticated. Libraries have long ago discovered the importance of authority lists of names, places and dates. Indeed, a number of international organisations have been working in this direction during the past century, including the Office Internationale de Bibliographie, Mundaneum, the International Federation on Documentation (FID), the International Union of Associations (UIA), branches of the International Standards Organisation (e.g. ISO TC 37, along with Infoterm) as well as the joint efforts of UNESCO and the International Council of Scientific Unions (ICSU) to create a World Science Information System (UNISIST). Over 25 years ago, the UNISIST committee concluded that: "a world wide network of scientific information services working in voluntary association was feasible based on the evidence submitted to it that an increased level of co-operation is an economic necessity".

The essential principle has already been demonstrated in the Getty Information Institute's Union List of Author Names (ULAN). It has also been demonstrated in the library world whenever national libraries create a union catalogue which combines names, subjects and places from all their local and regional libraries. Members of the MoU thus have much to gain by working closely with those active in creating digital libraries. If, for example, one simply combined the lists of names already available in RLIN, OCLC, BLAISE, PICA, GABRIEL, with those of the Marburg Archive, the Allgemeine Künstler Lexikon, ICONCLASS, the Getty holdings, and the lists owned by signatories of the MoU, one would have some significant first steps towards a future master list which will be essential in all serious attempts at a meta-data approach to cultural heritage and knowledge in general. Because such a list represents a collective public good it is important that it should be placed in safe-keeping with UNESCO linked bodies such as UNISIST or ICSU.

VIII. Search, Access and Navigation Interfaces

The digital reference room, when linked to digital museums and libraries will give access to enormous quantities of material. A prototype System for Universal Media Searching (SUMS) is being developed in the context of G7 pilot project 5 and the TEN MOSAIC project. Future versions will provide variable interfaces, which adjust in keeping with a user's level of education, cultural background and personal preferences. They will permit readers not only to find materials but also to contextualise, orientate, assess, see patterns and even survey omissions in research. Some of this will be accomplished using agents. It is foreseen that the prototype for SUMS, which integrates various tools for writing, editing and drawing will evolve into a System for Universal Multimedia Access (SUMMA).

IX. Self-Learning Environments

While the notion of electronic butlers (Negroponte) is perhaps too passive a model, there is no doubt that the evolution of agents will lead increasingly in the direction of new learning environments where persons can explore and learn on their own. Hence, integrating tools such as SUMMA will become much more than simple search engines. They will be help users to organise, learn and do research on their own, having recourse to teachers only as is appropriate

Conclusions

The Memorandum of Understanding has outlined a vision for a coherent approach to Multimedia Access to Europe's Cultural Heritage. It offers an enormous range of cultural, creative and financial opportunities. To achieve this requires a coherent approach based on internationally accepted standards. Hence, while the Memorandum focuses on Europe, it is useful to establish links with other major projects throughout the world.

One traditional model for access has been to gather materials in a centralised collection (e.g. the Library of Alexandria or the British Museum). A more recent model offered by the Internet is a set of completely distributed collections in a networked environment. Our suggestion is a new model which combines a centralised meta-database with distributed collections in individual museums, galleries and libraries. To achieve this, nine needs and challenges were outlined:

- 1) an open distributed processing environment
- 2) open demo room
- 3) toolboxes
- 4) strategies for digitising museum content
- 5) library connections
- 6) applications to education
- 7) meta-data reference "room"
- 8) search, access and navigation interfaces
- 9) self-learning environment

The Memorandum of Understanding (MoU) requires new co-operation between cultural institutions, industry and government and promises fruitful results for all partners concerned.

Abbreviations

FID	Based on its French name: Federation Internationale de la Documentation
UIA	Based on its French name: Union Internationale des Associations
UNISIST	Synopsis of the Feasibility Study on a World Science Information System Paris: UNESCO, 1971, p. xiii. August 1997

