 e-culture net	IST-2001-37491	WP5	D10
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IST-2001-37491

European Network of Centres of Excellence for Research and Education in Digital Culture

Previous Work and State of the Art

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 e-culture net	IST-2001-37491	WP5	D10
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Project Number IST-2001-37491
Project Title European Network of Centres of Excellence for Research and Education in Digital Culture (E-Culture Net)
Document Type PU – Public usage of the result
Document Number addition to Deliverable 1 and 3
Contractual date of delivery -
Actual date of delivery 02 June 2003
Title of Document Previous Work and State of the Art
Contributing work package WP1, WP3
Nature of Document Report
Author(s) Kim H. Veltman
Abstract To share digital culture multi-lingually requires considerable co-ordination through organisations, projects, standards, policy and networks. This survey reviews what has been achieved thus far in Europe. A final section considers briefly parallel activities elsewhere in the world

Keyword list

 e-culture net	IST-2001-37491	WP5	D10
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APPENDIX 1. PREVIOUS WORK AND STATE OF THE ART

Cultural Organisations, Projects, Standards, Policy and Networks:

Introduction

To share digital culture multi-lingually requires considerable co-ordination through organisations, projects, standards, policy and networks. This survey reviews what has been achieved thus far in Europe. A final section considers briefly parallel activities elsewhere in the world.

International Organizations based on Types of Collections and Media

In Europe, systematic treatment of cultural materials began with ecclesiastical collections in the Middle Ages. From the Renaissance onwards, royal, princely, ducal and other private collections played an increasing role. In the nineteenth century, Sir Anthony Panizzi's vision, which led to the British Museum inspired the rise of national libraries.

These national libraries, galleries, museums and archives soon took the lead in integrating efforts in different countries. For instance, Sir Charles Eastlake, the first director of the National Gallery of London (1855-1865) established an informal network concerning restoration with colleagues in France, Germany, and Italy.

By the end of the nineteenth century national libraries, museums and archives emerged as the major collections and places where systematic treatment thereof took place. In the course of the twentieth century the efforts of these institutions became linked through a number of international organizations, which typically dealt with a given type of organization, discipline, collection type, and/or specific media (Figure 1).

1927	Libraries	IFLA	International Federation of Library Associations ¹
1936	Telecommunications	ITU	International Telecommunication Union ²
1946	Museums	ICOM	International Council of Museums ³
1948	Archives	ICA	International Council on Archives ⁴
1969	Sound/Audiovisual	IASA	International Association of Sound and Audiovisual Archives ⁵
1975	Film Commissioners	AFCI	Association of Film Commissioners International ⁶
198x	Television	ITVA	International Television Association now MCAI
199x	"", Media	MCAI	Media Communications Association International ⁷
1999	New Media	IKT	International Association of Curators of Contemporary Art ⁸

Figure 1: Key international organizations founded to address specific disciplines

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

- 1931 Athens Charter⁹ (for the Restoration of Historic Monuments adopted at the First International Congress of Architects and Technicians of Historic Monuments)
- 1946 UNESCO (United Nations Educational, Scientific and Cultural Organization)¹⁰
ICOM (International Council of Museums)¹¹
- 1949 Council of Europe¹²
- 1950 Convention for the protection of Human Rights and Fundamental Freedoms¹³
- 1956 European Cultural Convention (Paris)¹⁴
ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property)¹⁵
- 1964 Venice Charter¹⁶ (International Charter for the Conservation and Restoration of Monuments and Sites)
- 1965 ICOMOS (International Council on Monuments and Sites)¹⁷
- 1972 UNESCO¹⁸ (Convention Concerning the Protection of the World Cultural and Natural Heritage)¹⁹
Canadian Heritage Information Network (CHIN)²⁰
- 1985 Granada Convention (which covers the architectural heritage)
- 1989 Culture Link,²¹ Network of Networks for Research and Co-operation in Cultural Development
CIRCLE (Cultural Information and research Centres Liaison in Europe).²²
- 1992 Valetta Convention (European Convention for the Protection of the Archaeological Heritage (revised)).
- 1996 Heritage Information Network (HEREIN)²³ “instrument for implementing and monitoring the European conventions on the architectural and archaeological heritage.”
- 2001 Lund Principles and Lund Action Plan.²⁴ European content in global networks co-ordination mechanisms for digitisation programmes
- 2001 MINERVA (MInisterial NETwoRk for Valorising Activities in digitisation)²⁵
- 2003 HEREIN database on cultural policies of European countries
- 2005 European University of Culture (Strasbourg)

Figure 2: Key dates in the development of cultural policy, related organizations, projects

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

1922	AFAA	Association Française d'Action Artistique (AFAA) ²⁶
1950	EBU	European Broadcasting Union ²⁷
1977	EMF	European Museum Forum ²⁸
1989	ETFF	European Television and Film Forum ²⁹
1992	EAVO	European AudioVisual Observatory ³⁰
1993	EITO	European Information Technology Observatory ³¹
1994	ECPA	European Commission on Preservation and Access
1994	EFAH	European Forum for the Arts and Heritage ³²
	ARTE	Association for European Television ³³
	ACE	Association des Cinématiqués Européennes ³⁴
1997	EFP	European Film Promotion ³⁵
1999	EMII	European Museum Information Institute ³⁶
1999	ESW	Euro Screen Writers ³⁷
	ETE	European Television Enterprises (ETE) ³⁸
2001	NEMO	Network of European Museum Organizations ³⁹
2001	Euromuse	Network of European Art Museums ⁴⁰
2002	ERPAnet	Electronic Resource Preservation and Access Network ⁴¹


Figure 3: Key European organizations founded to address specific media and disciplines

These international organizations, all based in Europe, contributed greatly to a better co-ordination in respective fields and to the establishment of basic standards. While excellent in themselves, these organisations focussed on their own field with little attention to their relation to other fields and media. Only in recent years has this begun to change. For instance, the audio-visual domain has founded the CCCAA (Co-ordinating Council of Audiovisual Archives Associations) and more recently the Standing Council of European Audiovisual Archives (SCENAA). Even these are limited to the audio-visual domain and do not address the whole spectrum of media.

Policy

In the course of the twentieth century, basic developments in policy⁴² (figure 2) were closely linked with the rise of new integrating institutions in the cultural domain. For instance, the signing of the Athens Charter on restoration of Historic Monuments (1931) occurred in the same year as the founding of the two separate institutions which are now combined as the Centre de Recherche et Restauration des Musées de France.⁴³

Similarly, the signing of the European Cultural Convention (Paris, 1956) occurred in the same year as the founding of ICCROM (International Centre for the Study of the Preservation and Restoration of Cultural Property).⁴⁴ The signing of the Venice Charter⁴⁵ (International Charter for the Conservation and Restoration of Monuments and Sites, 1964) led to the founding of ICOMOS (International Council on Monuments and Sites)⁴⁶ in the following year. The advent of the UNESCO Convention (1972) led to the founding of the Canadian Heritage Information Network (CHIN)⁴⁷ in the same year. More recently, the Lund Principles and Lund Action Plan

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

proved an important stimulus to the MINERVA project (MINisterial NETwoRk for Valorising Activities in digitisation).

European Organisations

While organisations such as IFLA, ICOM, ICOMOS began at the international level they soon developed branches at the European and other levels. For instance, ICOM has a branch for Europe and for German speaking museums (Austria, Germany, Switzerland).

Independent organizations at the European level arose mainly in the second half of the 20th century and especially in the 1990s (figure 3). Some of these have grown out of older institutions. For instance the Museum Documentation Association has led the development of the European Museum Information Institute (EMII), which has been working on a digital content format (EMIIDcf). Since 2000, there has been a dramatic rise in networks for these collection types/media at the European level (cf. figures 5-7).

A number of these projects have focused on new access methods, notably, AQUARELLE (Sharing Cultural Heritage through Multimedia Telematics),⁴⁸ Cultural Heritage Interchange Ontology Standardization tools (CHIOS).⁴⁹ These projects linking the efforts of French researchers at INRIA with those at ICS-FORTH (Crete), introduced important questions of problems of mapping between different authority files, ontologies and vocabularies.

Other projects in this direction are Metadata Engine project (META-E)⁵⁰ and the Academic Subject Gateway Service Europe (RENARDUS).⁵¹ These projects in turn have led to the recent expression of interest by SEMKOS (Semantic Web meets Knowledge Organization for Large-Scale Information Integration),⁵² which has links to E-Culture Net. They have also led to the French Ministry of Culture's important initiative, Accès Multilingue au Patrimoine (AMP), which produced an Expression of Interest and has also joined forces with E-Culture Net.

As might be expected, the areas of new media and particularly born digital art have generated a great deal of attention in the past decade. Much of the serious work has proceeded outside the public eye in major institutions such as the Centre Pompidou and the Bibliothèque Nationale de la France, which have the collection and preservation of such works as part of their mandate.

	IST-2001-37491	WP5	D10
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Conservation	CRISATEL
Preservation	3D-MURALE, AMICITIA, PAST, PRESTO, COLLATE,
Access Cultural Heritage	(ARCHEOGUIDE, ARTISTE, BRAVA, COVAX, CYCLADES, ECHO, ETB, LEAF, META-E, MIND, OPEN HERITAGE, REGNET, RENAISSANCE, RENARDUS, TOURBOT and accompanying measures such as SCHEMAS) ⁵³
Reference	Libraries Sector (ELISE I & II, LAURIN, MALVINE, ONE II & I, VAN EYCK I & II) ⁵⁴
Reconstruction	ARCHEOGUIDE, PAST, 3D-MURALE
Terminology	SALT ⁵⁵
Multilingualism	CLEF
Meta-Data	Semantic Web, ⁵⁶ Cultural heritage (ARCHEOGUIDE, ARTISTE, COVAX, ECHO, ELVIL2000, ETB, EULER, MALVINE, META-E, RENARDUS, SCHEMAS, TOURBOT, VAKHUM, VERITY

Figure 4: Some of the key projects re: digital culture in the 5th Framework

The EU has sponsored select projects such as Contemporary Culture Virtual Archives in XML (COVAX)⁵⁷ and the Open Collaborative Virtual Archives Project (CYCLADES, cf. figure 4).⁵⁸

There are a number of institutes mainly at the national level: e.g., V2 Organisation, Institute for the Unstable Media (Rotterdam)⁵⁹; C3 (Budapest)⁶⁰; ProContra (Moscow)⁶¹; Zentrum für Kunst und Medientechnologie (ZKM, Karlsruhe)⁶² and the Ars Electronica Centre (AEC, Linz).⁶³ Some of these organisations are further linked through a European Network for CyberART (ENCART).⁶⁴ One of the pioneers in this area has been the group at Sankt Augustin (formerly GMD, now Fraunhofer), which created the MARS (Media Arts and Research Studies)⁶⁵ laboratory and more recently Netzspannung's⁶⁶ CAT network tools⁶⁷ for knowledge discovery through visualisation using Kohonen maps and semantic nets. It is foreseen that this will be integrated into E-Culture Net's research matrices.

The European Union has made a number of efforts towards integration in this area. In the late 1990s, Commissioner Oreja' developed a vision of a film and television network.⁶⁸ In 2001, the EC made an open call for Technology Platforms for Cultural and Arts Creative Expressions (CPA 15),⁶⁹ which has led to the artnouveau⁷⁰ thematic network devoted primarily to new art and creativity using the digital media.

European Commission Projects

In its framework programmes the European Commission has made a considerable contribution to a more systematic approach by strategically addressing a series of problems of method with specific projects (figure 4). These projects have brought a number of useful, individual, practical solutions. Notwithstanding some efforts of concertation, in many cases the solutions provided by one project are not known or not accessible to members of another project. A theoretical framework and a coherent understanding of the entire field has yet to be implemented. This is one of the larger challenges of the e-Culture network.

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

Technology	Agent Cities, ⁷¹ AgentLink, ⁷² CaberNet, ⁷³
IDOMENEUS, ⁷⁴ MONET, ⁷⁵ NEURONET, ⁷⁶ RENOIR ⁷⁷	
Conservation	ENCORE ⁷⁸
Preservation and Access	ERPAnet ⁷⁹
Restoration	C2RMF ⁸⁰
Information Description	ISO TC 46 ⁸¹
Terminology	ISO TC 37 ⁸² , Infoterm ⁸³
Multilingualism	ELSNET ⁸⁴
Meta-Data	UKOLN ⁸⁵
Historical Research	NEHRN ⁸⁶
Integration	E-Culture Net

Figure 5: European thematic networks of excellence re: problems of digital culture

European Thematic Networks

An important step forward has been the creation of networks to address each of the above mentioned problems of method. In this respect, the European Commission has, in the past decade, made a great contribution (figure 5). Most of these deal with individual problems in general, rather than with their multi-lingual, multi-cultural and historical dimensions.

Some of these networks, such as ENCORE or NEHRN, are engaged in graduate teaching and training. As the new knowledge economy evolves there will undoubtedly be thousands of new specialized courses in Europe and elsewhere throughout the world. These networks have agreed to work with E-Culture Net which is concerned with creating more general European Masters and Doctorates and will refer students with more specialised interests to these organizations.

A second thrust of the European Union's efforts have been networks following the traditional disciplines and collection types covered by organisations (figure 8 cf. figure 3). Of these perhaps the best known are ERCIM and the Network of Excellence on Digital Libraries (DELOS),⁸⁷ which has strong representation from the computer science community. The scope of these networks varies greatly. For instance, the European Museums Network (EUROMUSE) has some 30 members. Some projects which are not officially called networks have the equivalent of a networking function, such as the European Library (TEL),⁸⁸ which is attempting co-ordination among libraries. This challenge is also being addressed in non EU sponsored projects such as the Gateway to European National Libraries (GABRIEL).⁸⁹

In the past years there have been new networks with respect to new, unstable Media, especially INCCA (International Network of Conservators of Contemporary Art),⁹⁰ which has also led to a recent Expression of Interest (Consortium).⁹¹ One of the challenges for thematic networks such as E-Culture Net has been to create roadmaps for greater co-ordination between these networks.

European Image Projects and Networks

	IST-2001-37491	WP5	D10
---	----------------	-----	-----

Physical networks in the cultural domain supported by the European Commission began in the 1990s. One of the first of these was RAMA⁹² (Remote Access to Museum Archives, 1992-1995). This led to the MENHIR (Multimedia European Network of High quality Image Registration, 1997-1998)⁹³ and Museums of Online (1997-), which launched Cultural Images Brokerage Service⁹⁴ in February 1998 and led subsequently to the Open Heritage⁹⁵ Project (2001).

Informatics, Mathematics	ERCIM ⁹⁶
Libraries	DELOS
Public Libraries	PULMAN ⁹⁷
Archives	MALVINE ⁹⁸
Museums	EUROMUSE ⁹⁹
Cinema	ECN (Europa Cinémas Network) ¹⁰⁰
Music	Interactive MusicNetwork ¹⁰¹
Creative arts	art nouveau
New, Unstable Media	INCCA

Figure 6: European networks of excellence re collection types/media¹⁰²

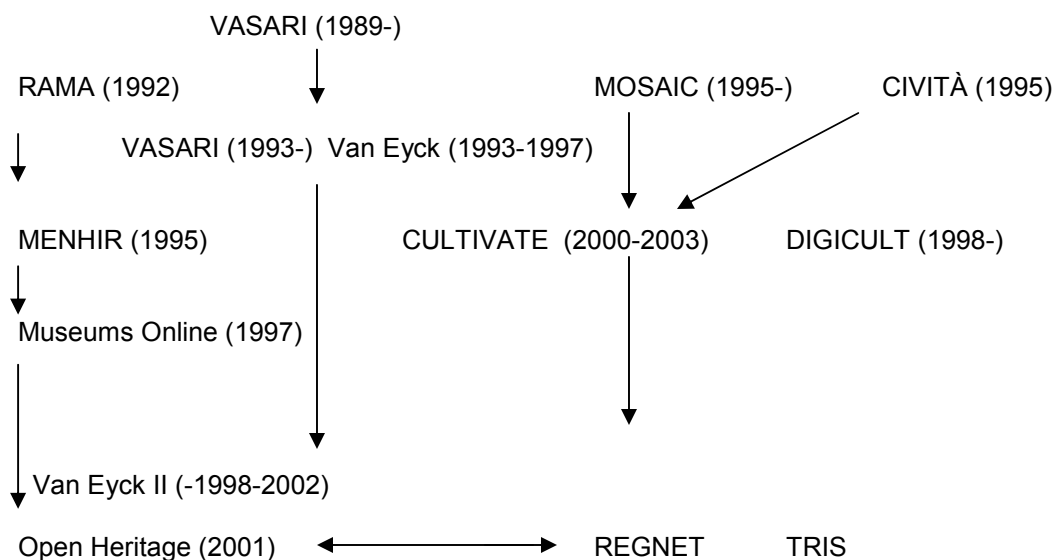


Figure 7: Survey of key EU projects with respect to networks of cultural images cf. Figure 4)

Already in 1989, VASARI (Visual Arts Systems for Archiving & Retrieval of Images) was started and continues in name to this day as the VASARI company.¹⁰³ In 1996, VASARI and the Videomuseum¹⁰⁴ carried out the MAGNETS (Museum And Galleries New Technology Study).¹⁰⁵ WP 4 on Market and General Economic Issues contained an Appendix A: Towards Open Multimedia Access to the World's Cultural Heritage: Museums and Galleries.¹⁰⁶

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

VASARI also initiated the VAN EYCK (Visual Arts Network for the Exchange of Cultural Knowledge) Project (1993-1997),¹⁰⁷ which “developed the technical means for storing, selecting and transmitting high quality images in digital form held in the collections of three art history photographic libraries.” VAN EYCK II (1998-2002) developed an online database of over 70,000¹⁰⁸ images, which was discontinued on 1 January 2003¹⁰⁹ due to lack of enough subscriptions to make the project economically self-sufficient. The problem of non-continuity of access to European projects remains a challenge.

1989-1992	project partner VASARI (DGIII),
1990-1994	project coordinator NARCISSE (DGXIII),
1996-1997	project partner VISEUM (DGXIII),
1997-1998	project partner MENHIR (DGIII),
1997-1998	project partner COST (DGXII),
1997-1999	project partner ACOHIR (DGIII),
1999-2000	project coordinator CRISTAL (DGX) ¹¹⁰

Figure 8: European Network projects with images sponsored by the C2RMF (Paris)


A third and perhaps the most important thrust in the direction of image networks began with the C2RMF, which was also a partner in the original VASARI project. In 1990, the C2RMF became the project co-ordinator for NARCISSE, the Network of Art Research Computer Image Systems in Europe.¹¹¹ This enabled a collection of 70,000 high resolution, scientific images to be digitized which were managed by a multilingual database.¹¹² This led to their participation in further projects including VISEUM, COST, ACOHIR and to their becoming co-ordinators of CRISTAL¹¹³ (Conservation & Restoration Institutions for Scientific Terminology dedicated to Art Learning Network):

to co-operatively create a new thesaurus for the access to interactive electronic documents, which includes information concerning interventions done on works of art, during studies undertaken in laboratories and restorations carried out by workshops. The multilingual dictionaries, which CRISTAL inherited from NARCISSE thesaurus, have been co-operatively elaborated through the web in order to be extended to the specialized vocabulary related to:

- paintings (of restorations and murals),
- sculptures and polychromy,
- graphic arts
- ceramics and metal works.

As a result of these European projects (figure 8) two large multi-lingual electronic databases have emerged with exchange compatibility and on line client/server navigator and viewer access using Netscape and Java¹¹⁴. These databases include more than 4 terabytes of information, which could potentially be made available to researchers throughout Europe. In 2001, C2RMF became a founding partner of E-Culture Net. In the course of the year C2RMF met with UzK to discuss the possibility of linking these databases via Digital Autonomous Cultural Objects (DACOs) to

state.doc		11 June 2003	10/24
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 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

new collaborative on line slide methods which are being developed in the PROMETHEUS project. This collaboration, which builds on twelve years of EU projects, will be one of the concrete starting points for the E-Culture NoE's integrating activities.

Cultural Service Centres

The earliest networked projects had focused on technical problems of sharing images in online environments. The idea of commercial organizations which could deal with museums and act as service centres began as early as 1992 with Musée (Museums Universally Supporting Education and Entertainment),¹¹⁵ which in 2002 became linked with Museum Partners “to improve the overall cost-effectiveness and efficiency of museum operations.” In Europe, Museums over States in Virtual Culture (MOSAIC, conceived in 1995),¹¹⁶ introduced this idea of cultural service centres as a means of making cultural products into a commercial reality, an idea also explored by the commercial sector through the Associazione CIVITÀ.¹¹⁷ Although some organisations became members of both MOSAIC and CIVITÀ, the two organizations remained formally independent.

A founding member of MOSAIC went on to develop the Cultural Service Center, Austria (Graz),¹¹⁸ which in turn became one of the technical members of the CULTIVATE¹¹⁹ programme (2000-2003). This claimed to “answer to the need for a newly structured network supporting the co-operation of all memory institutions (archives, libraries and museums) under the European Commission's Information Society Technologies (IST) Programme.”¹²⁰ CULTIVATE became linked with DIGICULT (Digital Heritage and Cultural Content, 1998-), the “part of **CORDIS** which provides information on all Research and Technological Development (RTD) activities of the European Union.”¹²¹

Some of the founders of MOSAIC and CULTIVATE went on to develop REGNET (Cultural Heritage in Regional networks).¹²² The Open Heritage and the REGNET projects have since become clustered.

One of the founders of Open Heritage is also a key individual in the TRIS¹²³ (Trials Support: supporting and facilitating the execution of IST TRIAL actions by encouraging standardisation, synergy, technology transfer and exploitation)¹²⁴ project and has informal links with the PULMAN¹²⁵ (Public Libraries Mobilising Advanced Network) Network of Excellence. Such projects evidence a recent trend to report on the achievements of other projects.

Comprehensive Networks

Already in 1989, UNESCO in conjunction with the Council of Europe established Culture Link,¹²⁶ (a Network of Networks for Research and Co-operation in Cultural Development) and CIRCLE (Cultural Information and research Centres Liaison in Europe).¹²⁷ In 1990, CIMI (Consortium for the Intechange of Museum Information)¹²⁸ began to address some needs for systematic sharing of materials from museums.

state.doc		11 June 2003	11/24
-----------	--	--------------	-------

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

In 1995, the G7 held a Ministerial Conference and Exhibition on the Information Society (Brussels, February 25-26).¹²⁹ This led to eleven pilot projects of which number five was Multimedia Access to World Cultural Heritage¹³⁰ (later called Electronic Museums and Galleries),¹³¹ which were first demonstrated at the G7 ISAD (Information Society and Developing Countries Conference, Midrand, 13-15 May 1996).¹³² These G7 initiatives led to projects intended to foster links between the EU and North America. One of these was the VISEUM (Virtual Museum International). This was intended to become the first serious demonstration of high bandwidth (ATM) connections with respect to cultural images mainly from the Canadian Museum of Civilisation and the Louvre.¹³³ Prohibitive cost of connections prevented this from becoming a successful venture.

Partially in response to the G7, global initiative, and partly to counter the overenthusiastic activities of Mr Bill Gates in the cultural sector, the European Commission launched a Memorandum of Understanding (MOU) for Multimedia Access to Europe's Cultural Heritage (1996-1998 of DG XIII, X, XXII).¹³⁴ The MOU had well over three hundred signatories. This led in turn to the MEDICI (Multimedia for EDucation and employment through Integrated Cultural Initiative) Framework, which was opened in Vienna in October 1998.

One of the results of the MOU was to set in motion the idea of a European Network of Centres of Excellence, which began officially without funding, at the opening of the MEDICI Framework in Vienna. Led by the Maastricht McLuhan Institute (MMI) a small number of European universities (the Scuola Normale in Pisa, Bologna, Madrid, and subsequently Vienna, Cologne and Oxford) laid the foundations for what became the E-Culture Net thematic network in June 2001.


TC 36	Cinematography
TC 37	Terminology and other language resources
TC 42	Photography
TC 43	Acoustics
TC 46	Information and documentation
TC 130	Graphic technology
TC 171	Document imaging applications
TC 173	Technical systems and aids for disabled or handicapped persons
TC 211	Geographic information/Geomatics
TC 225	Market research

Figure 9: Relevant Technical committees in the ISO

Standards

Parallel with the trend towards integrating organizations and projects through policy and networks has been a growing awareness of the need for standards and solutions used in common. Standards in the formal sense are just over half a century old at the international level. The International Organisation for Standardisation (ISO)¹³⁵ was founded in 1947. Among its 225

state.doc		11 June 2003	12/24
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 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

Technical Committees (TCs) eleven are relevant with respect to digital culture (Figure 9). Of these, TC 37 and 46 have had some influence especially on the library world. In the cultural field as a whole awareness of this work is often minimal.

Throughout the 1970s and 1980s awareness of the need for standards was largely through the professional bodies, i.e. IFLA looked after the library world, ICOM after the museum world. In addition there were a few organisations such as the Réunion des Musées de France, the Museum Documentation Association (MDA),¹³⁶ the Institut für JTC 1 Information technology.

Museumkunde (Berlin) and the Canadian Heritage Information Network (CHIN), which looked to larger frameworks.

The advent of computers changed this paradigm. In the digital mode, any medium can be translated into any other medium: hence a printed book can potentially become a series of images or appear in a film or conversely. In digital mode objects produced in one sense mode can potentially be translated into any other sense mode: hence an oral recording can be printed (in visual mode) or even printed in Braille (in tactile mode).

As a result the knowledge production life cycle now covers the entire spectrum of media and production modes and is no longer limited to single professions (e.g. printing). The full implications of this revolution are only beginning to become evident, and we still have no organisations to deal fully with the challenge.

As noted earlier, one of the first important responses to these emerging challenges was the founding of the CIMI (Computer Interchange of Museum Information) Consortium in 1990. In 1994, CIMI received a grant to support Cultural Heritage Information Online (CHIO). The project aimed to “create a database of multimedia folk art and standards and formats for representing information such as text, images, and publications.”¹³⁷ This led to CHIO II and the MIDIIS (Museum Initiative for Digital Information Interchange Standards) project.¹³⁸

In Europe, a directive on 13th September 1995 from the European Commission Directorate General III Industry to CEN/CENELEC/ETSI in the field of Information Technology and Telecommunications (reference number: SOGITS N 884) led to a project called "Standards for Cultural Heritage Information On-line," CHIO, which started in early 1997.¹³⁹ The North American CHIO and the European CHIO were not formally connected. The EU CHIO led to recommendations for standardization threads with respect to eleven areas (figure 10). In 1999, these results became the starting point of standardising efforts of the EU's OII (Open Information Interchange) Standards and Specifications, which produced a Museum Information Standards list¹⁴⁰ as part of a much larger initiative to provide information on standards in a series of areas (figure 10)¹⁴¹ This in turn became the basis of the EU's Diffuse standards list.¹⁴²

Independently of these high level efforts, in November 1995, DG XIII initiated an MOU for access to Europe's cultural heritage, which also had a committee to collect standards and resulted

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

in a publication. This led to the MEDICI framework, which also began a bottom up collection of standards.

In 1998, when the Cultural Heritage activities of DG XIII were moved from Brussels to Luxembourg the scope of the department first widened to include scientific and cultural heritage and then focussed on preservation and intelligent heritage as is reflected in the department's new title: Preservation and Enhancement of Cultural Heritage.¹⁴³ Interest in standards is now focussed on preservation and to benchmarking at the governmental level via MINERVA.

These problems have been compounded by the rise of so-called industry standards whereby large companies impose de facto standards on the market. Here efforts such as the World Wide Web (WWW) Consortium have played an intermediary role in bringing industry partners together with a larger user community. Through its culture and society track (initiated in 1998) the WWW has at least acknowledged the potential role of this dimension. Even so, close coupling between needs of industry and the real needs of users remains a challenge.

1. Documentation Standards
2. Metadata Standards
3. Interoperability and System Interface Standards
4. Composite Data Structures
5. Object Oriented Business and Application Models
6. Thesauri and Multilingual Thesauri
7. Digitisation
8. IPR, Watermarks
9. Access Control, Conditional Access and Payment
10. Identification of Objects
11. Preservation of Digital Archives

Figure 10: Areas for standardisation in cultural heritage according to the CHIO project

	IST-2001-37491	WP5	D10
---	----------------	-----	-----

<p>Electronic Commerce</p> <ul style="list-style-type: none"> <input type="checkbox"/> Marketing <input type="checkbox"/> Contract negotiation <input type="checkbox"/> Logistics management <input type="checkbox"/> Payment <input type="checkbox"/> Administration <p>Sectorial Data Interchange</p> <ul style="list-style-type: none"> <input type="checkbox"/> Product data <input type="checkbox"/> Scientific information <input type="checkbox"/> Geographic information <input type="checkbox"/> Medical informatics <input type="checkbox"/> Library information <input type="checkbox"/> Museum information <input type="checkbox"/> Archiving <p>Others</p> <ul style="list-style-type: none"> <input type="checkbox"/> Digital television <input type="checkbox"/> Miscellaneous applications <p>Data Categorization</p> <ul style="list-style-type: none"> <input type="checkbox"/> Metadata interchange <input type="checkbox"/> Classification <input type="checkbox"/> Searching <input type="checkbox"/> Directories 	<p>Data Coding for Interchange</p> <ul style="list-style-type: none"> <input type="checkbox"/> Character sets <input type="checkbox"/> Documents <input type="checkbox"/> Multimedia/hypermedia <input type="checkbox"/> Audio <input type="checkbox"/> Video <input type="checkbox"/> Raster graphics <input type="checkbox"/> Vector graphics <input type="checkbox"/> Colour information <p>Communications</p> <ul style="list-style-type: none"> <input type="checkbox"/> Electronic conferencing <input type="checkbox"/> Webcasting <input type="checkbox"/> Electronic mail and newsgroups <input type="checkbox"/> File transfer <p>Others</p> <ul style="list-style-type: none"> <input type="checkbox"/> Application program interfaces <input type="checkbox"/> Electronic data interchange (EDI) <input type="checkbox"/> Electronic payment mechanisms <input type="checkbox"/> Information security
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Figure 11: Survey of topics where the OII provided information about standards

In short, through the ISO, Europe leads the world with respect to standards of which a number are relevant for digital culture. The efforts of DG III have led to a series of useful efforts via CHIO, OII and Diffuse. The efforts of DG XIII have initiated other bottom up efforts. Integration of these efforts will need to be the next step.

Most of these efforts have occurred with respect to traditional categories. As a result Europe continues to tackle the problem of standards of the 21st century using organisations and categories stemming largely from the nineteenth and twentieth centuries. Needed is a new framework for the entire digital knowledge production life-cycle.

PRELIMINARY CONCLUSIONS

From the above emerge three fundamental challenges:

1) European organizations and especially the European Commission have made enormous contributions by addressing effectively all the basic ingredients needed for integration. There have been valuable standards, solutions, projects, on security, storage, multilingualism,

 e-culture net	IST-2001-37491	WP5	D10
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semantics, reconstructions, spatio-temporal access, interfaces, multimodal interfaces, virtual environments and even preliminary work on virtual heritage centres. A next step is a coherent framework whereby research resources, methods and critical thought can be shared in a secure, multilingual and collaborative environment. We need a combination of isolated elements to


Libraries	Museums	Archives	Broadcast Media	Unstable Media	Performance Media
Books	Paintings	Documents Film	Interactive TV	Kinetic Art	Theatre
Manuscripts	Drawings Letters	Television	Internet	Dance	
	Sculpture Protocols	Video	Email Performance Art		Music
			Collaborative Design		Email Performance Art
			Video		
			CSCW		
			CSCL		

Figure 12: Potential Spectrum of Enduring Knowledge in Memory Institutions to be shared in the Distributed European Electronic Dynamic resource (DEED)

provide a solution that allows us to share existing research and new e-content. The E-Culture Net Thematic Network has outlined a vision of how this might be achieved (cf. WPs 1, 3, 6).

2) A number of the projects have produced valuable research contents in the form of image and text databases, reconstructions of objects, sites and even cities. These resources range in size from a few megabytes, through hundreds of gigabytes to a few terabytes. These resources are not yet accessible to the research community for three basic reasons. They require a) a solution for sharing (1 above); b) an administrative framework for integrating research from local, regional and national levels and in some cases c) access to high-speed networks. The first two of these challenges have been addressed in the E-Culture Net vision (WPs 1, 3). To address the third challenge informal contacts with the EU's GEANT and Grid initiatives have been made. To operationalise these three solutions the creation of an EEIF is foreseen.

3) While it is easy to arrive at an interim, working solution for sharing, it is difficult to assure that these standards and solutions remain up to date. This challenge is elusive partly because our existing networks are organized in terms of disciplines/media types and problems of the analog tradition. For instance, projects such as PRESTO-factory are exploring the production life cycle of a single medium. Meanwhile, the digital mode calls for new cross-media and inter-media solutions. We need new research matrices to keep our solutions up to date. Needed is a new integration of the efforts of specialized networks and organizations in order to gain an understanding of the entire knowledge production life-cycle involving all media.

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

The E-Culture Net Thematic network produced a first set of such research matrices at the macro-level (in terms of organization) and the micro-level (in terms of processes) in order to keep solutions up to date (WP3). This will give leadership to the integration of efforts of specialised organisations and networks to understand the entire knowledge production life cycle involving all media. In addition WP7 has produced an operational online database to be used by the NoE. This database allows distributed information.

Three Integrating Principles

To answer these challenges three integrating principles are suggested: 1) a Distributed European Electronic Dynamic Resource (DEED); 2) Networks for Shared Content and 3) Research Matrices to update standards, solutions and trends.

Distributed European Electronic Dynamic resource (DEED)

The new solution for sharing should not be a centralized server for several reasons. A first is pragmatic: no single server is large enough to handle all the knowledge and information in the field of digital culture. Another reason is strategic. A centralized system is too likely to be open to attack. Having a distributed system is therefore important from a viewpoint of preservation. Needed therefore in the long term is a Distributed European Electronic Dynamic Resource (DEED). The E-Culture Thematic Network has identified at least eight components of such a resource, including a Distributed Digital Legal Repository (or Digital Centre of Memory of Culture, DCMC), a Virtual Reference Room; Personal and Collaborative Environments for E-Learning and a Virtual Agora. The DEED would integrate a whole spectrum of enduring knowledge (figure 12) with the new forms of collaborative and personal knowledge which are becoming available through the Internet.

Rather than attempting to achieve something so complex in a single, gargantuan project, a modular approach is almost certainly preferable. A preliminary Distributed Electronic European Dynamic resource (DEED) will allow sharing existing resources and to understand better the detailed challenges arising from a shared environment.

Networks for Shared Content

The existing networks typically unite organizations of a particular kind (e.g. museums, libraries) or partners working on a specific problem (e.g. preservation). Networks such as CULTIVATE are organized along national lines but are not focused on sharing content. Needed is a European E-Culture Net, which has branches in each country to identify and integrate content at national, regional and local levels. These branches must bring together cultural organizations, research institutions and industry in a single network.

	IST-2001-37491	WP5	D10
---	----------------	-----	-----

Research Matrices to update standards, solutions and trends

Any solution leading towards a DEED needs to be kept up to date. One way to do this is to have the players in the network (cultural organizations, research institutions and industry) report on their latest standards, solutions and trends. A second way is to have input from specialized networks (e.g. DELOS) and integrate their input with the insights of those in policy (e.g. MINERVA). In effect this means a new level of co-operation in the direction of a network of networks.


In the longer term we may need a new category of ISO standards which bridges individual media, disciplines and production modes to arrive at a new level of understanding with respect to the full range of digital culture. These cross-media and cross-sectorial standards need to be linked with European policy and applied and used throughout the cultural field. This would entail a new kind of network, which integrates cultural organisations, research institutions, industry and has close links to government. Fortunately, a number of pieces are already in place. The results of such a map of the knowledge production life cycle might later be integrated into a future version of the CORDIS database.

Combining these three integrating principles in a single E-Culture NoE will lead to a new integration of e-content, e-creativity with e-learning and new forms of e-entertainment and e-work (figure 13). Instead of uni-lingual access this will provide multi-lingual, multi-cultural access with historical dimensions. Instead of reflecting only today’s classifications, this approach will eventually provide access to multiple classifications at different levels (local, regional, national, international and global). Through such an approach we will have access to the unity of diversities that is the secret of Europe’s past and a key to its future.

The Webster Dictionary reminds us that a deed is among other things an “action” and “a signed and usually sealed instrument containing some legal transfer, bargain or contract.” A Distributed European Electronic Dynamic resource (DEED) as a secure, multilingual solution for sharing research and content is thus a fitting vision.



Figure 13: E-Culture Net integrates E-Content, E-Creativity, E-Learning and E-Work

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

Postscript: Elsewhere in the World

Work on the challenges of digital culture is underway all over the world. In 1972, the Canadian Heritage Information Network (CHIN) was formed. Starting as a centralised clearing house, CHIN evolved in the 1990s to become one of the first distributed networks linking image databases in hundreds of museums throughout the country. CHIN remains one of the most advanced examples of a cultural heritage network. It is particularly important because it includes a physical network, has taken part in very high-speed experiments through CANARIE (Canadian Advanced Network for Research Industry and Education), and is building bridges between museum, library, and archive networks.

In the United States culture is not considered to be a matter of the federal government. Consequently it is the only major country of the world without a Ministry of Culture. Accordingly, it is often represented at the international level by one of its largest cultural organizations: the Smithsonian Institution, and/or by the Getty Trust.

In the early 1980s when the Getty Art History Information Program and the Getty Conservation Institute were being formed they drew on a number of resources and personnel from both CHIN and the Canadian Conservation Institute (CCI).

In 1984, the Scuola Normale Superiore (Pisa) in conjunction with the nascent Getty Trust organised a second world conference on the use of computers and art history.¹⁴⁴ The Getty also established an Art History Information Program (AHIP), and at first promised to play a serious role in the cultural field. In 1995, the Getty AHIP Imaging Initiative launched a Museum Educational Site Licensing Project.¹⁴⁵ The following year the Trust published the Getty Research Agenda for Networked Cultural Heritage (1996). Soon after the Getty AHIP was renamed the Getty Information Institute (GII). It participated in both the G7 and MOU activities, before being closed in June 1999.

One of the founders of the Getty's Museum Educational Site Licensing Project, subsequently joined the founder of Archives and Museum Informatics,¹⁴⁶ which helped to found AMICO (Art Museum Image Consortium, 1997),¹⁴⁷ established the Museums on the Web Conferences (1997) and also organized the ICHIM (International Cultural Heritage Informatics Meetings, beginning in 1991). The year 1997 also saw the founding of the Museum Computer Network Conferences (MCN).¹⁴⁸

In the United States, the Coalition for Networked Information (CNI) and the National Initiative for Networked Cultural Heritage (NINCH) have been two of the leading organisations. While these are engaged in many interesting projects there is little evidence of a systematic approach to link libraries, museums and archives. It is telling that NINCH commissioned a European institute, HATII (Glasgow) to develop their system for them. The most impressive projects in the direction of integration have come from the Research Libraries Group (RLG) with their Cultural Materials project and the Ohio Computer Library Centre (OCLC) with their Dublin Core project. The National Science Foundation (NSF) has also had some projects linking with Europe and Japan in this domain.

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

Japan became very active in the field of digital culture in the latter half of the 1990s. At the national level the Japanese Digital Archives project introduced the idea of a digitisation as a matter of government policy. In 2000, the National Institute of Informatics founded a new Network of Centres of Excellence in Digital Silk Roads linking more than 70 institutions throughout Japan. This led to an international conference in 2001, and to the signing of a formal agreement with UNESCO in March 2003.

There are other significant organisations and networks in Russia, Australia (cf. Australian Culture and Recreation Portal)¹⁴⁹, China and elsewhere. While all of these countries have interesting solutions and many of them have quality content at the very highest level, almost without exception they are concerned primarily with solutions limited to their own country. As a result most are limited to uni-lingual solutions. Exceptions are Canada with its bilingual tradition (English and French) and China, which is working closely with ISO/Unicode to address challenges of its eight major dialects and its many languages. Notwithstanding colonialism and imperialism in the past, Europe remains unique as the only one of the five continents, which has sought to develop global solutions (figure 22) without imposing on others a single language or a single way of doing things. Perhaps, this starting point from a unity of diversities makes the European approach of interest everywhere in the world.

¹ <http://www.ifla.org/>

² <http://www.itu.int/aboutitu/overview/history.html> This was formerly the (ITU) International Telegraph Union founded in 1865. Another example of an early organisation is the ASIFA (Association Internationale du film d'Animation, founded in 1901).

See: <http://www.ifla.org/III/index.htm>

³ <http://icom.museum/organization.html>

⁴ <http://www.ica.org/static.php?ptextid=histoire&plangue=eng>

⁵ <http://www.iasa-web.org/iasa0001.htm>

⁶ <http://www.afci.org/index2.asp>

⁷ <http://www.itva.org>

⁸ <http://www.iktsite.org/>

⁹ http://www.icomos.org/athens_charter.html

¹⁰ <http://www.unesco.org/general/eng/about/what.shtml>

¹¹ <http://icom.museum/organization.html>

¹² http://www.coe.int/t/e/social_cohesion/soc-

[sp/general_information/02_Mission_Statement/introduction.asp](http://www.coe.int/t/e/social_cohesion/soc-general_information/02_Mission_Statement/introduction.asp)

¹³ <http://conventions.coe.int/treaty/en/WhatYouWant.asp?NT=005>

¹⁴ <http://conventions.coe.int/Treaty/EN/DeclareList.asp?NT=018>

¹⁵ <http://www.iccrom.org/eng/about/whats.htm>


¹⁶ http://www.international.icomos.org/e_venice.htm

¹⁷ <http://www.icomos.org/>

¹⁸ <http://whc.unesco.org/nwhc/pages/doc/main.htm>

¹⁹ www.unesco.org/whc/world_he.htm

²⁰ <http://www.chin.gc.ca/>

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

21 <http://www.culturelink.org/>

22 <http://www.circle-network.org/>

23 http://www.european-heritage.net/sdx/herein/national_heritage/introduction.xsp

24 http://www.cordis.lu/ist/ka3/digicult/lund_principles.htm

25 <http://www.minervaeurope.org/>

26 <http://212.180.100.48/index.php>

27 <http://www.ebu.ch/union/union.php>

28 http://stars.coe.fr/museum/emf_e.htm

29 <http://www.eim.de/TVForum.htm>

30 <http://www.obs.coe.int/>

31 <http://www.eito.com/previous.html>

32 <http://www.efah.org/>

33 <http://lessites.service-public.fr/cgi-bin/annusite/annusite.fcgi/nat6?lang=uk&orga=203>

34 <http://www.ace1.nl/>

35 <http://www.efp-online.com/>

36 <http://www.emii.org/>

37 <http://www.geocities.com/Hollywood/Academy/5698/>

38 <http://www.etve.com/>

39 <http://www.ne-mo.org/>

40 <http://www.smb.spk-berlin.de:8080/euromuse/home/index.jsp>

41 <http://www.erpanet.org/>

42 A more detailed list of such cultural policy documents is found at:
<http://www.getty.edu/conservation/resources/charters.html#1904>

43 <http://www.ics.forth.gr/isl/projects/cristal-french/c2rmf.html>

44 <http://www.iccrom.org/eng/about/whats.htm>

45 http://www.international.icomos.org/e_venice.htm

46 <http://www.icomos.org/>

47 <http://www.chin.gc.ca/>

48 <http://www.infoloom.com/gcaconfs/WEB/barcelona97/toche55.HTM>
<http://www.eu-esis.org/Presentation/Michard/Michard.htm>
<http://www.inria.fr/rapportsactivite/Ra-Dev98/mediaculture/AD98126.html>

49 <http://www.ics.forth.gr/proj/isst/Projects/chios.html>

50 <http://meta-e.uibk.ac.at/>

51 <http://www.renardus.org/>

52 <http://www.lub.lu.se/SEMKOS/>

53 <http://www.cordis.lu/ist/ka3/digicult/en/projects.html>. Note that many of those projects which are listed under access to cultural heritage return below in the thematic heading of Meta-Data.

54 <http://www.cordis.lu/ist/ka3/digicult/en/activity/tap.html#Information%20Engineering>

55 <http://www.cordis.lu/ist/projects/99-10951.htm>

56 <http://www.cordis.lu/ist/ka3/iaf/iii41obj.htm>

57 <http://www.covax.org/>

58 <http://www.ercim.org/cyclades/>

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

59 <http://www.v2.nl/index.php>
60 <http://www.c3.hu/>
61 <http://www.nettime.org/nettime-nl.w3archive/200004/msg00033.html>
62 <http://www.zkm.de>
63 <http://www.aec.at/>
64 <http://www.encart.net/>
65 <http://www.imk.fraunhofer.de/sixcms/detail.php?template=&id=1007>
66 <http://netzspannung.org/start/flash/>
67 <http://awake.imk.fraunhofer.de/>
68 http://europa.eu.int/comm/dg10/avpolicy/index_en.html
69 <http://www.cordis.lu/ist/cpt/2002cpa15.htm>
70 <http://pi.ijs.si/ProjectIntelligence.Exe?Cm=Project&Project=ARTNOUVEAU>
71 <http://www.agentcities.net/top.jsp>
72 <http://www.agentlink.org/>
73 <http://www.newcastle.research.ec.org/cabernet/>
74 <http://www.ced.tuc.gr/Research/IDOMENEUS.htm>
75 <http://monet.aber.ac.uk/>
76 <http://www.kcl.ac.uk/neuronet/>
77 <http://www.soi.city.ac.uk/~gespan/projects/renoir/proposal/proposal.html>. Cf. ERUDIT
<http://www.erudit.de/erudit/index.htm> which is no longer active.
78 <http://www.kulturnet.dk/homes/ks/encore/>
79 <http://www.erpanet.org/>
80 <http://www.ics.forth.gr/isl/projects/cristal-french/c2rmf.html>
81 <http://www.nlc-bnc.ca/iso/tc46sc9/>
82
<http://www.iso.ch/iso/en/stdsdevelopment/tclist/TechnicalCommitteeDetailPage.TechnicalCommitteeDetail?TC=37>
83 <http://linux.infoterm.org/infoterm-e/i-infoterm.htm>
84 <http://www.elsnet.org/>
85 <http://www.ukoln.ac.uk/>
86 <http://nehrn.hum.sdu.dk/>
87 <http://www.ercim.org/delos/>
88 <http://www.europeanlibrary.org/>
89 <http://portico.bl.uk/gabriel/>
90 <http://www.incca.org/>
91 http://consortium.cordis.lu/dsp_details.cfm?ID=33118
92 <http://media.it.kth.se/SONAH/ANALYSYS/race/pl7/present/rama.htm#Information>
93 <http://www.cordis.lu/esprit/src/mm-syn2.htm#24378>. This led to the creation of a non-profit company MUSEE, Inc. (Museums and Universities Supporting Educational Enrichment, Inc.) and the more commercial Museums On Line (<http://www.museum-online.com/>, no longer active).
cf. <http://www.cordis.lu/ist/98vienna/xmenhir.htm>

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

⁹⁴ <http://www.iihe.ac.be/scimitar/J0499/e-publishing.html>

⁹⁵ <http://www.openheritage.com/intro.html>

⁹⁶ <http://www.ercim.org/>

⁹⁷ <http://www.pulmanweb.org/>

⁹⁸ http://www.onb.ac.at/koop-litera/leaf/intro/malvine_leaf_flyer.pdf

⁹⁹ <http://www.euromuse.net/>

¹⁰⁰ <http://www.europa-cinemas.com/home.html>

cf. http://europa.eu.int/comm/avpolicy/media/cineday_en.html

¹⁰¹ <http://www.multimediamusicnetwork.org/>

¹⁰² cf other non EC networks such as ENCIP European Network for Communication and Information Perspectives¹⁰² cf. http://www.encip.org/static/encip/set_mission.lasso

¹⁰³ <http://www.vasari.co.uk/vasari.htm>

¹⁰⁴ <http://www.videomuseum.fr/magnt/magntc.htm>

¹⁰⁵ <http://www.vasari.co.uk/magnets/wp4/index.html#contents>

¹⁰⁶ <http://www.vasari.co.uk/magnets/wp4/app-a.html>

¹⁰⁷ <http://www.cordis.lu/libraries/en/projects/vaneyck.html>

¹⁰⁸ http://www.archimuse.com/mw2002/exhibit/ex_175000638.html

¹⁰⁹ <http://www.vaneyck.org/>

¹¹⁰ <http://www.ics.forth.gr/isl/projects/cristal-french/c2rmf.html>

¹¹¹ <http://www.ics.forth.gr/isl/projects/cristal-french/narcisse.html>

¹¹² <http://www.ics.forth.gr/isl/projects/cristal-french/narcisse.html>

¹¹³ http://www.ics.forth.gr/isl/projects/projects_individual.jsp?ProjectID=5

¹¹⁴ The multilingual painting database contains:

15,000 museological work files, scientific and technical photo-archive files on 160,000 photographic and radiographic films made till 1931, 65.000 ultra-high definition digitized images (6,000x8,000 pixels) are archived on 600 CD-ROMS and the contents of 4,000 reports which are partly published on html pages.

¹¹⁵ <http://www.musee-online.org/about.asp>.

¹¹⁶ <http://mosaic.infobyte.it/>. There were considerable delays in the formal beginning of this project due to personal judgements such that it did not begin formally until February 1998.

¹¹⁷ <http://www.associazionecivita.it/>

¹¹⁸ This individual was originally a member of Joanneum Research which has also produced the IMDAS (Integrated Museum Documentation and Administration System). Cf.

<http://iis.joanneum.ac.at/iis/Default.asp>

¹¹⁹ <http://www.be.cultivate-Europe.org/geninfoe.htm>

¹²⁰ <http://www.be.cultivate-Europe.org/paneure.htm>

¹²¹ <http://www.be.cultivate-Europe.org/geninfoe.htm>

¹²² <http://inf2.pira.co.uk/factsheets/inform/digicult/regnet.html>

¹²³ http://www.trisweb.org/tris/trisportalpro/tris/tris_project_staff.asp

¹²⁴ http://www.trisweb.org/tris/trisportalpro/tris/tris_project_sum.asp

¹²⁵ <http://www.pulmanweb.org/>

¹²⁶ <http://www.culturelink.org/>

 e-culture net	IST-2001-37491	WP5	D10
--	----------------	-----	-----

¹²⁷ <http://www.circle-network.org/>

¹²⁸ <http://www.cimi.org/history.html>

¹²⁹ http://europa.eu.int/ISPO/intcoop/g8/i_g8conference.html

cf. <http://www.ifla.org/documents/infopol/intl/g7/g7facts.txt>

Further G 7 documents: <http://www.tnm.go.jp/bnca/doc/Refer.en.html>

¹³⁰ http://europa.eu.int/ISPO/topics/i_MM.html

¹³¹ http://europa.eu.int/ISPO/intcoop/g8/i_g8pp_matrix.html

¹³² <http://europa.eu.int/ISPO/docs/services/newsletter/96/june/ISPOJUNE04.html>

http://www.yusei.go.jp/mpt_eng/Releases/International/news7-6-1.html

¹³³ <http://www.esat.kuleuven.ac.be/~konijn/viseum.html>

<http://www.cordis.lu/infowin/acts/rus/projects/ac238.htm>

¹³⁴ http://www.medicif.org/Dig_library/Old_MEDICI_docs/Moudocs/moutext.htm

¹³⁵ <http://www.iso.ch/iso/en/aboutiso/introduction/whatisISO.html>

¹³⁶ <http://www.mda.org.uk/>

¹³⁷ <http://www.cni.org/tfms/1994b.fall/perkins.html>

<http://www.cni.org/pub/CIMI/chiolink.html>

¹³⁸ <http://www.fis.utoronto.ca/special/metadata/overview.htm>

¹³⁹ <http://www.portia.dk/musea/finalreport/2.htm#2>

¹⁴⁰ <http://www.diffuse.org/oii/en/museums.html#CHIO>

¹⁴¹ <http://www.diffuse.org/oii/en/oiistand.html#oiistand>

¹⁴² <http://www.diffuse.org/museums.html>

The Diffuse project has been set up to provide neutral reporting on developments relating to standards and specifications in support of Key Action II (New Methods of Work and Electronic Commerce) and Key Action III (Multimedia Content and Tools) of the European Commission's Information Society Technologies (IST) programme. The project outputs are primarily targeted at potential and actual IST participants.

¹⁴³ <http://www.cordis.lu/ist/ka3/digicult/whoswho.htm>

¹⁴⁴ In 1977 the Scuola Normale had independently organised a: First international Conference on automatic processing of art history data and documents. Programme and abstracts of all conference transactions, pp. XXIII-55. Conference transactions I, I-XX, pp. 402.; Conference transactions II, XXI-XL, pp. 366. cf. <http://www.sns.it/Lettere/centro.htm>

¹⁴⁵ <http://library.wustl.edu/~listmgr/imagelib/Jan1995/0008.html>

¹⁴⁶ <http://www.archimuse.com/>

¹⁴⁷ <http://www.amico.org/join/members.html>

¹⁴⁸ <http://www.mcn.edu/MCN98/index.html>. Also important among the early pioneers was the MIP (Museum Informatics Project, University of California, Berkeley)

Cf. <http://www.mip.berkeley.edu/mip/index.html>

¹⁴⁹ <http://www.cultureandrecreation.gov.au/>