SIXTH FRAMEWORK PROGRAMME

PRIORITY IST-2002-2.3.1.12

Technology-enhanced Learning and Access to Cultural

Heritage

Contract for:

NETWORK OF EXCELLENCE

Annex 1 - "Description of Work"

Network acronym: **DELOS**

Network full title: DELOS: a Network of Excellence on Digital Libraries

Proposal/Contract no.: **G038-507618**

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1 Relevance to the Objectives of the IST Priority

The proposed NoE addresses the following challenges of the IST programme:

- **To overcome weaknesses in areas which are critical for European competitiveness**

Digital libraries were not an explicit subject of research until the 1990s. The initiative that really established digital libraries as a distinct field of research came in 1994, when in the United States NSF, DARPA, and NASA created the Digital Library Initiative (DLI). This initiative focused international attention on the field of digital libraries. Beyond the specific work that it funded, the programme gave shape to an emerging discipline. The Digital Library Initiative highlighted digital libraries as a challenging and rewarding field of research. The US thus exercised early and significant leadership in the development of digital library technologies thanks to DLI Phase I (1994) and Phase II (1999)). DLI is, currently, funded at about $11 million per year.

In Europe, partly stimulated by the US activities, the digital libraries field started to emerge as a distinct area of research in the middle of the nineties with the funding of some important national initiatives (for example, the eLib programme - UK, the Medoc project - Germany). In addition, the role played by the Fifth Framework Programme (FP5) of the European Commission in the emergence of digital libraries as a research discipline has been particularly important as it has funded a large number of European digital library projects. In particular, the EC recognized the need to stimulate the creation of an integrated European digital library research community and, for this reason, from 1997 on, supported first a working group and then a fully fledged FP5 Network of Excellence on Digital Libraries: DELOS. DELOS has had considerable success in stimulating European research activities and promoting the building up of expertise in DL-related fields in order to maintain European R&D in this important area at a globally competitive level. It is thus crucial that, with the end of FP5, Europe does not loose momentum, allowing the United States and Asia to move ahead in terms of scientific and technological competitiveness. In order to avoid this, we must find ways to ensure that European digital library research does not continue in a fragmented fashion; we need to create the conditions that will guarantee the growth and advancement of European research activities in a coordinated way.

For these reasons, we feel that there is a clear need for a large digital library initiative in Europe which can become the point of reference and center of excellence for all European research activities in this field, and which can prepare research plans and roadmaps indicating the directions for future actions and recommending the areas for priority interventions.

The Network of Excellence on Digital Libraries would greatly contribute to strengthening the scientific and technological excellence on digital libraries acquired so far in Europe. It would integrate, around a joint programme of activities, the critical mass of expertise needed to bridge the existing scientific gap between the European and US Digital Library research communities and would permit European research in the field to become a world force.

- **To structure European research by integrating research capacities across Europe**

As already stated an important role in the creation of a European digital library research community has been played by the DELOS Network of Excellence on Digital Libraries funded by FP5. DELOS has succeeded in mobilizing in its activities almost all the active European research teams in the digital library field. Currently, there are 63 members of DELOS from 16 different European countries. These include the major European Research Centers in Informatics (Fraunhofer-D, INRIA-F, CNR-I, CWI-NL, SICS-S, FORTH-EL, MTA SZTAKI-H, Austrian Academy of Sciences-A), 30 European university departments, representatives of interested application domains and ICT industry {broadcasting (BBC), electronic publishing (ELSEVIER, Springer Verlag), libraries (BN, ICCU), UK Office for Library and Information Networking (UKOLN), ICT industry (Intracom)}. All the most active research teams of DELOS have expressed their willingness to be members of the proposed NoE. In addition, other research teams (e.g. University of Edinburgh, University of Southampton, Lund University, Glasgow University),

with a good research record in the digital library field have been contacted and have expressed their willingness to become partners of the DELOS network.

The proposed NoE will build on top of the achievements of the DELOS NoE and will pursue the objective of structuring the European research space in the field of digital libraries by defining and conducting a joint programme of activities which will integrate the current research activities of a large number of active European research teams. We expect that the proposed programme of activities will have a strong and durable structuring impact on the European digital library research community and contribute to progress knowledge on the digital libraries domain.

- **To overcome the fragmentation of European research**

The FP5 DELOS NoE organized several concertation meetings (Luxembourg, February 2001, Brussels, May 2001, Rome, March 2002), bringing together all the DL projects funded by EC IST Programme, by NSF and by national DL initiatives as well as representatives of national funding agencies and large digital library initiatives, for the purpose of discussing ways of cooperation, and identifying mechanisms which could lead to harmonization between these initiatives.

These meetings evidenced that digital library research in Europe is still characterized by an extreme fragmentation. Although several national and Community DL projects are currently underway, they are all running in isolation without links and exchange of information between them.

Currently, the situation in Europe in the digital libraries field can be described as follows:

- In many EU countries important national initiatives in the digital library domain are under way;
- The EU FP5 is also funding a number of digital library projects;
- These initiatives, in large part, share common objectives and specific tasks. There exists, therefore, potential for synergies for the purpose of avoiding needless duplication of efforts;
- The state of development of these initiatives varies markedly from one country to another. Some of them have completed a first phase and are now refocusing their objectives, while others are either carrying out the first phase or are in a preliminary phase;
- To a large extent, these projects do not cooperate with each other. They are carried out in isolation and there is a lack of information on their activities.

The success of these meetings has shown that the time for a harmonization and collaborative action between all the European digital library initiatives is mature. As leverage to reach such an objective, we propose the establishment of a Network of Excellence on Digital Libraries.

- **To strengthen social cohesion**

The world, and in particular Europe, has accumulated an enormous heritage of wealth and beauty since the beginnings of history. One only has to think of the art treasures contained in our libraries, archives, and museums, or the huge and precious collections of observational data in the areas of world exploration, sky observation, earth sciences, the environment, medicine, etc. accumulated during the past centuries. A huge amount of material also has been produced by the entertainment industry (TV, movies, music). A large part of these collections “of the past” is currently available only on paper or in analogue form, with severe limitations on their accessibility. In addition, other impediments (technological, physical, linguistic, cultural, legal, economic) have so far prevented most citizens from taking full advantage of these existing collections of inestimable value. However, recent advances in digitization technologies are making the digital archiving of large collections both feasible and cost effective. The DELOS network aims at developing those technologies which will offer seamless universal and equitable access to those collections. This will have a formidable impact on almost all citizens’ activities (education, work, entertainment, culture, social activities, etc.). There is no doubt that by reducing

barriers of distance and supporting timely sharing of resources and content delivery, Digital Libraries can greatly improve citizens' work productivity and quality of life.

➢ **To preserve the ambient intelligence landscape**

Digital materials form the building blocks for learning and leisure, for scientific and historical research and for new business in the "ambient intelligence landscape". The effective and affordable preservation of digital records (whether digital objects, eContent, or electronic records) of European culture and science, as well as ubiquitous records of social and economic change, is fundamental to the IST Programme's overall aim of providing "new tools and business models for service design and provision and for content creation and delivery". The emergence and success of Europe's creative industries is closely tied to the successful development of effective, efficient and sustainable digital libraries. Long term access to the content of these digital libraries is heavily dependent on new research in digital preservation.

Since the aim of digital preservation is to preserve digital information or objects in an authentic, understandable and accessible over time fashion, the DELOS network will contribute to the sustainability of the Information Society and enable effective knowledge management across a range of sectors.

2 Potential Impact

The DELOS network should affect several aspects of the information society. In the following sections the potential impact of the Network is examined in detail.

♦ Strengthening S&T Excellence in the Digital Library Field

Here below we present the main reasons why there is a need to strengthen S&T excellence in the digital library field.

➢ **Uniqueness of the Digital Library Environment**

We believe that there are unique characteristics inherent in Digital Library applications that lead to unique research agendas. For the purpose of this document, the term "Digital Library" is used to capture everything that typically falls under a variety of terms, including "Digital Library", "Digital Museum", "Digital Archive", and others. There are three key characteristics that make a system a Digital Library and distinguish it from other kinds of systems:

Functionality. A Digital Library offers integrated services to a comprehensive digital collection of cultural or scientific information that is available primarily for reading, listening, viewing, etc and secondarily for expanding upon as well as for annotation. Some of the features that are particularly emphasized in Digital Library information systems are:

- Rich information needs
- Multiple sources of related information
- Rich data sources
- Heterogeneous information
- Multimedia information
- Defined user populations
- Motivated users
- Task-orientation
- Domain-oriented cross-lingual access
- Collaboration

Purpose. It is mainly used for learning and research.

Lifetime. It provides access to information whose value is preserved across long periods of time.

Focusing specifically on the data and the users of information systems, an "information space" can be identified, in which one dimension represents the level at which users and tasks are predefined and known in advance, and the other dimension represents the level at which the data has (known) structure. Given this information space, Digital Library applications can be distinguished from typical Web and database applications as shown in Figure 1.

Although they receive much attention in the commercial world, typical Web search engines assume very little about users, tasks, and the data they deal with. Consequently, they occupy a relatively small part of the information space, as shown the lower left corner of the figure. On the other hand, database applications (and some B2B Web applications) assume a great deal about users, tasks, and data. For example, the interaction with these systems is often limited to a few transaction types and data is typically defined using relational schemas. Hence, these applications also occupy only a small part of the space, in the upper right corner.

The remaining information space can be viewed as belonging to Digital Library applications. In this part of the space (which is by far the largest), information systems attempt to exploit knowledge about the users, tasks, and domain to improve access, but retain the flexibility of ad-hoc querying, filtering, presentation, etc. that is characteristic of many Web-based applications. This mixture of characteristics leads to many unique research challenges and interesting test-bed applications.

Another interesting comparison is that between Digital Libraries and the Grid. The latter is conceived as tying together heterogeneous computation and data resources through the use of middle-ware, and then applying techniques such as data mining and others on these resources to infer higher-level knowledge. This is essentially part of the functionality offered by a Digital Library system; hence, the Grid can be considered as one of the enabling technologies for Digital Libraries.

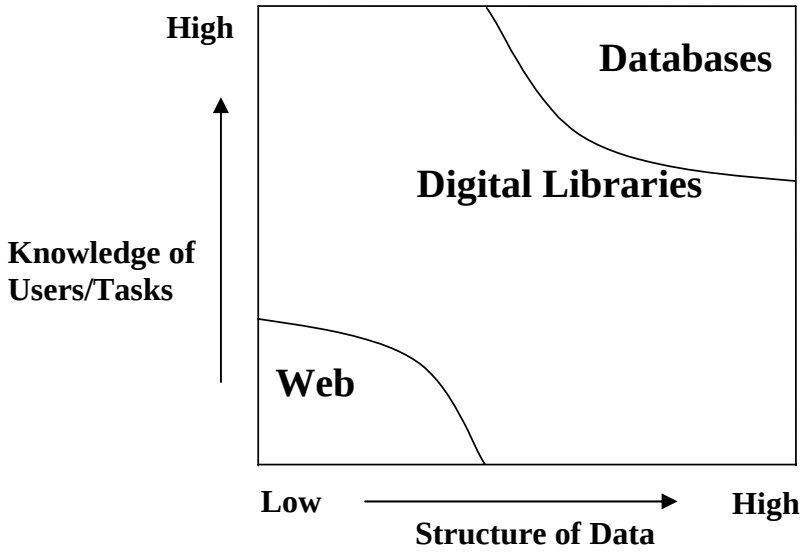

Figure 1: The Information Space for Digital Libraries

- **Digital Libraries: Essential Technologies for the Development of Challenging Transformations in European Society**

The US President's Information Technology Advisory Committee (PITAC), in a report in 2001 on “Digital Libraries: Universal Access to Human Knowledge”, identified several "National Challenge Transformations" as the essential prerequisites for enabling all citizens within their society to participate and fully benefit from the Information Age. In particular, transformation was considered necessary in the following areas:

- The Way We Communicate,
- The Way We Deal with Information,
- The Way We Learn,
- The Way We Design and Build Things,
- The Way We Conduct Research,
- The Way We Understand the Environment,
- The Way We Work,
- The Way We Practice Health Care,
- The Way We Engage in Commerce,
- The Way We Offer Government Services and Information.

PITAC recognized the central role played by Digital Libraries in bringing about transformation in these areas, as they all assume or require Digital Library capabilities.

We believe that the aforementioned transformations are crucial challenges for the European Union too, and their achievement depends significantly on the advancement of Digital Library technologies.

➢ Digital Libraries: the Key to unlock the Value of Cultural Heritage

Europe's cultural and memory institutions are facing very rapid and dramatic transformations mainly due to the use of increasingly sophisticated technologies, which become obsolete more and more rapidly. Today, archives, libraries and museums all over Europe face similar challenges, as they try to take advantage of the enormous potential that the use of digital libraries promises for memory institutions.

Technological innovation plays a major role in the way our cultural institutions develop strategies for valorizing their collections. Indeed, being digital for many European archives, libraries, and museums is no longer a future option but a reality of today. They have turned into "hybrid institutions" that take care of both analogue and digital cultural resources. The conversion of all sorts of cultural contents into bits and bytes opens up a completely new dimension of reaching traditional and new audiences by providing access to cultural heritage resources in ways unimaginable a decade ago. In the emerging knowledge society, there will be an increasing demand for high quality, enriched digital content as life-long learning becomes a reality and continuous education has already become a must. Cultural heritage institutions are in a prime position to deliver the kind of unique learning resources that are needed at all educational levels.

Digital Library technologies will play a major role in creating and delivering these new contents, which go far beyond the current stage of providing access to information about cultural heritage objects. In the future, users of cultural resources will be able to enjoy new interactive cultural heritage services and products that relate to their personal lives. They will be able to manipulate digital artifacts online and participate in communities of interest. They will be supported by intelligent tools that help them to locate the desired information to create their own works. Offering highly interactive and rich environments will become a competitive factor within the cultural heritage community.

Cultural heritage institutions can utilize digital library technologies as effective instruments to direct public interest back to the original objects in their trust, by providing contextual information, enlightened with narratives and visualizations with computer-aided rendering and displays. As experience has shown, appropriate use does increase the interest in the original

collection, and cultural heritage institutions should not neglect this opportunity to add value to their holdings. Thus, European cultural heritage institutions not only hold the key to a treasure chest of unique resources but, with the development of the next generation of digital library technologies, they will also have the potential to turn the key and unlock the true value of the rich cultural heritage of Europe.

Finally, the development of the digital library technologies will impact directly on all those industries that provide products and services to, or with, the cultural sectors.

♦ Adding Value to European Research in Digital Libraries

There are several reasons why Digital Library research should be primarily funded by and conducted at the European level:

- Information of interest to be stored and maintained within a Digital Library, is by definition multinational, e.g., cultural and scientific heritage is essentially global.
- Digital Libraries are predominantly international establishments, spanning many countries.
- From a technical standpoint, the Digital Library field is very rich and complex, and therefore complete expertise in all of its aspects is more easily found in an international environment.

In addition, the Network will capitalize on the research activities and results achieved by Digital Library projects (e.g. Collate, Cyclades, Echo, ETRDL, MIND, SCHEMAS, Scholnet, etc.) conducted at national as well as European level

♦ Spreading of Excellence beyond the Participants in the Network

Digital Libraries is a relatively new field. Very few European universities give courses on this domain. There is a need for a more extensive inclusion of courses (at undergraduate and graduate level) on digital library topics in university curricula, and also for the setting up of digital library competence centres which provide specific user communities with access to advanced digital library technologies, services, test-beds, expertise and knowledge which will allow them to take-up these technologies and services.

The DELOS network will establish a Virtual D-Lib Competence Center (distributed over three physical locations), which will provide education for research, memory institutions and industry in the field of Digital Libraries through the following initiatives.

An International Inter-university PhD degree on Digital Libraries. The Competence Centre will start proactive actions with some of the academic institutions participating in DELOS, in order to establish agreement between them for the purpose of defining and granting a PhD in Digital Libraries. That should provide graduate students from different disciplines a common view and understanding of the main Digital Library technologies and applications. Students will be appointed a main supervisor from one of the institutions that have agreed to the program, and the students will have the possibility of spending periods of time in different institutions. The final PhD title (or equivalent) will be granted by the institution of the main supervisor.

A Series of Digital Library Euro-conferences. The Network would support the European Conference series in research and advanced technology for Digital Libraries, intended to give researchers from universities, research centers, industry and government the opportunity to meet once a year to discuss evolving research issues and applications.

A Series of Thematic Workshops. A series of thematic workshops will be organized. The objective is to give the opportunity to European researchers coming from academia, industry, and interested application communities to communicate problems, requirements and solutions within different Digital Library areas; and to exchange working experiences. The workshops will also give to the different communities whose advancement is affected by the Digital Library technologies the possibility to learn about the latest research developments in this field and will provide the opportunity to disseminate the results of the workshops to the larger Digital Library community in the form of workshop proceedings.

A Series of Brainstorming Workshops. A series of brainstorming workshops will be organized. The objective is to define road map reports in the field of Digital Libraries and to provide valuable input for the definition of future research programmes in the domain of Digital Libraries both for the EC and for national research funding agencies.

A Series of Bilateral Workshops between European and non-European countries. The objective is to establish collaborative actions with other research communities outside of the European Union, in order to strengthen those collaborations already established by the FP5 DELOS NoE (with the US and the Russian Digital Library communities) and to extend them to include other countries (for example, the countries of the Mediterranean area, Canada, Australia, Latin America), with which the European Union has in place an agreement for scientific cooperation under the 6th FP.

A Series of Summer Schools. A series of Summer Schools will be organized. They will provide a high level course on the domain of Digital Libraries and its underlying technologies. Moreover, they will offer a unique opportunity for a complete update on all aspects of Digital Libraries and will encourage contacts between participants, lecturers and interested parties. The schools will be directed to members of the research community (in the wide sense): primarily graduate students, but also young researchers and professionals involved in R&D in Digital Library related areas.

A Series of Awareness Events. These events will be targeted at the European memory institutions and industry related to Digital Libraries. The aim is to present the recent developments in the field of Digital Libraries and demonstrate how they could improve the services or the productivity - depending on the type of community involved.

♦ Durable Structuring Impact on European Research

The DELOS joint programme of activities will result in a number of tangible technological outcomes, which will survive beyond the conclusion of the Network.

- A number of running prototypes to experiment with Digital Library technologies.
- An evaluation infrastructure to measure and evaluate new Digital Library technologies and system performances.
- A European D-Lib competence centre.
- An annual European scientific conference on Digital Libraries.
- A yearly summer School on Digital Libraries.
- An international inter-university PhD degree on Digital LIbraries
- An exchange programme for researchers.

All these outcomes will cause structural changes in the way research is carried out in the field of Digital Libraries. Note that these changes are not of a purely administrative or organisational nature. The changes, resulting from DELOS activities will durably affect how research is carried out in Europe: a culture of integrating research goals, an integrated training of young researchers and an integrated education across academia, memory institutions and industry will be the durable outcomes of DELOS.

2.1 Contributions to Standards

It is expected that during its lifetime, the Network will make a considerable contribution to the development of DL-related standards. In the Web age, standardization is driven not just by traditional institutions such as the International Organization for Standardization (ISO) and the European Committee for Standardization (CEN), but by professional and industrial initiatives such as the IEEE Standards Association, Dublin Core Metadata Initiative (DCMI), and World Wide Web Consortium (W3C) and by collection-oriented activities such as Open Archives Initiative (OAI). All such efforts rely extensively on input and feedback from the research community, as techniques originating on the "bleeding edge" of research gradually stabilize and

acquire a critical mass of users. Key areas where scientific work in DELOS stands to make particular contributions to standardization include the following:

- Digital preservation, where international standards are needed for defining, implementing, managing, auditing, and certifying digital repositories and preservation services;
- Archival metadata formats and preservation frameworks for complex multimedia objects;
- Audiovisual information access, where relevant multimedia standards such as MPEG-7 must be adapted to usage scenarios in which content is delivered in a diversity of formats and through a diversity of channels;
- Digital library evaluation, an important area of NoE activity that will aim at developing standard techniques, methods, and measures for use by the entire DL community;
- Semantic interoperability constructs building on Resource Description Framework and the Web Ontology Language (OWL) to provide infrastructural support for the mapping and conversion of metadata;
- The economics of metadata, where feedback on how much metadata is "enough" for improving DL performance has important implications for the simplification or complexification of the relevant standards; and
- Descriptive ontologies for mediating intellectual access to digital resources in automated environments.