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European Network of Centres of Excellence in Digital Culture and ICT

Unpublished, Maastricht 1998-2000. Available at:

Abstract

The European Network of Centres of Excellence in Cultural Heritage is part of the MEDICI framework of co-operation of the European Union. The network acts as a high-level, scientific and scholarly point of reference for MEDICI. Each centre acts as co-ordinator for a nexus of problems. The network comprises government and university research institutes as well as industrial research and development departments. This permits new combinations of cultural heritage with Information and Communication Technologies (ICT) and multimedia. The collective research agenda includes wider issues related to the emerging European information and knowledge society, as shaped by cultural content, innovative use of advanced ICT and in particular Internet evolution.

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0	Background	

Cultural heritage represents one of Europe’s central assets and is a key to future diversity within a single European Union. It is also an important source for future employment. Systematic access to cultural heritage requires its being available in digital form. At first sight, cultural heritage is about paintings in galleries, objects in museums as well as music, theatre and performance arts in collections and archives. These paintings and objects typically represent figures based on written sources (religious texts such as the Bible, Ramayana or Buddhist scriptures; or literary classics such as the Homer’s *Iliad*, Ovid’s *Metamorphoses*, or the Japanese *Tale of Genji*. Cultural heritage thus requires relating paintings and objects in galleries and museums to these documents which inspired them and to the environments (churches, castles, palaces, homes) for which they were originally produced. This requires new integration between cultural objects in museums and knowledge concerning those objects in libraries and archives.

Cultural heritage is also much more than paintings in galleries and objects in museums. As UNESCO has made us aware, cultural heritage includes archaeological sites, historical cities and remarkable natural sites (e.g. Plitvice Waterfalls in Croatia).¹ At a deeper level cultural heritage is a key to understanding how each culture has its own principles of knowledge organisation, interpretation and expression. Culture relates to how we see the world differently and is thus closely linked with philosophy, our principles of truth, our theory and practice of society. Culture relates to how we learn and how we transmit what we know in different ways. Culture and education are thus intimately linked.

As Marshall McLuhan has shown each medium affects the message which it conveys. The shift from manuscripts to printed books during the Renaissance had profound effects for the organisation of knowledge and how it was communicated. The advent of multimedia is bringing equally profound changes. Digitising culture is not just about shifting knowledge from books to computer screens. It is changing the amounts of knowledge we can consult, the ways we access and present knowledge, our definitions of what it means to know. For these reasons the shift towards an information and a knowledge society will ultimately change aspects of everything that we think and do. On the other hand, we cannot understand these changes without a deep understanding of their context and the traditions from which they come. This is why study of historical and cultural dimensions of knowledge is more important than ever for Europe’s future.²

The European Commission has long recognized the importance of cultural heritage in this larger sense and began with many isolated efforts through various sectors.³ An important step towards a systematic approach was DGXIII’s Memorandum of Understanding (MOU) for Multimedia Access to Europe’s Cultural Heritage (1996-1998). The MOU confirmed that over four hundred and fifty signatories including companies, public and private organisations,

non-governmental institutions, museums and other cultural institutions are interested in co-operation.

The Multimedia Education and employment through Integrated Cultural Initiatives (MEDICI) Framework provides a next phase of this activity. MEDICI is a framework of co-operation addressed to any organisation, which shares its goal of promoting the innovative use of ICT and multimedia for access, understanding, conservation and exploitation of Europe's cultural heritage. MEDICI promotes the partnership between Museums, Cultural Institutions, Universities, Industry and other relevant public and private organisations and implements a mechanism, based on the sharing of experiences and co-operation among its participants, which will provide information and specific services in order to facilitate the take-up of advanced ICT services and applications in the cultural heritage sector. The MEDICI Secretariat (Milan) is developing a web-site with emerging hardware and software standards, templates for contracts, lists of possible sources for funding, as well as notable examples of products. This web-site⁴, which will integrate efforts of major cultural bodies such as UNESCO, ICOM, ICOMOS, ICCD, RMN, MDA, the Marburg Index and CIMI¹, will serve as an electronic version of a best practice handbook for multimedia in the cultural domain. As such it will provide cultural institutions, particularly smaller museums with reliable information about the state of the art and provide them with working solutions which they could not afford to undertake on their own. Thus, the MEDICI secretariat in Milan is focussing on (best) practice.

A focus of the Centres of Excellence is research leading to new theory (and practice). To this end, within the MEDICI Framework of co-operation, a new European Network of Centres of Excellence in Digital Cultural Heritage is being established. This network, led by the Maastricht McLuhan Institute (MMI), has seven basic goals (cf. <http://www.mmi.unimaas.nl>):

1. Interoperability of Content
2. Identify Quality
3. Multimedia Education and Training
4. Research
5. Policy
6. Share and Create Content
7. International Dissemination.

The underlying purpose of the core Centres of Excellence is to develop theoretical methods, and critical thinking in the realm of ICT, which serve as a guide for professionals in particular and society at large. In addition to these core centres, which are concerned with theory and all seven goals, there will be two further sets of Centres of Excellence with more specialised goals, namely, Training (goal 3) and Creativity (goal 6).

As a whole the MEDICI framework includes a series of different approaches to problems of cultural heritage. On the one hand, there is an effort to work with traditional institutions such as UNESCO, ICOM and IFLA, which have tended to approach cultural heritage with a top-down approach. On the other hand, the special interest groups within MEDICI represent a bottom-up approach, whereby potentially any group is free to discuss problems in the field, which they see as important. Between these extremes, the Centres of Excellence represent efforts of a series of leading institutions in the field to co-operate in identifying key theoretical questions, problems and challenges. Ultimately the Centres will mediate between both the

¹ For a list of acronyms see Appendix 1.

top-down efforts of other cultural networks as well as the bottom-up efforts of the special interest groups in order to create new matrices of co-operation. In so doing it will enable MEDICI to achieve the high goals of its name: Multimedia EDucation and employment through Integrated Cultural Initiatives.

1 Intellectual Infrastructure for Interoperability of Content

In addition to pipelines, the exchange of information and knowledge requires an intellectual infrastructure for interoperability. Important contributions are being made by the Internet Engineering Task Force (IETF) of the Internet Society and by the World Wide Web (W3) Consortium, particularly through their Resource Description Framework (RDF). Within Europe there are important initiatives such as the Global Info project. North American initiatives such as the Dublin Core in the realm of metadata and ontologies (the American term for *thesauri*) also mark a useful step in this direction. A fundamental shortcoming of these solutions is that they are focussed almost exclusively on contemporary knowledge and as such ignore the historical and cultural dimensions of knowledge organisation. Interoperability of content reflecting the complexities of Europe requires study and research on at least ten fronts (figure 1):

1. Method	Scuola Normale, Pisa
2. Access	?
3. Reference	MMI, Maastricht
4. Conservation	ENCOR, Copenhagen
5. Reconstruction	University of Bologna
6. Terminology	Infoterm, Vienna
7. Meta-Data	UKOLN, Bath
8. New Media	GMD, St. Augustin
9. Technology	Politecnico di Milano
10. Economics	?

Figure 1. Ten areas which require research to attain interoperability of content.

Each of these domains will be led by a Centre of Excellence. Institutions concerned with 1-7 will address these problems from the viewpoint of content, while those in 8-10 will address these problems from the viewpoints of new media, technology and economics respectively. Initially each Centre will propose a specific project. This will establish practical connections among members of the network, which is crucial given the overlap between various problems. In future, these institutions can also help to suggest relevant clusterings of projects both from the point of view of content (1-7) and the viewpoints of technology and economics (8-10). Together these will allow a better exploitation of resources by creating more efficient conditions of co-operation. The overall MEDICI framework aims at voluntary co-operation rather than obligatory co-ordination.

1.1 Method

Scuola Normale, Pisa

The twentieth century has seen an important shift from a narrow study of history as persons and events to a greater appreciation of context through interdisciplinary studies, which include a series of other fields: history of art, history of architecture, history of science, history of philosophy, social history, etc. Traditional historical studies, which focussed mainly on textual materials, were well suited to printed publications. By contrast, the new approaches

entail a wide range of sources including illustrated manuscripts, paintings, drawings, prints, engravings which lend themselves admirably to the emerging multimedia potentials of the Internet. Needed are concrete examples of how this can be done, using scaleable methods such that they can serve as models for future methods of publishing, learning and research.

While the new electronic media offer wonderful new possibilities in this context, they also introduce fundamental questions pertaining to historical method, including encoding of sources, and information retrieval.

Encoding of Sources

One of the fundamental contributions of electronic markup languages, specifically SGML and XML, is that they separate the content of a source (text, images, tables or drawings), from the features of its structure (typographic structure, page numbering etc.) and presentation. METHOD, a project headed by the Scuola Normale at Pisa, will explore how these new markup languages can be used to improve access to historical sources.⁵ An important feature of this work will lie in correlating textual and visual source materials.

Information Retrieval

The (new) markup languages are completely device independent, i.e. they can run on different operating systems. As such they offer an important step towards interoperability of content, whereby materials in both museums and libraries can be retrieved efficiently. The Pisa (Scuola Normale) METHOD project will establish the foundations of this new approach. In conjunction with Vienna, Pisa will explore the implications thereof for a virtual collaboratory with respect to philosophy. In conjunction with MMI, Pisa will extend these principles for use in virtual reference rooms (see 3 below).

Veracity and Quality of Sources

In the longer term, the encoding of sources will need to provide users with detailed information about sources of texts and images, the state of those images (whether they are first, second or third generation images), their resolution etc., so that we shall eventually have electronic equivalents to footnotes in order to establish the veracity of the materials being studied and some indication of the quality of surrogates with respect to the originals on which they are based.

In the past two years, the Scuola Normale has acquired special significance in the Italian scene because it has led an initiative to create an Italian network of centres of excellence in the realm of cultural heritage. The Dutch Cultural Heritage Group (DEN, i.e. Digital Erfgoed Nederland) and MMI are in discussion to create a similar national network for the Netherlands. Following this principle the core networks can then serve as integrating nodes for various national networks throughout Europe.

1.2 Access

Lead Partner: ?

Interfaces are a well recognized problem in all domains of computing. The Association of Computing Machinery has a Special Interest Group for Computer Human Interface (ACM SIGCHI). Qua theory, the Advanced Visual Interfaces (AVI) group brings together leading

experts on a biennial basis, while the European Commission has a cluster of 13 projects dedicated to Intelligent Information Interfaces (Icube), some of which deal specifically with aspects of cultural heritage (e.g. HIPS). At the level of the Special Interest Groups (SIGS), number 1 devoted to Virtual Museums and Exhibitions has a section devoted to human perception and is working with the Human Interface and Technology (HIT) Lab (Seattle).

Particularly with respect to cultural heritage, developments in mobile, wireless technology promise enormous implications for interfaces. New types of handheld computer tablets known as Personal Intelligent Agents (PIAs), will allow users to download information from the Internet without a wired connection at home or while standing in front of a painting in a museum using the JINI/HAVI standard (Sun/Philips etc.). With the advent of Universal Mobile Telecommunications Systems (UMTS) in 2002, this wireless access will literally be available anywhere at anytime.

Such technologies can potentially make available the contents of museums, galleries, libraries and archives using a single set of coherent interfaces. A project, possibly headed by the Bonnefanten Museum, will explore how these new technologies can help to bridge the gap between high art (original) and low art (copies, versions), to link information concerning the surface of a painting (the domain of curators and connoisseurs) and the various layers beneath the surface (the domain of conservators and restorers using new methods such as infrared reflectography) and make this accessible both to experts through networks and aspects thereof to the general public through special exhibitions and as part of regular museum visits. Part one of this project focusses on surface-beneath the surface; part two on high-low art and part three relates to how these problems are reflected by new art forms using the new technologies. All attempts at communicating digital cultural heritage are necessarily about new kinds of copies and thus raise anew many of the questions posed by Walter Benjamin in his now classic essay, *The Work of Art in the Age of Mechanical Reproduction (Das Kunstwerk im Zeitalter seiner technischen Reproduzierbarkeit)* (1936).⁶

1.3 Reference

Maastricht McLuhan Institute (MMI)

While museums and libraries may differ in many ways, the terms used and rules for access to information need to be standardised in order to link information about the objects in museums, with detailed studies of those objects which exist in libraries. With respect to technological standards, important, preliminary work is being carried out by CIMI and other organisations. In addition we need to develop authority lists for names, subjects, places, and times. If these are to be effective they need to reflect cultural differences at any given time and historical changes in the course of the centuries.⁷

Search engines such as Yahoo and Altavista are limited because they search using only contemporary terms. Reference rooms of libraries are effectively the repositories of the search methods of the collective memory of mankind. As such they offer an infinitely richer array of search strategies. At the same time reference rooms in digital form potentially offer one of the keys towards interoperability of contents. For these reasons, MMI is developing the concept of virtual reference rooms.⁸

At project within the EC's IST programme I-MASS (Information Management and interoperability of content for distributed Systems of high volume data repositories through multi agent Systems) will explore multiple agent systems in the context of a virtual reference

room in conjunction with Pisa (Scuola normale) and Vienna (Infoterm). A project on Limburg Cultural Heritage (DELIM) is developing the concept of virtual reference rooms at a regional level, with a view to subsequent links with the efforts of Digitale Erfgoed Nederland (DEN) at the national level. The virtual reference rooms will build on Pisa's work on historical method. In conjunction with the work on terminology (see 1.6 below) these reference rooms will also provide users with variant names and switching mechanisms between contemporary terms and concepts in earlier classification systems, thus providing a first step towards a historical approach to names and concepts.

In itself, digitising thousands and eventually hundreds of thousands of reference works does not offer a solution. These reference works need to be linked in new ways such that anyone, be they an advanced scholar or an ordinary citizen, can find things much more effectively. One must be able to go from a term in a subject catalogue, to its definition in a dictionary, its explanation in an encyclopaedia, to relevant titles in bibliographies, library and book catalogues, to partial contents as in abstracts and reviews as well as to full contents.

This requires coherent interfaces. These need to adjust for levels of education and experience, for different approaches to space and time, for different needs with respect to quantity and quality and adjust to user preferences. To this end MMI is developing a System for Universal Multi-Media Access (SUMMA). This builds on the prototype System for Universal Media Searching (SUMS), which was chosen to represent Canada as part of G7 pilot project 5 and in the Museums Over States in Virtual Culture (MOSAIC) projects. The new interfaces will move seamlessly from two-dimensional lists to three-dimensional landscapes. This requires integration of existing tools, close co-operation with other European projects such as ICubed and building on new experiences qua access posed by new remote, mobile devices.

1.4 Conservation and Restoration European Network for Conservation, Restoration, Education (ENCoRE)

The new technologies are changing our methods of conserving and restoring our heritage. For instance, the Uffizi is scanning in each of its paintings at 1.4 gigabytes per square meter. This will provide researchers and students with enormously greater detail about works of art than has traditionally been available in printed textbooks. An art history based on access to the minutest details of paintings, will be very different from that based only on classic examples known mainly through photographs in standard texts or on local examples.

As noted above (in 1.2), curators and connoisseurs have traditionally studied details on the surface of paintings, while conservators and restorers have studied details below the surface of paintings. These professions often proceeded in parallel without direct contact even when the same painting was being studied. The Bonnefanten's proposed project will explore the technological side of how remote, wireless devices offer new ways of co-ordinating knowledge of surfaces with knowledge of layers beneath the surface. It will also experiment with the problems of making such materials available on line both to professionals (curators and conservators) and members of the general public.

The ENCoRE network (Copenhagen), will lead a further consortium to explore the methodological implications of using these new tools. How will the professions of conservators and restorers change when then can compare on-line without leaving their office, the exact colours of paintings by a particular painter such as Botticelli, dispersed in a series of collections including the Uffizi, the National Gallery (London), and the Louvre (Paris). What

effects will simulations have on future interventions of restorers? In this context how useful is it to put on-line real life experiences such as the recent restoration of Piero della Francesca's cycle showing the *Story of the True Cross* (Chiesa di San Francesco, Arezzo)? This consortium will also include the important work by Laura Moltedo and her team at the Consiglio Nazionale delle Ricerche (CNR, Rome).⁹

1.5 Reconstruction

Università di Bologna

Around the world thousands of reconstructions of historical buildings and monuments are being made. Some of these entail archaeological sites (e.g. Pompeii, the Roman Forum) and even entire cities (Bologna, Paris and Virtual Helsinki). These reconstructions introduce many new problems of interpretation. For instance, an American reconstruction of the *Basilica Ulpiana* in the Roman Forum is very different from one made in Rome. Needed are critical methods to make such reconstructions and new criteria to weigh their relative value. This is a further prerequisite for global interoperability of content.

In some cases, these reconstructions are being used as models and simulations to test hypotheses about architectural, social or economic realities of the past. For instance, the reconstruction of Bologna, which traces dynamically the growth of the city during the Middle Ages, is being used to resolve debates about the city's water and sewage systems in the thirteenth century. The reconstruction of Pompeii is being used to test hypotheses about economic life in the first century.

The NUME¹⁰ project led by the University of Bologna is exploring methodological problems relating to reconstructions, notably: a) methods for creating relational databases for the historical sources pertaining to such reconstructions; b) development of Geographical Information Systems (GIS) methods of applications for the analysis of a territory, potentially to be linked with GPS under UMTS; c) feasibility study for the representation of archaeological data in 4-D (i.e. 3-D space plus time); d) study of user interfaces for navigating in 4-D space-time environments; e) criteria for reconstruction of cities from written and visual sources. This project will include work co-ordinated by Pisa concerning reconstructions of Pompeii and Rome as well as the historical survey of the field by Maurizio Forte (now CNR).

Such reconstructions of cities, archaeological and historical sites are often hundreds megabytes and sometimes several gigabytes in size. The networked centres of excellence can make these models more generally available using high-speed networks. At present, town planners and environmentalists are developing analogous models in attempting to simulate future growth in towns and regions. Thus awareness of these historical models may prove of great importance in unexpected fields. Indeed cultural heritage activities entailing the past may offer important lessons for our future.

1.6 Terminology

Multicultural Terminology and Classification

Infoterm, Vienna

Terminology is another essential ingredient for a global interoperability of contents. Projects in the Fourth Framework such as Van Eyck have already made preliminary studies of the potentials of linking different classification systems (that of the Rijks Bureau voor Kunsthistorische Dokumentatie) and thesauri (Iconclass).

Required is greater standardisation, harmonisation and an integrated approach to multi-media resources including libraries (GABRIEL, ONE-II, PICA, RLIN, OCLC); museum systems (Aquarelle, Marburg, CHIN), publishers (e.g. Reed-Elsevier, specifically Saur, Bertelsmann); recent media such as film (e.g. the archive at Göttingen), television (e.g. the Nederlands Audiovisual Archief) and new Internet resources such as Internet Subject Catalogues (DUTCHES, DESIRE, BUBL).

With respect to standardisation of modern terms and their multilingual treatment the most important centre is Infoterm (Vienna) the home of ISO Technical Committee 37 on Terminology. This co-ordinates efforts of other institutions such as the Fédération Internationale de la Documentation (FID, The Hague), the International Federation of Library Associations (IFLA) and the International Society of Knowledge Organisation (ISKO).

Infoterm is directly linked with Pisa and MMI through the I-MASS project with a view to integrating the latest methods of terminology into historical method and virtual reference rooms. Infoterm will lead a further project that bridges authority files, classification systems and thesauri, while addressing problems of multilinguality.

Together these projects will help to provide multiple new access points for searching and lead to many more documents becoming available. This poses new challenges with respect to users' economy of attention. Accordingly a second phase of these projects will examine the potentials of agents in filtering information for personalised needs. Coupling the aims of filtering with actual practice will lead to more realistic prototypes for the future. A third component will explore the implications of new quantities of sources and new types of multimedia for collaborative learning, electronic notebooks and courses.

Historical Terminology Scuola Normale Superiore, Pisa

Systematic searching in the realm of cultural heritage requires study of historical terminology. It is, for instance, relatively easy to translate a term such as *science* into the German *Naturwissenschaften* or the Latin *scientia*. Yet a search of fourteenth century sources under *scientia* would lead one to *knowledge* rather than *science* which, at that time, was typically listed under *philosophia naturalis*. Required, therefore, is a historical and etymological approach to terms, concepts and their place in evolving classification systems. The Scuola Normale (Pisa), working with the Accademia della Crusca (Florence) has done fundamental work on the history of Italian words. Research institutes, such as the Istituto Centrale per il Catalogo e la Documentazione (ICCD, Rome), and the Istituto di studi sulla ricerca e documentazione scientifica (CNR, Rome) are making valuable contributions but often in isolation. The Sapienza (Rome) has also done important work on an historical dictionary of philosophy.

Accepted versus Emerging Terminology Union Internationale des Associations (UIA), Brussels

In the latter nineteenth century there were efforts at a universal bibliography. This led to awareness that there are accepted concepts, some needing to be standardised and others in a process of clarification. These three domains gradually became the purview of three organisations: the Fédération Internationale de Documentation, ISO Technical Committee 37

(and the Global Group connected with it), and the Union Internationale des Associations which tracks emerging terminology.

One of the underlying challenges of the projects outlined above and future projects within the Centres of Excellence is to create synergies between modern terminology (Vienna), historical terminology (Pisa, Rome), and emerging terminology (Brussels).

1.7 Meta-Data

As noted earlier, one of the fundamental contributions of electronic documentation (through markup languages such as SGML and XML), has been a clear separation of content from presentation thereof in different forms. To achieve this one needs both the original information (content) and meta-data, i.e. information about that information. Meta-data is therefore one of the cornerstones for global interoperability of content. With recent trends for machines to communicate directly with machines without human intervention, meta-data has become all the more central.

Not surprisingly, therefore, meta-data has invariably become a buzzword in recent ICT projects. Many discussions are based on the pioneering efforts of the Dublin Core (DC) initiated by OCLC in Dublin, Ohio. While immensely useful as a pragmatic interim solution, the Dublin Core approach has two fundamental shortcomings: 1) it focusses entirely on contemporary knowledge without attention to cultural or historical changes in knowledge; 2) it focusses exclusively on static knowledge.

As an accompanying measure within the 5th Framework, the United Kingdom Office for Library and Information Networking (UKOLN) in conjunction with Price Waterhouse Coopers (PWC), the Museum Documentation Association (MDA), MMI and the Gesellschaft für Mathematik und Datenverarbeitung are exploring some of the basic features and templates required for a more systematic approach to metadata (FILAMENT).

Needed are new dynamic methods, which will enable access to the complexities of historical and cultural diversity, such that we can develop new kinds of dynamic knowledge maps, some of which are evolutionary. This involves at least seven aspects, each of which will require independent projects.

Individuals (Who?)

First, there is a need for dynamic knowledge of individuals: a) changing historical knowledge about an individual, b) changing perceptions of an individual and c) changing assessments of the authority of literature concerning an individual.

Objects (What?)

Beyond the initial problem of access to a specific object in a museum, library, archive or to free-standing monuments, is the larger challenge of how to access all the related objects which have derived from or been affected the object: the copies, replicas, versions, imitations and sometimes pastiches. Needed are methods to show how these forms evolve and change over time in different places.

Concepts and their Relations (What?)

Presently we have many different classification systems and thesauri. Concrete proposals for mapping among these systems exist (Williamson, McIlwaine). Systems such as the Universal Decimal Classification (UDC) and developments in terminology allow more systematic treatment of relations among subjects into classes such as subsumptive, determinative, ordinal etc. (Perrault). A dynamic system, which allows us to switch between classifications in different cultures and historical periods would provide new kinds of filters for perceiving and hopefully appreciating subtleties of historical and cultural diversity.

An integration of the methods outlined above will lead to new kinds of knowledge maps, which allow us to trace the evolution of concepts both spatially in different countries and temporally, in different historical periods. This will allow us to return with new depth to problems of standard/model versus variants/versions, of centre versus periphery and the role of continuity in the spread of major forms and styles of expression.

Space (Where?)

Current printed maps in atlases are static. Historically the boundaries of maps change. In conjunction with the European Space Agency much work is being done in the area of co-ordinating Geographical Information Systems (GIS) and Global Positioning Systems (GPS). The spatial meta-data project would produce dynamically changing atlases and link this with GIS and GPS. This is a pre-requisite for visualising changing political boundaries. Coupled with information concerning cities and events and other historical data, this will permit much more nuanced search strategies.

Time (When?)

Related is the problem of historical-temporal meta-data, whereby one has a standard method for correlating the different time scales of various chronological systems and calendars. Coupled with historical data this will be a significant step towards studying history from multi-cultural points of view.

Narratives (How? Why?)

As noted in the introduction, the larger context of cultural heritage requires not only access to a given subject or episode (such as the *Crucifixion* or *Diana and Actaeon*), but also a) access to how this subject is spread through paintings and other works of art, and b) access to the context of these subjects, the narratives from which they derive.

The reason why this is of fundamental importance lies in a paradox: the most diverse narratives are precisely about the most familiar stories. Uniqueness cannot simply be generated by trying to be different, by rejecting others and removing them through ethnic cleansing. Uniqueness comes through sharing common stories, which inspire fundamental values (respect for life, truth etc. as in the 10 commandments), and then expressing them differently. To visualise and make visible the complexities of these historical diversities of expression is our thus our best hope for understanding the challenges of future diversity. Inherent in such questions lie the seeds for understanding changing definitions of Europe and for developing a vision of the Europe of tomorrow: dynamic phenomena, processes rather than static definitions.

Needed, therefore is a new dynamic approach to meta-data which will effectively re-organise our treatment of all the basic elements in cultural heritage, namely, individuals (Who?), objects (What?), concepts and their relations (What?), space (Where?), time (When?), and narratives (How? Why?). This will make possible a global interoperability of contents, which reflects adequately the complexities of cultural and historical knowledge. As will be clear from the foregoing, all of the projects considered in the context of the Centres of Excellence will, in some way contribute to this vision. Even so the problems entailed are so fundamental and monumental that they cannot reasonably be solved by typical two-year projects within the Commission's framework programmes. For this reason it is recommended that the European Commission address the challenge of this new kind of meta-data in the context of its long-term research programmes.

1.8 New Media **GMD, St. Augustin**

Cultural heritage has traditionally been perceived and studied in terms of static images, typically photographs in books. In the course of the past century the advent of film, television, radio and video have added an estimated 40 million hours of audio-visual materials. (If one includes footage this figure would be much higher). These offer an enormous repertoire of new primary sources, not only for contemporary history but also for our understanding of the past through documentaries of the kind made famous by Lord Kenneth Clark's *Civilisation* series.

Traditionally scholars have developed methods to assess the veracity and reliability of textual sources. If film, television and video are to be used for scholarly purposes, then new methods are needed to weigh the relative significance of static vs. dynamic sources and to indicate the context and original intent of these materials. How, for instance, will a student in future be able to discern the difference between a documentary video clip and a fictive sequence from *Saving Private Ryan* or *Forrest Gump*. New technologies such as watermarking and the W3's Resource Description Format (RDF) may help in this regard. The new kinds of meta-data outlined above will make a contribution.

It is foreseen that the GMD in a consortium with CSELT (responsible for MPEG4 and 7), and W3 (RDF), will work on technological aspects of this problem, integrating existing efforts. In addition to these technological solutions, there is needed also a new critical awareness of the problems of interpretation introduced by these new dynamic media. This should become a component of the GMD project, the results of which can then be integrated within the postgraduate courses developed by the Centres of Excellence.

1.9 Technology **Politecnico di Milano**

Global interoperability of content assumes global interoperability of the pipelines. Theoretically these are two clearly separate problems. In terms of the ISO, the pipelines entail levels 1-6 (namely, physical, data-link, network, transport, session and presentation), whereas contents involve level 7 (applications). Most of the global interoperability projects thus far have focussed on pipelines and specifically those where a specific layer is involved.

Practically, however, there are a number of areas where technological interoperability and interoperability of contents are almost inseparably connected. In the case of databases, for instance, both interoperability of database formats (such as ODBC, and JDBC) and interoperability of database contents (standardised authority names) need to be considered together, if a productive result is to be achieved. Hence the MEDICI secretariat at the Politecnico di Milano is taking three steps. First it is organising a series of competence centres to deal with each of these problems. Second, it proposes, as an accompanying measure within the Fifth Framework Programme, to lead a project on heterogeneous distributed databases with cultural content. This will build on earlier efforts in this direction such as RAMA and AQUARELLE. Third, it is foreseen that the Politecnico di Milano, in conjunction with PriceWaterhouse Coopers, GMD, JRC, MMI and other partners will lead another project as an accompanying measure which will create a technology framework in a number of areas (figure 2).

Area	Partners
1. Capture (Digitisation Techniques, Colour, Image Proofing)	
2. Storage and Archiving	
3. Software tools and Freeware	
4. Distributed Heterogeneous Databases	
5. Human Perception, User Interfaces	
6. Quality Assurance	
7. Production and Publishing	Darmstadt, GMD, IPSI
8. Disclosure and Discovery	Bath, UKOLN
9. Search Engines and Concept Browsing	Heraklion, FORTH
10. Multilingual Access	Vienna, ISO TC 37, Global Group

Figure 2. Ten areas needed for a technology framework. The first six are presently being addressed as individual themes within the SIG for virtual museums. It is foreseen that competence centres will be developed for each of these. All ten areas entail an overlap between technological interoperability and interoperability of content.

1) Agent-based computing	(AgentLink– 27225)
2) Distributed Computing Systems Architectures	(CaberNet –21035)
3) Information and Data on Open Media	(IDOMENEUS–6606)
4) Language and Speech	(ELNET – 6295)
5) Model-Based and Qualitative Reasoning Systems	(MONET–22672)
6) Neural Networks	(NEURONET–961)
7) Requirements Engineering	(RENOIR – 20800)
8) Uncertainty Techniques in Information Technology	(ERUDIT–8193)

Figure 3. A list of existing ESPRIT networks of Excellence which can serve the needs of the Centres of Excellence in Digital Culture in their quest for interoperability of content.

Of these themes, agents are already linked with an ESPRIT network of excellence. In future the technology framework should expand to include a number of other existing ESPRIT networks relevant to cultural heritage (figure 3) .

On the basis of this framework, it will be possible to identify overlap and need for co-ordination between projects, as well as indicate the gaps and missing links in the 5th and

subsequent Framework Programmes. An important aspect could be the assessment of the impact of the projects funded in Key Action III, in terms of Commission objectives as well as objectives of key organisations in various areas. The intermediary results of this activity could recommend particular foci and priorities for the rolling work plan of FP5. This group could also provide suggestions for clusters of technologies, which can then be co-ordinated with the content need of the centres of excellence. This activity could be supported by a technology watch and forecast of key technologies in the area of content creation and access. Major bodies connected with standards in these fields (e.g. ECMA, EBU) and companies with special qualifications in assessment of impact (e.g. PWC) could also contribute. This framework, from the standpoint of technology, will be complemented by the framework for content (see 1.1-7 above) provided by other Centres of Excellence.

1.10 Economics

Lead: Aix en Provence or London?

Finally, global interoperability of content requires study into the economic realities and potentials entailed in this quest: an economic framework for digital cultural heritage.

Interoperability of Content	Points of Reference	Multimedia Education	Research	Policy Development	Share and Create Content	International Dissemination
1. Method						
2. Access						
3. Reference						
4. Conservation						
5. Reconstruction						
11. Terminology						
12. Meta-Data						
8. New Media						
9. Technology						
10. Economics						

Figure 4. Matrix showing the relation between conditions for interoperability of content and other basic goals of the Centres of Excellence.

This includes practical challenges such as secure transactions, for which the results of the MOU on e-commerce should offer solutions; copyright, for which the successors to projects such as INDECS (formerly IMPRIMATUR) should offer solutions and more theoretical questions of how one makes business cases for what are essentially new reproductions of culture.

A First Matrix

In the foregoing pages we have outlined ten problems which need to be addressed in order to attain global interoperability of content (figure 1). Each member in the new European Network of Centres of Excellence in Digital Cultural Heritage will be responsible for solutions to one of these problems. Ultimately all these solutions also need to be integrated. To this end, two further steps will be taken.

First, each member will lead a project, which at the same time entails co-operation with other partners. Thereby the theoretical Network of Centres will also become a practical web of co-operating partners. Having gathered information concerning interoperable content in their domain, each of the ten core centres of excellence will apply this element to the other six goals in order to create a matrix of responsibilities (figure. 4). For instance, the Scuola Normale, which: 1) focusses on interoperability of content qua historical method in cultural heritage, will also 2) serve as arbiters of quality on historical method; 3) identify materials on and partners for European Postgraduate Multimedia Education in historical method; 4) pursue research on historical method; 5) explore policy implications thereof; 6) share and create new content pertaining to historical method and 7) disseminate content in this field internationally. Similarly, another centre will do so qua access. In short each founding Centre will become a clearing-house for one of the ten fundamental aspects of interoperability, and pursue the other goals of the Centres with this focus. Second, as the general clearing-house for all the Centres, Maastricht will co-ordinate the efforts of the projects and integrate these individual elements through the development of interoperability of content labs (see 8 below).

Interoperability of content of cultural heritage marks a first step in a larger vision for a complete interoperability of both scientific and cultural content: a bridging of Snow's Two Cultures. This requires integration with the important work already underway for a global network of scientific literature and knowledge (Global Info Project). Only then will the global information ecosystems envisioned by the European Commission become a reality. By acting as initial node and co-ordinator of a European Network of Centres of Excellence in Digital Culture and ICT, MMI hopes to play its role in an evolving vision of a European Information and Knowledge Society.

2 Identify Quality

As is evident from the above matrix each centre specialising in some aspect of interoperability of content will focus on methods and technologies in that domain. They will explore useability of existing technologies and how to integrate best practices. The computer and electronics industries are producing an unprecedented number of new devices. These range from small handheld devices which combine the capacities of a telephone, computer and a fax, through network computers and PCs, to massive parallel computers. Input devices now include mice, remote devices, electronic programming guides (EPGs), and dozens of other devices such as voice activation and gesture technologies. There are computer monitors, television monitors, enhanced TV's (which are sometimes enhanced computer monitors), as well as flat screens, including Organic Light Emitting Displays, (OLEDs) and nanotubes. How many and precisely which of these devices are suited for cultural heritage? The Networked Centres of Excellence will serve as test-sites for these inventions to determine which are the best and useful technologies for cultural heritage. The Centres can then work with industry in determining which combinations of these devices offer optimal solutions to the needs of the cultural community.

The Commission continues to invest billions of euros on pre-competitive research into new technological solutions. There was a danger that this would result in many isolated solutions. Hence, the fifth framework has as a general goal the integration of many hitherto disparate technological solutions. The Networked Centres of Excellence can integrate best practices from such projects, providing experimental test-beds for new technological solutions in the context of high-speed networks using cultural content. The technology in advanced museum projects such as VISEUM and AQUARELLE can, for example, be linked with library projects such as DESIRE, and access projects such as ICube to test their efficacy and to demonstrate synergies that arise from combining hitherto piecemeal solutions.

A number of these solutions have more universal applications. For instance, the Louvre has already developed software for secure transactions of products relating to their museum shop. The MENHIR project has developed a solution for images at different resolutions using JPEG's pyramidal tiling methods. CSELT, in conjunction with a series of ACTS projects is developing solutions for moving images in the context of MPEG4 and MPEG7. The centres can combine such solutions and offer smaller museums practical solutions, which they could not develop on their own.

Global interoperability of networks has long been recognised as one of the fundamental preconditions for an information society. This challenge is being addressed at the world level through G8 pilot projects and at a European level through various R&D and deployment initiatives. These are providing the pipelines for high-speed transfer of information. The experimentation with best practices by the centres of excellence will offer new content for those initiatives. Through integration with other projects, the Centres will reveal a whole that is much greater than the sum of its parts. The role of the network headed by Maastricht will be to co-ordinate these efforts and use the results of individual centres in helping MEDICI to develop further its best practice handbooks.

3 European Multimedia Education

Core Centres

At the undergraduate level, the ERASMUS programme provides many opportunities for students to travel to different universities in order to acquire an education with a larger European view. One of the basic goals of the Centres of Excellence is to establish a postgraduate equivalent for the ERASMUS programme. In this context, a role of the Centres is to prepare students for the practical challenges of combining technological convergence with the need for continued cultural diversity. In keeping with the above matrix (figure 4), each Centre will develop multimedia degrees in their particular area at the Masters and Doctoral levels. These scholarly degrees will have a high degree of theoretical and critical context.

The aim is to create degree programmes, which can be followed at a combination of universities. Hence a student might begin postgraduate work in Maastricht, spend a term or two in Vienna, and finish their doctorate at Pisa or conversely. While the exchange programmes are intended primarily for postgraduate students, it will be useful to have some exchanges for professors in order for them to become more aware of different learning styles in various centres. Co-ordination of these new degrees will overlap somewhat with co-ordination of research (see 4 below).

Teaching and Training Centres

The Core Centres will focus on theory and a critical framework. A second Network of Training Centres will be more technically oriented; will have more direct links with industry, will focus on practical applications and assure that students have a mastery of the latest hardware and software in the realm of multimedia tools. Although these two networks will often proceed in parallel as independent strands, it is foreseen that those concerned with theory will also need high competency in software programs and other technological developments, such that a person based at a core centre may not infrequently attend courses at a training centre. Conversely, there will be arrangements for those at training centres to attend courses at core centres in order to gain a greater critical acumen or deeper theoretical basis. A third Network of Centres will primarily be concerned with creativity: the artistic implications of the new technologies (see 6 below).

Other Research Networks

A fourth network will link the above with other emerging research networks. For instance, the University of Pisa is developing an Italian Consortium, FORMA (*Formazione, ricerca e metodologie Applicate ai Beni culturali*), which includes the International Centre for Architecture, Andrea Palladio (Vicenza), the Institute and Museum for the History of Science (Florence), the universities of Benevento, Catania, Perugia, Rome 1 (Sapienza), and Rome 3. This consortium is focussing on the creation of a new two year multimedia Master of Arts (M.A), in which one year would focus on developing critical methods through study of the history of perception and representation, while an (optional) second year would emphasise training in the use of new technologies (cf. training below).

As mentioned earlier, there is also a Northern European Historical Research Network (NEHRN). They are developing a Doctor Communitatis Europae (DCE) and have agreed to join the MEDICI Framework as has the Research Institute for Austrian and International Literature and Cultural Studies (INST).¹¹ There is also interest from the University of Rome which, in conjunction with twelve other European Universities, has established a network for a Euro PhD on Social Representations and Communication.¹² The challenge is to build on these isolated initiatives to create a coherent approach to European Multimedia Education at the postgraduate level.

4 Fundamental Research

Fundamental research issues, which are central to the development of a European information society, comprise a wide range of questions in the humanities and social sciences, including:

- *Epistemological*: what are the implications of digitisation for the constitution and character of knowledge?
- *Sociological*: what are the implications of digitisation for the constitution of the information society?
- *Knowledge engineering*: what are the implications of digitisation for knowledge management and interface construction?
- *Political/legal*: what are the implications of digitisation for the management and property of cultural heritage?

- *Philosophical*: what is the role of digitalisation of cultural heritage in constituting identities?
- *Art Theory*: how do the work of art and the spectator constitute each other in a digitised virtual museum as compared to a real museum?
- *Economic*: what are the economic models applicable to the new cultural resources?

Two larger sets of questions are of particular interest:

1) How will massive databanks of cultural heritage change our views of art history and cultural studies in general? There is a danger that the new global networks will lead to a homogenisation of our cultural repertoire—that which Barber has called a “MacWorld effect.” During the Renaissance greater communication among the city states inspired greater individuality. By analogy, how can we develop the new networks in the European information society to sustain and even increase cultural diversity? Will the new access to digital versions of paintings, drawings, sculptures and other cultural artefacts through digital, virtual, and imaginary museums undermine our awareness of the real, the physical, and the very meaning of the original? Or will a new interest among new social groups be generated, which also results in increased real visitors’ numbers to real museums? Alternatively, will we in future be faced with new kinds of theme parks that are so captivating as pseudo-experiences, that they will threaten to replace our real experiences?

2) What impact will these contents have on our collective awareness of (cultural) memory? Will the new media erode our traditions of cultural heritage as a public domain or offer new ways of making these treasures publicly available. In either case how will this affect our notions of society? One major company now speaks of publishing in terms of an audience of one. Will new techniques such as “intelligent” agents therefore lead us ineluctably towards isolation and solipsism because we no longer have anything we share as a whole? Alternatively, will they transform positively our approaches to research and learning? What are quantitative and qualitative ways in which the new media will change what we learn and how we learn? What are the implications of such technologies for social structures, for communities, for nationalities, even for our definitions of what it means to be human?

In the past, such questions were the focus of departments of cultural sciences, communications, information science, and humanities or, more generally, faculties of arts and sciences and this will continue in future. The networked Centres of Excellence will:

- a) have a liaison function in making available new sources for study and research
- b) co-ordinate the development of new post-graduate degrees in multimedia. Eventually this will lead to more specialised European Masters and Doctoral programmes in each of these areas of multimedia, and will provide a new generation of multimedia professionals with a truly European outlook.

Here the role of the Maastricht will be to create indexes of a) specialised research projects; b) courses and c) seminars relating to digital cultural heritage in the various Centres of excellence, indicating those seminars and courses which are accredited in degree programmes. This will serve two purposes: 1) to identify new courses, which can be integrated within the postgraduate European multimedia degrees and 2) to signal future directions for European multimedia research.

5 Contribute to Cultural Policy Development

Closely related to the above is the question of contributing to the development of new cultural policy which, in Europe, is enormously complex. In countries such as France it is theoretically centralised, but in practice there are frequently differences in approach between the Ministère de la Culture, the Réunion des Musées Nationaux and the Louvre. In Germany, culture has traditionally been directed by the individual states. Policy for museums and galleries is often under different groups than policy for film, television, or communications. Yet in an emerging world of convergence, new integrating policies are needed. In this context some important initiatives have been taken by the International Institute of Communications (IIC). The Centres of Excellence can serve as a context for creating a more coherent European approach to these questions.

6 Share and Create Content

Major film and television archives are concerned with making accessible their materials for educational purposes. For instance, the Nederlands Audiovisueel Archief is making samples of their archives available to six universities, one of which is Maastricht, using high speed networks. Similar initiatives are underway in France and Italy. Once again there is a danger that each country will develop separate solutions for access to these materials. Hence another role of the centres will be to ensure that common access methods are developed for these sources from different countries.

Initially the networked centres of excellence will link together universities with museums and libraries as these are the only ones with access to high speed networks. In parallel to this, a European Schoolnet is being developed to link elementary and secondary schools across the continent. In countries such as England such schools are being integrated within a national grid for learning. A newly formed European Education Partnership (EEP) is helping this process. The experience of the centres of excellence can thus develop repertoires of reliable content, subsets of which can subsequently be used for the elementary and secondary levels.

Creativity Centres

In addition to using existing materials as new primary sources for academic research, the centres of excellence can also play a role in stimulating new content creation. To this end, in addition to the networks of Core Centres (on theory) and those on Training, there will be a third network of Centres of Excellence devoted to creativity. This can build on the European Network for CyberART (cf. <http://www.encart.net/>), which includes centres such as the Zentrum für Kunst und Medienforschung (ZKM, Karlsruhe), and Ars Electronica (Linz). These should be co-ordinated with other emerging networks. For instance, a recent report from the High Level Group on Audiovisual Policy recommends that “a network of European film and television schools should be established to link centres of excellence.”¹³ Linking the Centres of Excellence for Digital Cultural Heritage with these film and television centres of excellence, will bring further interplay between traditional static content of paintings from museums, books from libraries and the dynamic content of film and television. The links with museums and libraries can thus ensure new sources for European culture through better access to its cumulative memory of creative traditions.

7 International Dissemination

When the MOU was originally formulated it was consciously articulated as a facilitator for access to European Cultural Heritage, in parallel with the original aims of G7 pilot project 5: Multimedia Access to World Cultural Heritage. Since there have been efforts at closer co-operation between G8 and the MOU. The challenge remains of using the European experiences as a model for activities around the world. Two approaches are under discussion: demonstration rooms and dissemination by television and film.

7.1 Demonstration Rooms

One day these technologies will theoretically be available to anyone, anywhere, at any time. In the short term, there is a real need for those in museums and citizens as a whole to see real examples of what is possible. To this end it would be enormously useful to pursue the idea of demonstration rooms discussed in the context of G8 pilot project 5 (June 1997) at the Canadian Embassy in Rome. These rooms can demonstrate concretely that beyond the narrow aims of an information highway lies a deeper vision of a knowledge society which is transforming our approaches to learning, experience and hopefully, wisdom. They will disseminate the best examples produced within the research community of the centres of excellence to a wider audience of politicians, industry leaders and citizens at large. This will provide European countries with a showcase for displaying their achievements to the world, and at the same time an excellent insight into examples being developed elsewhere.

7.2 Television and Film

The possibility of using the centres of excellence for new content creation has already been mentioned. In the short term, a subset of the materials developed within the MEDICI framework could be used for the production of television shows on new technologies such as *Mediamente* of RAI. This would prepare the public for a future when the general bandwidth of the Internet has increased sufficiently. The use of cultural heritage materials generated by the networked centres of excellence will also contribute to the need for sustained cultural diversity as outlined in a recent report on *A Global Cultural Diversity Television Initiative* by the Canadian Working Group of the International Institute of Communications (IIC).

As outlined above, the MEDICI framework is expanding its connections with international organisations such as UNESCO, ICOM, and ICOMOS. In collaboration with the network established through the G8 pilot project this network can be expanded to include corresponding organisations in other countries such as the Canadian Heritage Information Network (CHIN) and the U.S. National Initiative for Networked Cultural Heritage (NINCH) and their Coalition for Networked Information (CNI). In so doing the European network of centres of excellence in cultural heritage can contribute towards the G7's original vision of Multimedia Access to World Cultural Heritage.

7.3 World Bank, Culture and Tourism

The World Bank in conjunction with the Government of Italy and UNESCO is exploring ways of linking these emerging networks with new business in the developing world, particularly through tourism. Hence the approach here outlined can serve as a model for connections with other countries around the world.

8 Interoperability of Content Labs and Matrices of Co-operation

The MEDICI Secretariat will provide a survey of practical achievements in the field of cultural heritage. The MEDICI Centres of Excellence will provide an intellectual and theoretical foundation for these developments through a series of four networks: 1) Core Centres; 2) Teaching and Training; 3) Creativity and 4) other Research and Education Networks (such as NEHRN). Linking the practical work of the MEDICI framework and the theoretical work of the Centres of Excellence will be a network of MEDICI Interoperability of Content Labs. These Distributed Interoperability Labs will build on the experiences of the ESPRIT Networks to create new Demonstration Rooms to make accessible: a) research examples from the Centres of Excellence; b) traditional examples from content networks (of museums, libraries and archives) and combine these with c) new forms of learning and creativity (European Schoolnet, Film and Television Network; and other Cultural Networks). These demonstration rooms will serve as models for new types of Virtual Museums and Exhibitions. As such the Interoperability Labs will serve a role of integration between both theory and practice and input and output (figure 6). A step by step summary of these developments is outlined in Appendix 3.

To accomplish Multimedia Access to Europe's and eventually the World's cultural heritage many efforts are required. A primary need is that these efforts are well co-ordinated. Hence the Centres of Excellence are founded on a principle of matrices of co-operation. A first matrix will be formed by linking the ten conditions for interoperability with other basic goals of the network (figure 4). Within the Fifth Framework of the European Commission, practical projects can strengthen co-operation across the European Network of Centres of Excellence. Each of these projects will further the new connections among institutions and individuals outlined at the outset, namely, museums, libraries, archives, universities, publishers and industry. In a first phase this can include a package of ten projects each led by a different centre (figure 4). These projects can in turn help define further clusters of projects to ensure that there is a cumulative dimension. The Core Centres in their links with training centres for the use of software and hardware will create a second matrix. The creativity labs with their connections to future film and television labs will produce a third matrix.

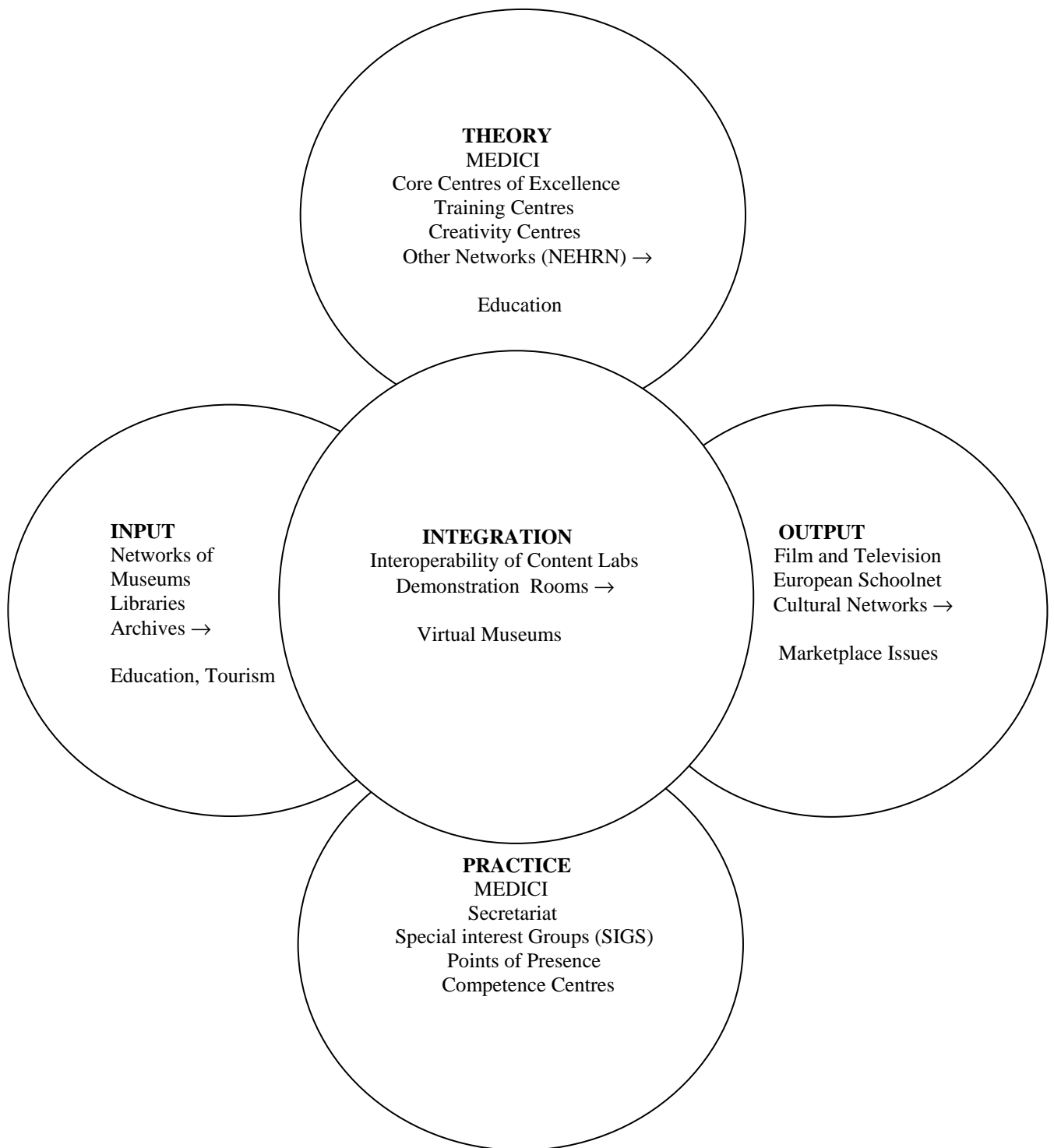


Figure 5. The chief MEDICI activities and their links with other European Initiatives.

Theory	Matrices
I. MEDICI Centres of Excellence	
1) Core	Interoperability of Content and Goals
2) Teaching and Training	Training and Research
3) Creativity	Film and Television
4) Other Research Networks	NEHRN
5) Other Cultural Bodies	(cf. Appendix 2)
Practice	
II. MEDICI Office	
6) Special Interest Groups (SIGS)	Goals of Centres
7) Interoperability of Content Labs	ESPRIT Networks and Museums

Figure 6. Outline of how the theoretical efforts of the MEDICI Centres of Excellence are linked with other practical initiatives by a series of seven matrices.

The Core centres qua education with their connections to existing research and educational networks such as the Northern European Historical Research Network (NEHRN), the European Schoolnet and the European Education Partnership (EEP) will produce a fourth matrix. At a more practical level, linking the goals of the Centres with the themes of the Special Interest Groups (SIGS), which have evolved within MEDICI will create a fifth matrix (Appendix 1). Thereby the bottom-up approach of the SIGS can also contribute to basic goals of the Centres. Linking the goals of the Centres with both existing (Appendix 2) and proposed cultural networks (e.g. European Museum Institute) will lead to a sixth matrix.

The Interoperability of Content Labs will develop demonstration rooms at the Core Centres and elsewhere. These rooms will have links with relevant ESPRIT networks of excellence (e.g. agents) and will effectively combine (content) input networks (museums,¹⁴ libraries and archives) with output networks (film and television, European Schoolnet and other cultural networks), to create a seventh matrix (figure 6).

At the moment museums, libraries, archives and other cultural institutions are creating their own look and feel for homepages. Important consortia such as CHIN and Marburg have demonstrated some of the potential benefits to be gained from creating a common set of interfaces to a series of dispersed, heterogeneous collections. In the Interoperability of Content Labs, practitioners from museums can work together with theoreticians and programmers to develop solutions on a European scale.¹⁵

The European Network of Centres of Excellence will, therefore, do much more than provide a theoretical dimension for the MEDICI Framework. They will link emerging networks in the cultural sector (figures 5-6) to integrate theory and practice and to permit new applications of cultural heritage in the realms of education, tourism and future employment.

9 A Series of Steps

The Centres of Excellence and the MEDICI Framework will establish an interrelated set of networks for Multimedia Access to Europe's Cultural Heritage as foreseen by the MOU and help lead to Multimedia Access to World Cultural Heritage as envisaged by the G7. It is

important to recognize, however, that this can only be achieved reasonably through coherent integration of a series of steps, a modular approach, whereby one project builds upon the other. As such, given proper support, the Centres of excellence can begin almost at once and at the same time contribute towards what must be a long term vision.

While a detailed time-line for these developments is beyond the scope of the present document, some indication of the time-frames is nonetheless useful. Using the framework outlined above as a point of departure (figure. 5), we can note that, with respect to practice, most of the key elements are already underway, namely: Secretariat, Special Interest Groups (SIGS), Points of Presence and Competence Centres. With additional funding these elements could be fully in place within twelve months. With respect to theory, given funding, the Core Centres of Excellence, the Training Centres and the Creativity Centres could also be established within twelve months, as could initial links with other networks such as the Northern European Historical Research Network (NEHRN).

If each of the ten core centres becomes engaged in projects, funded through the Fifth Framework Programme or a similar structure, then solid links among these centres could be established over the next two to four years. Given the complexities of different educational jurisdictions (sometimes provincial and sometimes federal) the establishment of Multimedia Masters and Doctoral Programmes is also likely to take three to four years.

More difficult to predict is the time-frame for integration of theory and practice envisaged through the establishment of interoperability of content labs, drawing on input from networks of museums, libraries and archives in order to produce new output through Film and Television Networks, the European Schoolnet and other Cultural Networks. The basic ingredients are in place. The Commission has made integration of networks among museums, libraries and archives a specific aim of the Fifth Framework. Already in the Fourth Framework there was a concept of concertation meetings designed to integrate results from disparate projects. If this happened more systematically, to the extent of becoming a criterion for further funding, then enormous advances towards interoperability of content could be achieved within the present five-year programme.

On the output side, there is also a need for political support if Minister Oreja's vision of a new European network of film and television schools is to become a reality. Indeed politicians must recognize that while a combined Europe can provide serious alternatives to the Hollywoodization of culture, individual countries within the Union are simply too small in terms of population or economy to pose such an alternative.¹⁶

The interoperability of content labs must evolve into demonstration rooms and then into prototypes for virtual museums. This evolution could see first results within twelve months and yet will remain an ongoing process. Here a complicating factor is that these demo rooms and prototype virtual museums need to be linked through broadband network connections. As noted earlier there has been a tendency to separate interoperability of pipelines from interoperability of content. For instance, none of the Trans European Networks (TEN) projects presently entails cultural content. With a proper co-ordination of interoperability on both fronts (pipelines and content), much progress could be made within the next three years. With the advent of Universal Mobile Telecommunications Systems (UMTS) in 2002, there will be new challenges for integration of terrestrial broadband networks with new mobile and satellite networks. These challenges will continue as the meaning of broadband shifts from two megabytes (according to some), to gigabytes, terabytes and eventually exobytes.

Cultural heritage builds on taxpayers' money and is thus linked to some extent with the public good. One challenge is to link this heritage with education both in the school and in the home such that it can become accessible to all. At the same time, economics is necessarily an important factor in the evolution of this framework. Here comprehensive solutions for copyright, digital signatures and secure transactions are being developed for electronic commerce and particularly in the banking and the publishing industries. If these techniques were made accessible in the cultural sector, much progress could be made even within a twelve-month period.

Interoperability of content in its full form requires a dynamic approach to meta-data. This entails enormous problems, which cannot be solved in a two-year project or even a five year framework. For this reason we have recommended that the European Commission make meta-data into one of its long-term concerns along with other basic challenges such as digital libraries and requirements engineering. To achieve lasting results in this domain may well take twenty years. Some technologists will find this shocking and ask if it cannot happen faster. No doubt this could be so if the combined annual budget for cultural institutions such as UNESCO, were somewhat more than the equivalent of seven minutes of the annual budget of the U.S. military as is presently the case.

Financial issues aside, it is humbling to remember that culture is a cumulative process, which works in different time scales. One of the most impressive scholarly projects of the past century is a Catalogue of Italian Manuscripts. The project was begun in 1897. As of today it has now reached volume 104 and is still going strong. It has taken a century but it can continue to be a useful instrument for the next millenium. The Centres of Excellence must remind us that the quest for cultural excellence has inspired us since the beginnings of recorded history thousands of years ago. They must provide us with new access to the fruits of that quest in order that we may recognise that quest more clearly and thereby keep alight that flame for the next and many millenia to come.

10 Criteria for Membership

All members of MEDICI are welcome to apply provided that they meet the criteria for membership:

- The institution, usually a department of a university, museum or industry, must actively be engaged in research concerning the European information society generally, with a specific attention to new technologies and cultural heritage.
- The institution offers M. A. and Ph.D. courses, or has close connections to other degree granting institutions. (Hence, professional, governmental and non-governmental institutions in the field of cultural heritage, which offer apprenticeship or study programmes for students also qualify).
- The institution has a commitment to share information and technologies in the context of education.
- The institution has a clear proposal of how it fits into one of the basic networks: e.g. core centres, training, creativity, museums.
- The institution is, or will in the near future be, connected to a high-speed network. (The institutes will start to disseminate subsets of their results along narrower available bandwidths.)

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11 Glossary of Acronyms

ACTS	Advanced Communications and Technologies Services
ADSL	Asynchronous Digital Subscriber Line
ATM	Asynchronous Transfer Mode
CHIN	Canadian Heritage Information Network
CSELT	Centro Studi e Laboratori Telecomunicazioni
CIMI	Consortium for the Interchange of Museum Information
CNI	Coalition for Networked Information
DESIRE	Development of a European Service for Information on Research & Education
EEP	European Education Partnership
EMII	European Museum Information Institute
EPG	Electronic Programming Guide
FID	Fédération Internationale de Documentation
GABRIEL	Gateway to European National Libraries
ICCD	Istituto Centrale per il Catalogo e Documentazione
ICOM	International Council of Museums
ICOMOS	International Committee on Monuments and Sites
ICube	Intelligent Information Interfaces
IETF	Internet Engineering Task Force
IFLA	International Federation of Library Associations
IIC	International Institute of Communications
ISO	International Standards Organisation
JPEG	Joint Picture Experts Group
MDA	Museum Documentation Association
MEDICI	Multimedia Education and Employment through Integrated Cultural Initiatives
MMI	Maastricht McLuhan Institute
MENHIR	Multimedia European Network for High Quality Images Registration
MPEG	Motion Picture Experts Group
NINCH	National Initiative for Networked Cultural Heritage
OLED	Organic Light Emitting Display
RDF	Resource Description Format
RMN	Réunion des Musées Nationaux de France
SGML	Standardized General Markup Language
SUMMA	System for Universal Multimedia Access
TEN	Trans European Networks
UIA	Union Internationale des Associations
UNESCO	United Nations Educational Scientific and Cultural Organisation
WISEUM	Virtual Museum International
XML	Extensible Markup Language

Appendix 1a Special Interest Groups (SIGS) of MEDICI

1. Virtual Museums and Exhibitions General Framework

SIG 1.1 Digitisation techniques, colour and image proofing

SIG 1.2 Archiving tools

SIG 1.3 Software Tools and freeware

SIG 1.4 Distributed Heterogeneous DB: interoperability of systems

SIG 1.5 Human perception and communication effectiveness

SIG 1.6 Quality Assurance

2. ICT in Museums and Archives

SIG 2.1 ICT in Museums and Archives

3. ICT in Science Centres and Museums

SIG 3.1 Life from the Eclipse Project

SIG 3.2 Remote experimentation in chemistry

SIG 3.3 European discoveries exhibition

SIG 3.4 Scientific Museums Browser

4. ICT for Monuments and Sites

SIG 4.1 Conservation, protection and risk evaluation

SIG 4.2 Monuments and Sites archiving tools

5. Cultural Heritage Multimedia and Education

SIG 5.1 Art History, Multimedia and ICT

SIG 5.2 Economics of Cultural Heritage, Multimedia and Education

SIG 5.3 Network to establish PhD in History and Computing

6. Cultural Heritage, Multimedia and Tourism

SIG 6.1 New MMCH Products for Tourism

SIG 6.2 Distribution Strategies for MMCH products

SIG 6.3 Virtual visitor and the real visitor

SIG 6.4 Increase of revenue and /or visitors with MMCH products

SIG 6.5 Co-operation models for museums, technology industry and tourism

7. Marketplace Issues and Trials

SIG 7.1 State of Art (Projects, funding opportunities and business models)

SIG 7.2 Market opportunities

SIG 7.3 Trials promotion

8. Best Practice Handbooks

SIG 8.1 IPR protection methods and tools

SIG 8.2 State of Art (Technologies etc.)

SIG 8.3 Contract Templates

SIG 8.4 Quality Assurance

Appendix 1b. Centres of Excellence Goals as Framework for MEDICI SIGS

1. Interoperability of Content

- | | |
|---|-------------------------------|
| 1. Method | Scuola Normale, Pisa |
| 2. Access | Bonnesanten |
| 3. Reference Rooms and Common Interfaces | MMI |
| Action Lines | |
| 2. ICT in Museums and Archives | |
| SIG 2.1 ICT in Museums, (Libraries) and Archives | |
| 3. ICT in Science Centres and Museums | |
| SIG 3.4 Scientific Museums Browser | |
| 4. Conservation and Restoration | Istituto Centrale, CNR |
| Action lines | |
| 4. ICT for Monuments and Sites | |
| SIG 4.1 Conservation, protection and risk evaluation | |
| SIG 4.2 Monuments and Sites archiving tools | |
| 5. Reconstructions | Bologna |
| 6. Terminology | Vienna |
| 7. Meta-Data | UKOLN |
| 8. Multimedia | GMD |
| 9. Technology | Milan, JRC |
| Action Lines | |
| 8. Best Practice Handbooks | |
| SIG 8.2 State of Art (Technologies etc.) | |
| • Production and publishing | Darmstadt, GMD, IPSI |
| Action Lines | |
| 1. Virtual Museums and Exhibitions General Framework | |
| SIG 1.1 Digitisation techniques, colour and image proofing | |
| SIG 1.2 Archiving tools | |
| SIG 1.3 Software Tools and freeware | |
| SIG 1.4 Distributed Heterogeneous DB: interoperability of systems | |
| • Disclosure and discovery | Bath, UKOLN |
| • Search engines and concept browsing | Heraklion, FORTH |
| • Multilingual access | Vienna, ISO TC 37 |
| • User interfaces and information space browsers | Rome, AVI and Icube |
| Action Lines | |
| 1 Virtual Museums and Exhibitions General Framework | |
| SIG 1.5 Human perception and communication effectiveness | |

10. Economics

London

Action Lines

5. Cultural Heritage Multimedia and Education

SIG 5.2 Economics of Cultural Heritage, Multimedia and Education

6. Cultural Heritage, Multimedia and Tourism

SIG 6.2 Distribution Strategies for MMCH products

SIG 6.4 Increase of revenue and /or visitors with MMCH products

SIG 6.5 Co-operation models for museums, tech. industry, and tourism

8. Best Practice Handbooks

SIG 8.1 IPR protection methods and tools

SIG 8.2 State of Art (Technologies etc.)

SIG 8.3 Contract Templates

2. Arbiters of Quality

Action Lines

1. Virtual Museums and Exhibitions General Framework

SIG 1.6 Quality Assurance

8. Best Practice Handbooks

SIG 8.4 Quality Assurance

3. European Multimedia Education

Action Line

5. Cultural Heritage Multimedia and Education

SIG 5.3 Network to establish PhD in History and Computing

4. Fundamental Research

Epistemology

Sociology

Knowledge Engineering

Politics

Law

Philosophy

Art Theory

Action Lines

5. Cultural Heritage Multimedia and Education

SIG 5.1 Art History, Multimedia and ICT

6. Cultural Heritage, Multimedia and Tourism

SIG 6.3 Virtual visitor and the real visitor

Economics

Education

5. Cultural Policy

6. Share and Create Content

Public Domain

Action Lines

3. ICT in Science Centres and Museums

SIG 3.1 Life from the Eclipse Project

SIG 3.2 Remote experimentation in chemistry

SIG 3.3 European discoveries exhibition

Private Domain

Action Lines

6. Cultural Heritage, Multimedia and Tourism

SIG 6.1 New MMCH Products for Tourism

7. International Dissemination

Appendix 2 European Cultural Networks (source: Council of Europe)

Performance art (Theatre, music, opera.):

Académie Européenne des arts de geste	(Les Transversales)
Baltic Music Network	(BMN)
Bancs d'Essai Internationaux Cologne	(BEI)
Consortium pour le Coordination d'Études Européennes sur le Spectacle et le Théâtre	(CONCEPTS)
Convention Théâtrale Européenne	(CTE)
Dance Network Europe	(DNE)
European Concert Halls Organisation Amsterdam	(ECHO)
Euro Festival Junger Artisten	(EFJA)
European Forum of Worldwide Music Festival	(EFWMF)
European Network of Information	
Centres for Performing Arts	(ENICPA)
European Music Office	(EMO)
Europe Jazz Network Ravenna	(EJN)
Fête Européenne de la Musique	(FEM)
Informal European Theatre Meeting	(IETM)
Intercultural Production House for the Performing Artists (IPHPA)	
Music Organisations of Europe	(MORE)
Network Dance Web	(NDW)
Performing Arts Research Training Studios	(P.A.R.T.S)
Red Espanola de Teatros. Auditorios y Circuitos de Comunidades Autonomas	(RETACCA)
Réseau Printemps	(RP)
Réseau Européenne des Centres d'Information du Spectacle Vivant	(RECISV)
Réseau européen des services éducatifs des maisons d'opéra	(RESEMO)
Théâtre Contemporain pour le Jeune Public	(Archipel)
Union des Théâtres de l'Europe	(ETE)

Visual and Multimedia art:

Cartoon Arts Network	(CAN)
Conseil Européen des Artistes	(ECA)
European Children's Television Network	(ECTN)
European Network of Paper Art and Technology	(ENPAT)
European Textile Network Strasbourg	(ETN)
European Video Services	(EVS)
Germinations	
Réseau Pandora	(RP)

Books and Reading:

Collège Européen des Traducteurs Littéraires...	(CEATL)
European Bureau of Library, Information and Documentation Associations	(EBLIDA)
European Libraries Cultural Network	(ELCN)
Réseau Européen des collèges de Traducteurs Littéraires Arles	(RECT)

Réseau Européen des Centres de traduction
de la poésie contemporaine (RECTPC)
Women's Art Library-International Network (WALIN)

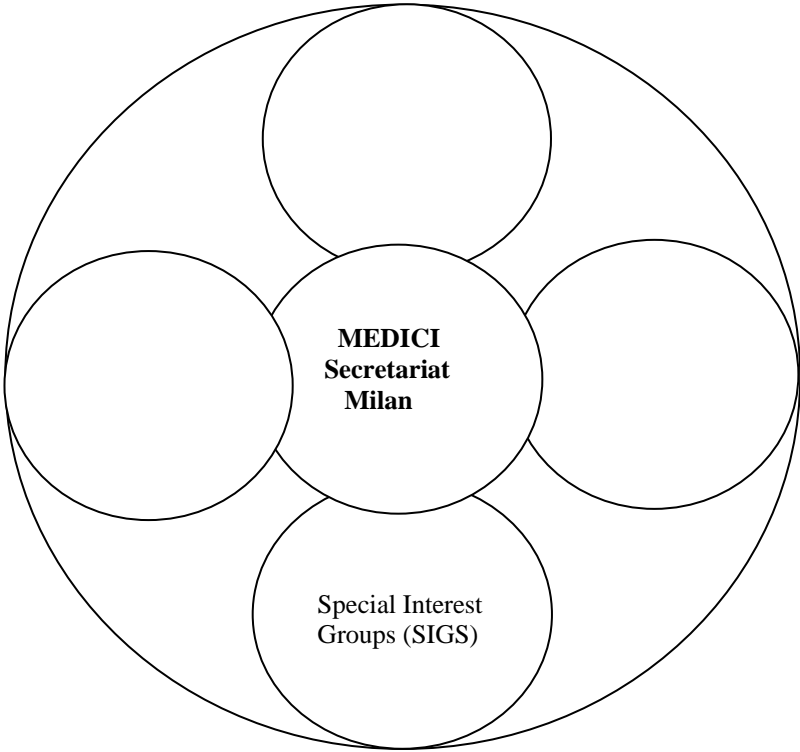
Cultural Heritage, Conservation and Museums:
European Commission on Preservation and Access (ECPA)
European Confederation of
Conservator-Restorators' Organisations (ECCO)
European Cultural Foundation (ECF)
European Environmental Bureau (EEB)
European Forum of Heritage Associations (EFHA)
European Network to Promote the Conservation
and Preservation of the European Cultural Heritage (ENPCPECH)
Telematic Network for Cultural Heritage-Patridata (TNCHP)
Europa Nostra united with the
International Castles Institute (EUROPA NOSTRA-IBI)
European Heritage Group (EHG)
Network of European Museums Associations (NEMO)
Union of European Historic Houses Associations (UEHHA)

Cultural Administration, Management and Policy:
European Network of Cultural Managers (ENCM)
Centre Européen de la Culture (CEC)
Council of European Artists (ECA)
Gulliver Clearing House Amsterdam (GCH)
European Forum for the Arts and Heritage (EFAH)
European Network of Cultural Administration
Training Centres Brussels (ENCATC)
Réseau des Administrateurs Culturels Brussels (ORACLE)

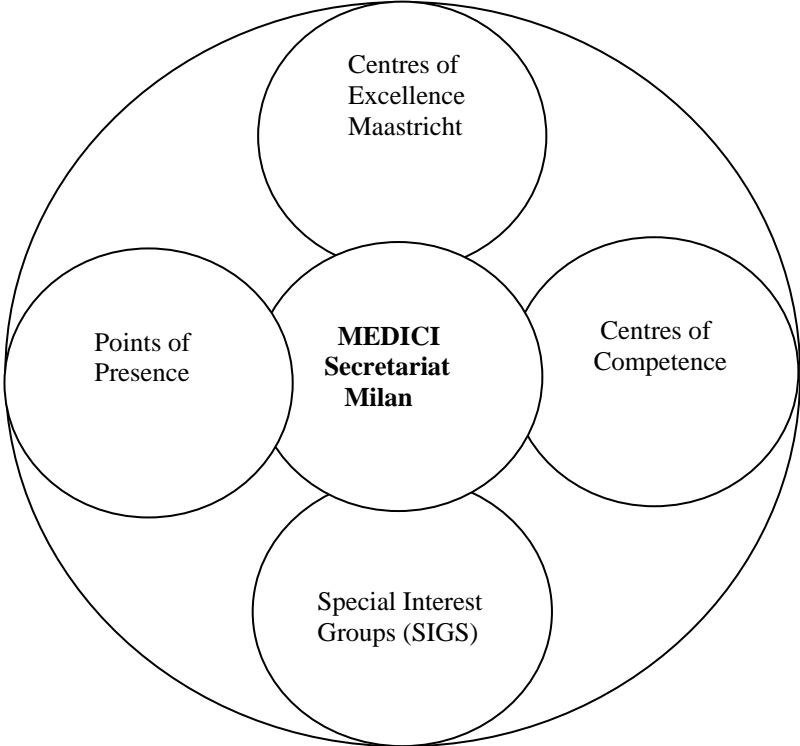
Several Cultural Fields at the same time:
Association des centres culturels de rencontre (ACCR)
Réseau des centres culturels-monuments historiques
Association of European Cities and Regions for Culture(Les Rencontres)
Association internationale des centres de
résidences d'artistes Berlin (RES ARTIS)
Banlieues d'Europe
Collège Européen de coopération culturelle (CECC)
Développement de l'Action Culturelle
Opérationnelle en Région - Nord-Pas-de-Calais (DACOR)
Eurocities
European Computer Network for the Arts (ECNA)
European League of Institutes of the Arts (ELIA)
European Network of Cultural Centres Brussels (ENCC)
European Network of Centres of Culture and Technology (ENCCT)
Network of European Cities of Culture (NECC)
Réseau Pépinières européennes
pour jeunes artistes Marly-le-Roi (Pépinières)
Réseau Européen des Centres Culturels et
Artistiques pour l'Enfance et la Jeunesse or

European Network of Art Organisations for
Children and Young People (EU.NET.ART)
Réseau des Villes européennes des grandes découvertes (RVED)
Réseau Euro-Sud des Centres Culturels (RESCC)
Trans Europe Halles Paris (TEH)

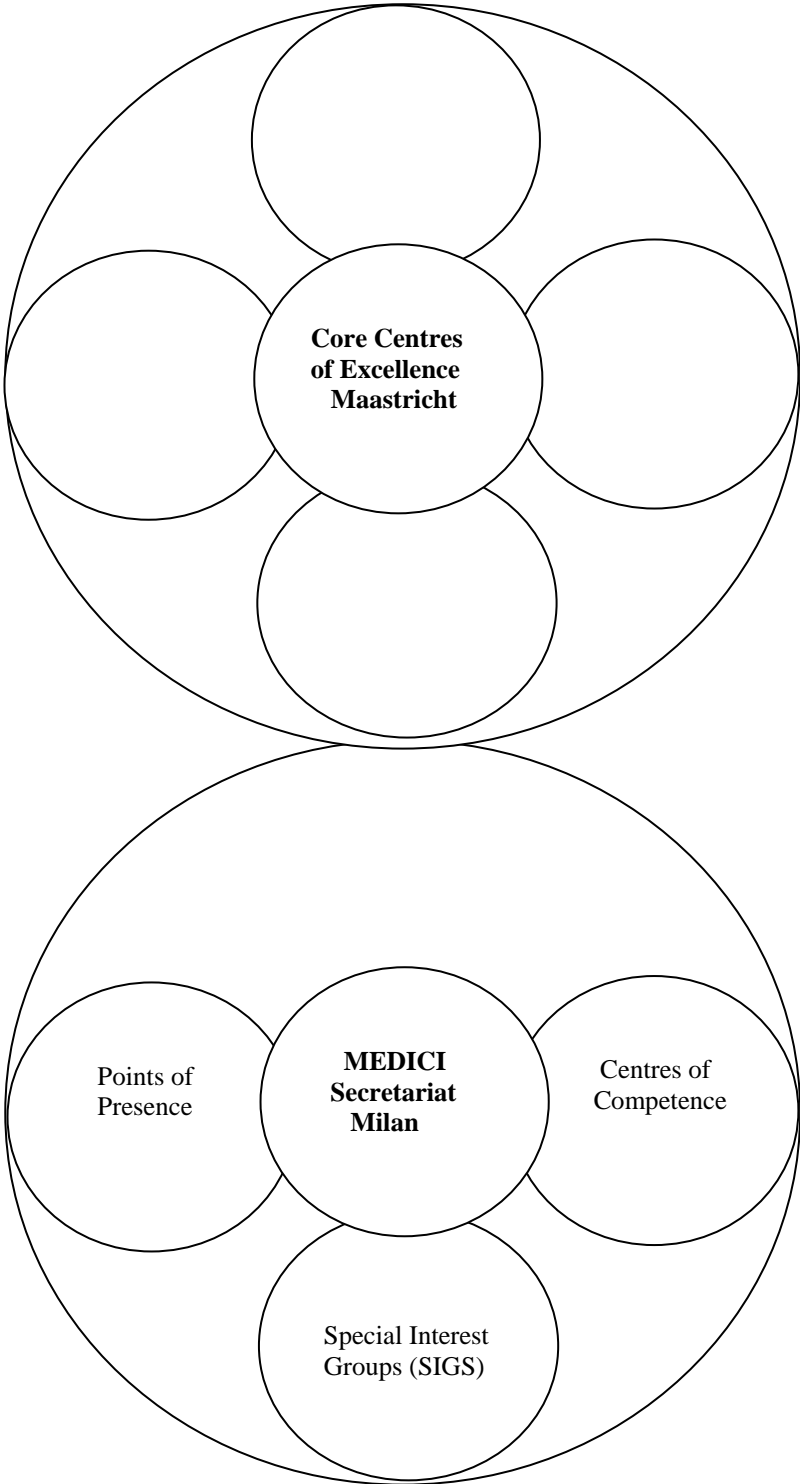
Appendix 3: The Evolution of MEDICI Phase 1



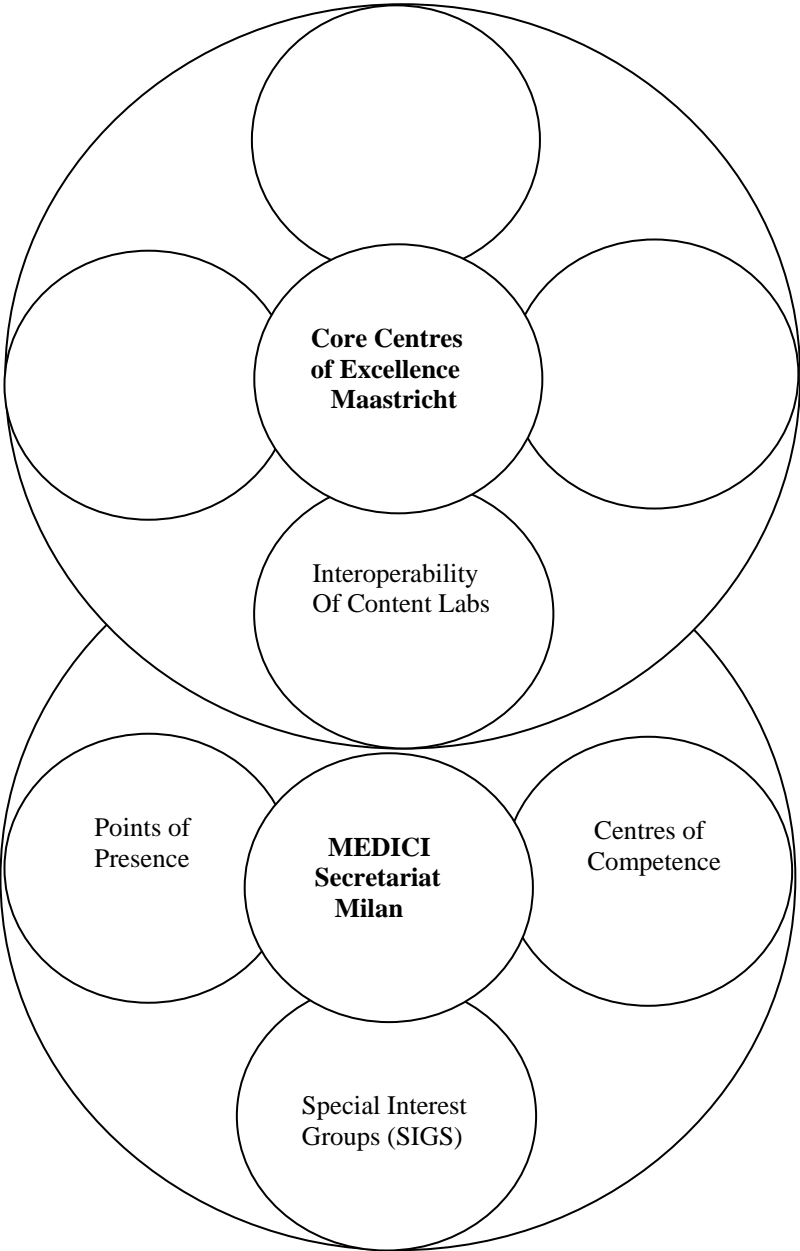
The Evolution of MEDICI Phase 2



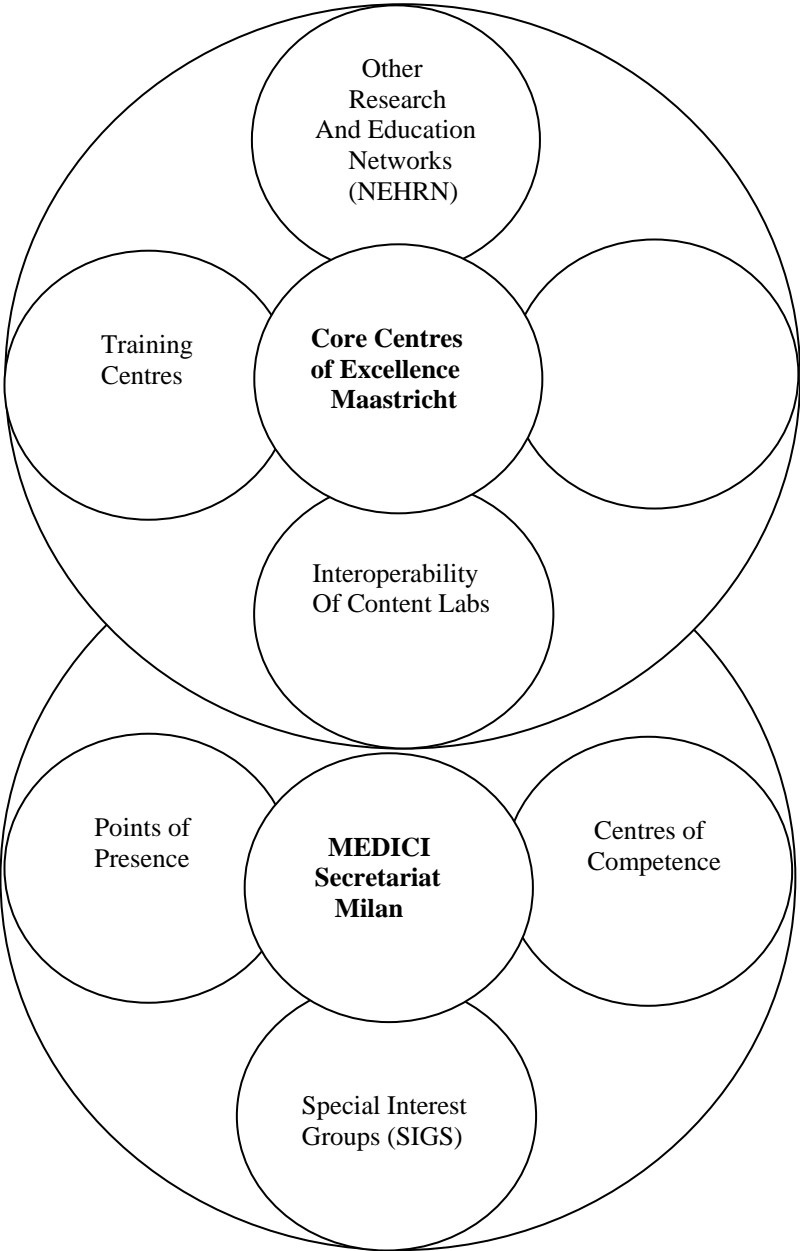
The Evolution of MEDICI Phase 3



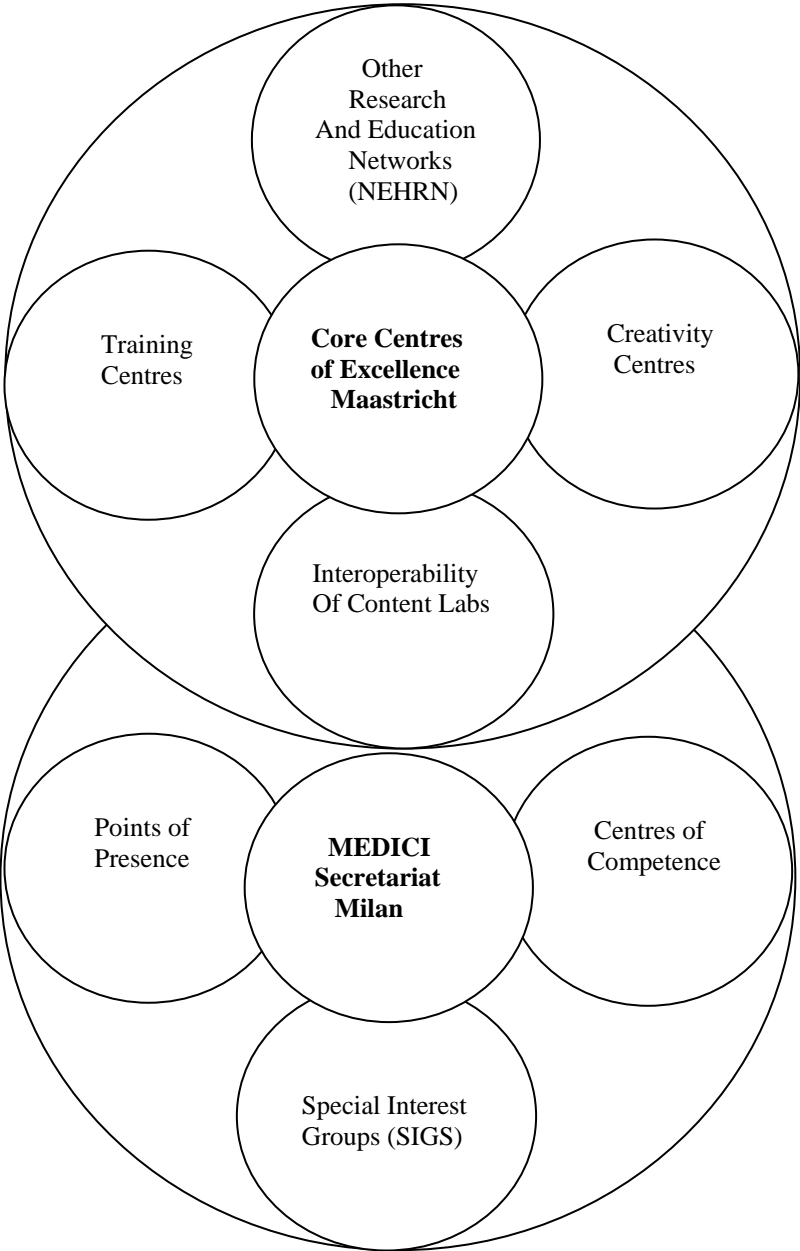
The Evolution of MEDICI Phase 4



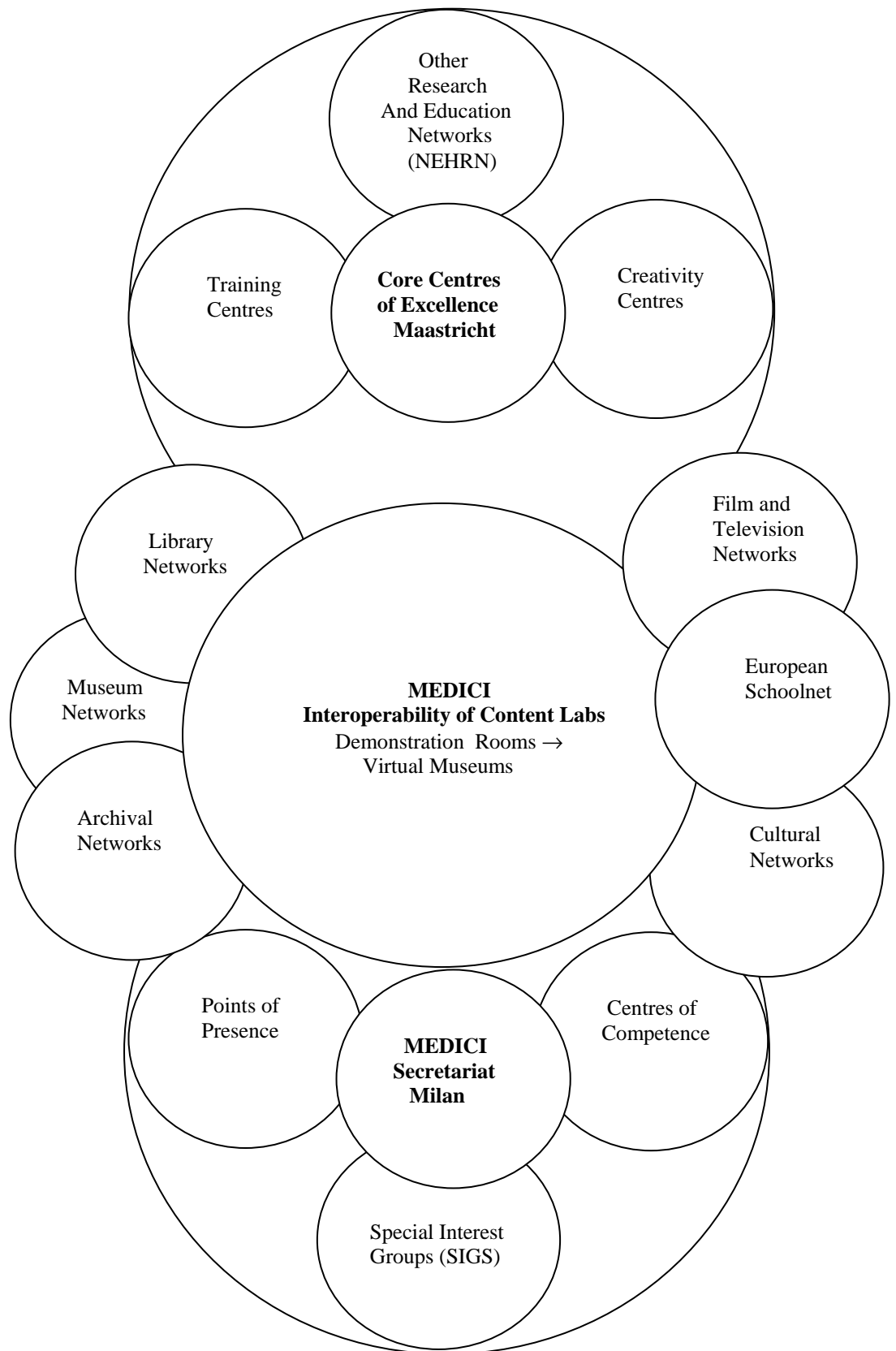
The Evolution of MEDICI Phase 5



The Evolution of MEDICI Phase 6



The Evolution of MEDICI Phase 7



Notes

¹ See: <http://www.geog.fu-berlin.de/eurocis/whl/index.html>

² This explains why the Maastricht McLuhan Institute (MMI) is a European Centre for Digital Culture, Knowledge Organisation and Learning Technology). In addition to the principles of knowledge organisation, the new media are bringing changes to a) processes and systems and b) organizational structures; c) production principles and d) policy. These aspects are being addressed by a new International Institute of Infonomics (IioI), with which MMI has close links.

³ Specifically, DGX re: culture, XIII re: advanced technologies, III re: industry, XII re: research and XXII re: education.

⁴ See: <http://www.medicif.org>

⁵ The materials used by the Pisa led consortium include:

- a) dictionaries
- b) textual descriptions and visual representations of monumental complexes (e.g. Pompeii and Palazzo Pitti)
- c) antiquarian treatises
- d) visual museums (in illuminated atlases)
- e) connoisseurs' notebooks (Goethe, Ruskin, Cavalcaselle)
- f) iconology treatises (e.g. Ripa) and descriptions of ephemeral apparatus for feasts
- g) architectural treatises (particularly Vitruvius and Leon Battista Alberti) and lexical archives for architecture
- h) art and technology treatises (corpus of machines by Francesco di Giorgio Martini)
- i) treatises on optics, perception, and techniques of representation.

⁶ See: <http://www.wbenjamin.org/links.html#writings>.

⁷ For a further discussion of this theme see the author's "Cultural and Historical Meta-data: MEMECS (Metadonnées et Mémoire Collective Systématique)," *WWW9*, Amsterdam, 2000 (in press), pp. 1-13.

⁸ See: "Digital Reference Rooms: Access to Historical and Cultural Dimensions of Knowledge," *INET '99*, San Jose, June 1999 (<http://www.isoc.org> and at the mmi site <http://www.mmi.unimaas.nl>).

⁹ See: <http://www.iac.rm.cnr.it/>

¹⁰ See: <http://www.cineca.it/visit/NUME/>

¹¹ See: <http://www.adis.at/arlt/institut/>

¹² See: <http://www.euophd.psi.uniroma1.it/>

¹³ See: http://europa.eu.int/comm/dg10/avpolicy/index_en.html.

¹⁴ A number of the great museums and cultural institutions of Europe already have projects to digitise their collections and make these available through CD-ROMS and the Internet. Recently there have been plans to create a new virtual gallery, a Eurogallery, which will combine individual elements from a network of museums: e.g. the National Gallery (London), Réunion des musées nationaux (Paris), Van Gogh Museum (Amsterdam). Also under discussion is that major museums will form networks to provide different kinds of Internet offerings aimed at: a) the general public (e.g. Berlin); b) education (Louvre) and c) professional curators and conservators (MDA possibly via a new European Museum Information Institute).

¹⁵ As a first step in this direction, MMI, in conjunction with the Amsterdam/Maastricht Summer University, recently organised a three-day summer course on Digital Cultural Heritage. Such courses and workshops provide scholars and museum professionals with a meeting ground for sharing theoretical ideas and practical techniques. Such neutral meeting places will also foster informal encounters and further greatly the goals of sharing, creating and disseminating cultural content.

¹⁶ This applies equally in other realms. By 2003 Europe will have more Internet users than the United States. A combined Europe will then be in a very different position qua matters of Internet governance especially if it has made alliances in the Far East.