



## The Key Role of the DELOS Network of Excellence in Establishing Digital Libraries as a Research Field in Europe

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### Abstract

It was only in the mid-1990s that Digital Libraries became a research topic in Europe. The European Union was then instrumental in supporting and promoting the subject. One key element of that support was the establishment of the DELOS Network of Excellence. Its central role in the development of digital libraries in the period 1997-2007 in Europe and its contributions are outlined in this paper.

**Key Words:** Digital Libraries; DELOS; Europeana

### 1. Introduction

Digital Libraries were not an explicit subject of research in Europe until the middle of the nineties. A series of initiatives and projects, partially funded and promoted by the European Union, led to the establishment of the DELOS Network of Excellence, which has played a key role in establishing the Digital

Library (often here abbreviated as DL) field as a distinct area of research in Europe.

An initiative, full of future fruitful consequences, was the creation of the DELOS Working Group on Digital Libraries (1997–1999), funded by the EU ESPRIT (European Strategic Program on Research in Information Technology) Long Term Research Programme, in the frame of the Fourth Framework Program (FP4). The objectives of the DELOS WG was to create an awareness of the main DL research issues and to stimulate research in this field, to encourage collaboration between European research teams active in the DL field, and to establish links with on-going international projects in the DL field. An important achievement of the DELOS WG was the establishment of a formal collaboration with the National Science Foundation (NSF) in the US, which resulted in the establishment of five joint EU-US collaborative Working Groups to take stock of state-of-the-art in the field and to define future research directions. The working groups were funded by NSF on the American side and by the European Commission on the European side. On both sides there were officers, including Steve Griffin at NSF, and Bernard Smith and Patricia Manson at European Commission (EC), far sighted enough to see the relevance of those initiatives for the future of the libraries.

In year 2000 the DELOS WG applied to become a Thematic Network under the EU 5<sup>th</sup> Framework Program (FP5) and, thanks to its very successful activity and the support of the interested EU Officers, the proposal was approved and the DELOS WG became the DELOS Thematic Network of Excellence on Digital Libraries (2000–2003). The main objectives of the DELOS Thematic Network were to: (i) contribute towards the creation of a European DL research community; (ii) provide a forum where researchers, practitioners and representatives of Research Libraries could exchange ideas and experiences; (iii) cooperate with on-going standardization activities in fields relevant for the DL area; (iv) facilitate take-up of DL technologies; and (v) improve international cooperation.

The last step in the DELOS evolution came in 2004 with its application to become a Network of Excellence (NoE) under the EU 6<sup>th</sup> Framework Program (FP6), a step encouraged by EU Project Officers, Bernard Smith and Patricia Manson, given the excellent record of activities of the DELOS Thematic

Network. Following an independent evaluation, the proposal was selected for funding and DELOS became the “DELOS NoE,” from 2004 to 2008. Its mission was to integrate and coordinate on-going research activities of the major European research teams in the field of Digital Libraries. The focus was on networking and structuring the European research teams working on DL technologies in order to consolidate an emerging community, and on becoming the reference point in Europe for DL-related activities. At the end, the DELOS NoE integrated 59 Research Centers and Universities, engaging about 300 researchers, carrying on activities in many different fields, all related to Digital Libraries.

Since the beginning, the activities of DELOS focused on identifying and defining those research fields that could lead to a rapid development and establishment of Digital Libraries as a “discipline.” To this end DELOS organized and promoted activities that could facilitate the exchange of ideas, enable capacity building, and foster the establishment of working relationships among researchers in the field (yet to be defined) of Digital Libraries. The main activities of DELOS were therefore focused on:

- Brainstorming workshops
- Thematic workshops
- Cooperation with NSF
- Summer schools and Exchange Program
- The European Conference on Digital Libraries (ECDL, later renamed TPDF)

For bibliographic references to the outputs of these activities, please see the note at the end of the paper.

## **2. Brainstorming Workshops**

The series of Brainstorming Workshops was intended to bring together top researchers from all the parts of the world, with the objective of defining “future research direction” in the field of Digital Libraries and to provide input for the definition of future research programmes both for the European Commission and for the national research funding agencies. In total DELOS organized five Brainstorming Workshops:

- Digital Libraries Future Research Directions for a European Research Programme, 13–15 June 2001, San Cassiano, Italy (Ioannidis, 2001).
- Digital Libraries Main Research Themes for a European Research Programme, 6–7 December 2002, Pisa, Italy.
- Digital Libraries Future Research Directions, 8–10 July 2004, Corvara, Italy (Del Bimbo, Gradmann, & Ioannidis, 2004).
- Recommendations and Observations for a European Digital Library (EDL), 5–6 December 2005, Sophia Antipolis, France (Ioannidis, 2005a).
- Reference Model Workshop, 1–2 June 2006, Frascati, Italy.

Collectively, those workshops (especially the first three) delivered a series of “roadmaps” for research, pointing to the topics that (at that time) needed further understanding and development in order to exploit all the capabilities that digital libraries might offer. The main research themes outlined in the first report (2001) are just the topics investigated by the Joint DELOS/NSF Working Groups (see below).

It is worthy of note that in the final report of the very first workshop (2001), there was the first idea of the Europeana Digital Library, in the form of a recommendation for the “establishment of an Initiative for an Integrated European Cultural Digital Library leading to the development of a Digital Library of European history and Cultural Heritage.” The idea was further presented and discussed with representatives of the major European National Libraries during the fourth workshop (Ioannidis, 2005a).

In the first report arising from the San Cassiano workshop (2001), there was also the first DELOS Grand Vision:

*“Digital Libraries should enable any citizen to access all human knowledge any-time and anywhere, in a friendly, multimodal, efficient and effective way, by overcoming barriers of distance, language, and culture and by using multiple Internet-connected devices.”*

It can be noted that the main emphasis here is about “access,” which was a concern for the Internet and the Web of that time.

Just a few years later, in the final report of the third brainstorming workshop at Corvara (Del Bimbo et al., 2004) DELOS provided a second Grand Vision:

*“The potential exists for digital libraries to become the universal knowledge repositories and communication conduits for the future, a common vehicle by which everyone will access, discuss, evaluate, and enhance information of all forms.”*

This second vision took into account the rapid evolution of the Internet and the Web from a “publishing media,” where the main issue was access to the information, to a “social media” platform, where the main issue was creation and exchange of information and collaboration.

### **3. Thematic Workshops**

The series of Thematic Workshops was intended to provide the opportunity to European researchers to present results of on-going research activities, to exchange opinions and experiences in an informal and friendly environment, and to establish working relationships. In total, DELOS organized ten Thematic Workshops, and the themes of the workshops give a clear idea of what were the main research topics discussed during them:

- Information Seeking, Searching and Querying in Digital Libraries, 11–12 December 2000, Zurich, Switzerland.
- Personalization and Recommender Systems in Digital Libraries, 18–20 June 2001, Dublin, Ireland.
- Interoperability and Mediation in Heterogeneous Digital Libraries, 8–9 September 2001, Darmstadt, Germany.
- Evaluation of Digital Libraries: Testbeds, Measurements, and Metrics, 6–7 June 2002, Budapest, Hungary.
- Multimedia Contents in Digital Libraries, 2–3 June 2003, Chania, Crete, Greece.
- Digital Library Architectures: Peer-to-Peer, Grid, and Service-Oriented, 24–25 June 2004, S. Margherita di Pula, Cagliari, Italy.
- Audio-Visual Content and Information Visualization in Digital Libraries, 4–6 May 2005, Cortona, Italy.
- Future Digital Library Management Systems: System Architecture and Information Access, 29 March–1 April 2005, Schloss Dagstuhl, Germany.

- Digital Repositories: Interoperability and Common Services, 11–13 May 2005, Heraklion, Crete, Greece.
- Personalized Access, Profile Management, and Context Awareness in Digital Libraries, 29–30 June 2007, Corfu, Greece.

#### 4. Cooperation with NSF

One of the main accomplishments of the “first” DELOS, back in 1997, was the establishment of a formal collaboration relationship with the National Science Foundation, which already in 1995 had established the Digital Library Initiative (DLI, later continued with DLI2). In the frame of this collaboration between NSF and the European Commission, five working groups were formed, each one with two co-Chairs (one from Europe and one from the US), to explore key research topics:

- Intellectual Property and Economics
- Interoperability
- Global Resource Discovery
- Metadata
- Multilingual Information Access.

The main recommendation that emerged in the final report from all the working groups (1998) was to “increase substantially the level of collaboration both across disciplines as well as across geographical boundaries.”

Another recommendation worth noting (given the time it came out) was “to explore the development of new *information objects* and information genres, in particular digital-only objects having a highly dynamic nature which cannot be handled by traditional approaches.”

The cooperation with NSF continued with the organization of an “All Projects Workshop,” held in Rome in March 2002. The main idea behind this workshop was to bring together researchers from projects funded by the Information Society Technologies Research Programme of the EC and the Digital Library Initiative (Phase 2) of the NSF. Both funding agencies were supporting substantial research concerned with digital libraries and the responsible Officers (Pat Manson for EC and William Bainbridge for NSF) presented their expectations to develop the enabling technologies as well as basic principles for DL design, implementation, and operation.

The main outcome of this joint concertation meeting was the establishment of another series of joint working groups with the mandate of defining research agendas for specific digital-library-related critical areas and identifying strategic topics and activities for cooperation between EU and US researchers. The seven working groups were:

- G1 Spoken-Word Digital Audio Collections
- G2 Digital Libraries Information-Technology Infrastructures
- G3 Personalisation and Recommender Systems in Digital Libraries
- G4 ePhilology: Emerging Language Technologies and Rediscovery of the Past
- G5 Digital Imaging for Significant Cultural and Historical Materials
- G6 Digital Archiving and Preservation
- G7 Actors in Digital Libraries

The conclusions and recommendations of these working groups were published in a special issue of the *International Journal on Digital Libraries* (Volume 5, Issue 4, August 2005). It contains also a global view of the open research issues identified by DELOS and how they were addressed by the working groups (see Table 1) (Ioannidis, 2005b).

Table 1: Research issues addressed by the working groups.

Research issue	G1	G2	G3	G4	G5	G6	G7
Collection building	■	■	■	■	■	■	■
Collection access and navigation	■	■		■	■	■	
Non-traditional objects	■			■	■	■	
Collection preservation	■	■		■	■	■	■
Basic system architecture		■				■	
Openness		■		■			
Interoperability and metadata	■	■	■	■	■	■	■
Scalability		■				■	
Availability		■					
Session/workflow management		■	■		■	■	■
Security	■	■	■		■	■	■
Quality	■	■	■	■	■	■	
Digital library administration		■					■
User interfaces		■	■		■		■
Information visualisation	■	■	■	■	■		
Personalisation and customisation		■	■	■	■		■
Community information spaces			■				■
Multilingual and multicultural	■	■	■	■	■	■	
Universal access			■				■
Multichannel access			■				

The issues are grouped into three main categories, corresponding to the simple view of a Digital Library (the one at the base of the Reference Model), with the *content* on one side, the *usage* on the other and a *management* block in between providing the access and the functionality needed by the users to interact effectively with the content. Looking at the table row-wise, it can be seen that many topics appear of significance in the reflections of many different working groups, indicating at the same time that there could be a “generic” solution for those topics, but that a “multidisciplinary” approach would be needed to appropriately tackle them. Looking at this Table almost 15 years later, we can see that many topics are no longer “hot research issues,” while others are still the focus of scientific investigation, such as Collection Preservation or Information Visualization or Interoperability and Metadata.

## 5. Summer Schools and Exchange Program

The series of Summer Schools was intended to provide high-level courses on the domain of Digital Libraries and its underlying technologies to support knowledge dissemination and thereby to extend the research community. The schools were 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. In total DELOS organized nine Summer Schools:

- Digital Library Technologies, 9–13 July 2001, Pisa, Italy.
- Digital Libraries Technologies, 8–12 July 2002, Pisa, Italy.
- Digital Libraries Technologies, 6–10 September 2004, Pisa, Italy.
- Digital Preservation for Digital Libraries, 5–11 September 2005, Sophia-Antipolis, France.
- Digital Preservation in Digital Libraries: Emerging Approaches, 4–10 June 2006, San Miniato, Italy.
- Digital Preservation in Digital Libraries: Realizing Possibilities, 3–8 June 2007 – Pisa, Italy.
- Multimedia Digital Libraries, Machine learning and cross-modal technologies for access and retrieval (jointly with MUSCLE project), 12–17 June 2006, San Vincenzo, Italy.



- Digital Libraries for the Digital Librarian: Making the Journey from Traditional to Digital Libraries (jointly with NSDL), 28 May–2 June 2007, Settignano, Firenze, Italy.
- Digital Preservation in Digital Libraries, 8–14 June 2008, Tirrenia, Italy.

It can be noted that after the initial generic “educational purpose,” the DELOS Summer Schools focussed on two major issues (which remain significant research areas today) related to digital libraries, namely Preservation of digital objects and Multimedia content.

In addition to the Summer Schools, which proved to be a very effective mechanism to bring together young researchers from different countries and organizations and to stimulate broadening of the community of researchers, during the last four years of its funded period DELOS ran an “Exchange Program.” Under this program, a researcher from one research centre could spend from one to three months at another institution (in a different country) to bring forward joint research, with DELOS covering the expenses related to the foreign residency. In total, 26 researchers took advantage of this initiative and the outcomes were seen in terms of publications, research proposals, technical developments, and improved research activities.

## **6. ECDL**

Back in 1997 DELOS started the series of European Conference on research and advanced technologies for Digital Libraries (ECDL, later renamed TPDL – Theory and Practice in Digital Libraries – to avoid a naming conflict with the European Computer Driving License). ECDL rapidly became the main forum where the European DL community was meeting each year in order to present research results and discuss and exchange new ideas and experiences. The conference attracts every year more than 300 participants and in 2017 it will celebrate its 21<sup>th</sup> edition with its Conference in Thessaloniki, Greece.

## **7. Conclusions**

It is difficult to point to some specific result of DELOS as a proof of its validity. DELOS was a “networking mechanism” and neither developed *directly*

any killer application, nor patented any new technology. Its influence could rather be measured by the effort spent in building a DL research community and by the global outcomes of that community.

From an instrumental prescriptive in the four years ending in December 2007 DELOS directly organized 37 events, which engaged about 2000 participants, 1200 of who came from organizations that were not DELOS partners. In the same period, DELOS participated in 67 events organized by other institutions, with a total of about 4300 participants, 3900 of which coming from non-DELOS partners. Taking into account the duration of those events, in total DELOS was involved in about 8000 person/days of research and outreach in this four year period.

As part of its activity, DELOS constructed a digital library, comprising about 1200 documents ranging in time from 1993 to 2008 (e.g., published papers, project reports, working papers, internal notes, presentations) related to Digital Libraries and in some way connected to DELOS. During the last period (2004–2007) the “DELOS Community” published 689 papers. More than 75% of them were by authors coming from two (or more) different institutions.

One of the main achievements of the DELOS NoE was the initial definition of the “DELOS Digital Library Reference Model,” a formal and conceptual framework describing the characteristics of the Digital Library Management Systems and aiming at laying down their foundations and the development of a Reference Architecture of a Digital Library Management System. The model was subsequently refined and consolidated by the [DL.org](http://DL.org) project (Candela et al., 2011) and is still in use today in some University courses, as an introduction to the main concepts underlying the Digital Library Universe.

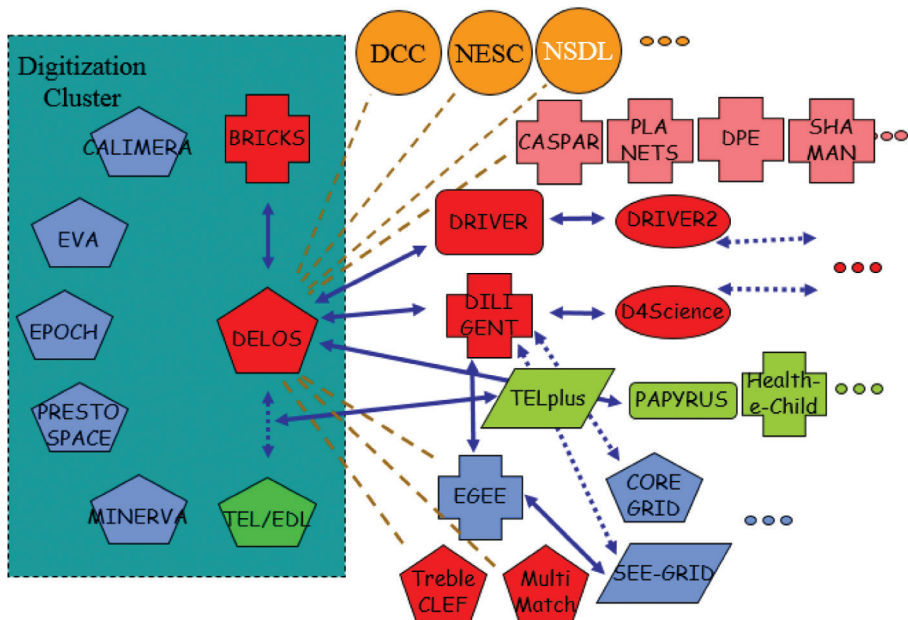
In addition, some important spin-offs of the DELOS activities were:

- the CLEF initiative (Conference and Labs of the Evaluation Forum, formerly known as Cross-Language Evaluation Forum) is a self-organized body whose main mission is to promote research, innovation, and development of information access systems with an emphasis on multilingual and multimodal information
- the INEX initiative, which started as an initiative for the evaluation of XML retrieval and has evolved over time into an evaluation forum for Focused Retrieval search engines.

In conclusion, the main merit of DELOS is to have significantly contributed to the creation of a European DL research community and to the establishment of relevant spin-off initiatives. The main factors underlying the creation of this community have been the face-to-face meetings, facilitating the exchange of ideas and the establishment of working relationships. All those activities, promoted and organized by DELOS, would not have been possible without EU funding. The funding provided to the Scientific and the Administrative DELOS coordinators (CNR-ISTI and ERCIM) was needed for the organization and the logistics of all the events promoted by DELOS; the funding provided to the NoE partners was needed to support the participation of the researchers to those events, as the national funds would not have allowed such massive participation.

Thanks to the funding under three different European Programs (FP4, FP5, FP6) and the continued support of the responsible EU Officers, DELOS has accomplished a long journey towards promoting research in the DL field. This has deeply influenced the Research, Development, and Educational

Fig. 1: EC funded projects deriving from DELOS.



activities in the Digital Library field in Europe, creating at the same time significant expertise that can be found today at the base of some of the major efforts of the European Commission in this field, such as Europeana, the Digital Library of European Culture, which has today more than 30 million objects, or OpenAire, an infrastructure supporting Open Access to Research Repositories and Virtual Research Environments. Figure 1 depicts some of the EC funded projects that can count DELOS as one of the ancestors.

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## Note to the references

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As mentioned in this paper, DELOS collected into the DELOS Digital Library about 1200 documents (ranging in time from 1993 to 2008) related to Digital Libraries and in some way related to the DELOS activities. Unfortunately, during the last migration to a more current system, access online to the library has become problematic. If you are interested in a copy of some of the DELOS publications (especially the internal reports and notes, not published elsewhere), please send an email to one of the authors: [name@isti.cnr.it](mailto:name@isti.cnr.it).