



i2010: A European Information Society for Growth and Employment

i2010 is Europe's answer to the fast-moving changes in technologies and global markets brought about by digital convergence. Launched by Commissioner Viviane Reding in June 2005, it is a strategic framework to boost Europe's digital economy, and is a key part of the EU's renewed Lisbon strategy for growth and jobs.

i2010 presents a package of proactive policies to improve the competitiveness of Europe's information society and media industries, and to harness the potential of digital technologies to drive innovation across the European economy and society. To do this, i2010 sets out three policy priorities:

- Creating a **Single European Information Space** to seize the opportunities of digital convergence. i2010 will promote a common set of regulations that govern the supply of content and services and the operation of networks, irrespective of the underlying technologies used.
- **Innovation and Investment in R&D**, taking steps to ensure Europe puts more into ICT research and gets more out. i2010 proposes to set up trans-European demonstrator projects to test promising research results; and to better integrate small and medium-sized enterprises into EU research.
- Promoting an **Inclusive European Information Society** by closing the gaps between the information society 'haves and have nots'. i2010 proposes providing better services for citizens, an Action Plan on eGovernment, and a far-reaching initiative on inclusion and related actions.

The i2010 strategy will be implemented partly by the Commission and EU-funded programmes, and partly by the Member States. A wide range of policy instruments will be used.

Further information: <http://ec.europa.eu/i2010/>

Digital Libraries Initiative

One of the key proposals of i2010 is a series of flagship initiatives in areas impacting on quality of life. **Digital libraries** is one of these i2010 flagship initiatives. The others are Independent Living for the Ageing Society and the Intelligent Car.

Within DG Information Society & Media of the European Commission, the Digital Libraries initiative is managed by Directorate E, 'Content'.

Contacts: Pat Manson, patricia.manson@ec.europa.eu
Javier Hernández-Ros, javier.hernandez-ros@ec.europa.eu

For further information on the Digital Libraries initiative see:
http://ec.europa.eu/information_society/activities/digital_libraries/

Linking European Policies

This brochure has been produced by Information Society Policy Link (ISPL), an initiative of DG Information Society & Media that aims to link information society projects with European policy-makers across a wide range of policy domains.

The initiative has generated information on projects' policy contributions and achievements covering around 20 policy areas. This brochure is part of a new series focusing on i2010 themes. In addition, the initiative organises workshops to stimulate dialogue between researchers and policy-makers on key policy issues.

All publications plus information on policy workshops and other news are available via the ISPL website at:

http://ec.europa.eu/information_society/activities/policy_link/

A great deal of additional information on the European Union is available on the Internet. It can be accessed through the Europa server (<http://europa.eu>).

Cataloguing data can be found at the end of this publication.

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> Foreword

Europe's future prosperity as a knowledge-based economy and society depends on ready access to diverse information. The internet is the most powerful new tool we have had for storing and sharing information since the Gutenberg press. We must use it to make the wealth of material in Europe's libraries and archives accessible to all.

Ensuring European information resources are easier and more interesting to use online, while making sure that intellectual property rights are well protected, is a key aim of the European Commission's Digital Libraries initiative. This is one of three flagship projects under the EU's i2010 strategy – a European Information Society for growth and jobs – for boosting Europe's digital economy. Over the next five years at least six million books, newspapers, photographs, manuscripts, maps, archival records, films and music fragments will be made available online to anyone with a web connection. The initiative will also exploit the potential of digital repositories of scientific data as tools for Europe's scientists and engineers.

The Digital Libraries initiative is part of a package of measures under i2010 to create a single European Information Space, offering affordable and secure high bandwidth communications, rich and diverse content, and digital services. It aims to ensure Europe benefits from world-class digital library services through harmonising policy, mobilising stakeholders, and co-funding research and deployment of digital services. For instance, to boost European digitisation efforts, the Commission will co-fund the creation of a Europe-wide network of digitisation centres. It will also look at relevant aspects of intellectual property rights in the context of digital libraries.

This brochure provides an insight into the contributions that ICT research and deployment programmes are already making to our policy objectives in this field. Such actions are an essential part of Europe's drive towards an inclusive, knowledge-based economy and society.



Viviane Reding
European Commissioner for Information Society and Media



> Europe's Knowledge Assets at a Mouse Click

Europe's cultural institutions – libraries, museums and archives – are a hugely valuable resource. They represent Europe's collective memory and are essential in enabling ready access to the digital content necessary for boosting Europe's digital economy and society.

Making Europe's cultural and scientific heritage available online provides an immense reservoir of starting materials for Europe's artists and scientists; and information and communication technologies provide powerful tools with which to exploit them, to the benefit of all. Once digitised, our cultural and scientific heritage can be used as input for a wide range of information products and services. Indeed, innovation in digital content and services will play a key role in the future growth of sectors such as education, culture, tourism, media, science and business.

Many cultural institutions are already using the new technologies successfully, digitising their collections and providing users with improved access and services. Much more remains to be done, however, to speed up digitisation activities and improve the accessibility and flow of information.

The European Commission's Digital Libraries initiative – part of the i2010 programme for boosting Europe's digital economy – aims at making European information resources easier and more interesting to use online. It builds on Europe's rich heritage combining multicultural and multilingual environments with technological advances and new business models.

Making the resources in Europe's libraries and archives available on the internet is not straightforward. On the one hand, we are talking about very different materials – books, films, photographs, manuscripts, maps, speeches and music. On the other, we have to select from very large volumes – for example, 2.5 billion books and bound periodicals in European libraries and millions of hours of film and video in broadcasting archives.

In a Communication issued in September 2005, the Commission set out its view on how Europe can turn the digital libraries vision into reality. It aims to make, over the next five years, six million books, documents and other cultural works accessible online through the European Digital Library web portal (see box). This figure could be much higher as, by 2010, potentially every library, archive and museum in Europe will be able to link its digital content to the European Digital Library infrastructure.

To achieve this, the European Commission has identified three key areas for action:

- ❖ Digitisation of analogue collections for their wider use in the information society.
- ❖ Online accessibility, a precondition for maximising the benefits that citizens, researchers and companies can draw from the information.
- ❖ Preservation and storage to ensure that future generations can access the digital material and to prevent precious content being lost.

In addition, digital repositories of scientific information are essential elements to build European infrastructure for knowledge sharing and transfer, feeding the cycles of scientific research and innovation up-take.

This brochure, after a presentation of the basic issues and challenges relating to digital libraries and digital repositories, presents an overview of ongoing projects in these priority areas.

The final section summarises the activities conducted at European level to achieve progress in relation to digital libraries and digital repositories.



The European Library Portal

One of the foundations for the European Digital Library initiative was provided by The European Library (**TEL**) project. Originally set up by eight of the European national libraries, The European Library is a portal which offers access to the combined resources (books, magazines, journals, etc.), both digital and non-digital, of the 45 national libraries of Europe. Now a real, operational service, it offers anyone with an interest a simple route to access European cultural resources (see www.europeanlibrary.org).

The European Library service is aimed at users worldwide, both professional and non-professional, who want a powerful and simple way of finding library materials. Moreover, it is attracting researchers from Europe and around the world to a vast virtual collection of material from all disciplines. It offers free searching and delivers digital objects, some free, some priced.

The service offers a number of unique features. It brings together disparate collections on your desktop and allows for cross-collection searching. Results are presented in an integrated way with full delivery of digital objects. It is a major contribution to research both in making resources widely available and by making possible new connections through exploitation of a huge virtual library collection. In short, the European Library encourages new research!

So far the service offers direct access to around a million digital items, and millions of catalogue reference records. Currently, there are around 25,000 users, but the number is increasing fast. Experience to date has emphasized that much more needs to be digitised, in particular to correct a bias towards the humanities, rather than science, in current national collections.

A follow-on project, **TEL-ME-MOR**, is supporting the national libraries from the ten new EU Member States in becoming part of The European Library initiative. It will help ensure that European Library services are available in all the ten new Member States' national libraries with an interface in their local language. The work of the European Library is also being supported through **DELOS**, a Network of Excellence looking at long-term issues in digital library research.

Results from these projects can be seen as the embryo of a European Digital Library, under the i2010 programme, which will build upon the TEL-infrastructure to provide a highly visible, multilingual access point to the digital resources of Europe's cultural institutions.

In particular, the **EDL** (European Digital Library) project, funded under the eContent^{plus} programme, will strengthen and expand The European Library network, creating access to digital collections more quickly than would otherwise be the case. It will enlarge The European Library collaboration to a further nine countries, bringing the total to 31 by 2007 and adding a further 40-60 digital collections. EDL will further develop the platform and organisational network for co-operation between national libraries and for the co-ordination of national initiatives on a European level. It will offer an ideal point of entry to the digitised material of national libraries and other European cultural institutions, and will help find solutions crucial to the development of the European Digital Library.

www.europeanlibrary.org



> Our Digital Memory

What are Digital Libraries?

Digital libraries are organised collections of digital content made available to the public. They can consist of material that has been digitised, such as digital copies of books and other 'physical' material from libraries and archives. Alternatively, they can be based on information originally produced in digital format. This is increasingly the case in the area of scientific information, where digital publications and enormous quantities of raw data and software are stored in digital repositories. Both aspects – digitised and born digital material – are covered by the i2010 Digital Libraries initiative.

The initiative addresses all types of material: books, audiovisual, photographs, documents in archives, etc. The technology is beginning to enable users to find and work with information in all these forms. Information about Leonardo da Vinci, for example, can exist in the form of his work, books about him, documents with his drawings, films, etc. The challenge is to create a digital library that combines these resources. This will also make it possible to tap the vast and diverse potential of Europe's written text, image and sound archives.

One Single Entry Point to European Digital Content

Technology is moving fast and there are potentially many different ways of creating virtual European libraries. We should not aim at one single site or structure, but combine efforts in all the countries. **What matters is to integrate access.** This does not mean that the libraries or digital collections should be merged in a single database or library. Ideally, the user should be able to search in different collections through one single entry point and use the material. This would avoid the need to know about and visit multiple libraries.

To make European information resources easier and more interesting to use, we, in Europe, need a common effort across three areas.



Digitisation of Analogue Collections

The main reason for digitising Europe's libraries and archives is to make them available to users in an online environment. In some cases, however, digitisation is not primarily used to make content more accessible, but to guarantee its survival.

At present, only a small part of European collections has been digitised. Digitisation activities exist in all the Member States, but efforts are fragmented and progress has been relatively slow. A number of challenges impact the pace and efficiency of digitisation in Europe.

- ❖ *Financial challenges:* Digitisation is labour-intensive and costly. Choices will have to be made as to what can be digitised and when.
- ❖ *Organisational challenges:* Duplication of effort must be avoided. This can only be achieved by a sustained coordination effort at national and European level.
- ❖ *Technical challenges:* To improve digitisation techniques so as to do it cost-efficiently and affordably.
- ❖ *Legal challenges:* Digitisation presupposes making a copy, which can be problematic in view of intellectual property rights (IPR). The limited use that can legally be made of the resulting digital copies is a further disincentive for digitisation.

Online Accessibility of Digital Content

Under current EU law and international agreements, material resulting from digitisation can only be made available online if it is in the public domain or with the explicit consent of the rightholders. Therefore a European Digital Library will in principle be focused on public domain material. Coverage beyond public domain works would require either a substantial change in the copyright legislation, or agreements with rightholders.



Other questions also arise in relation to online accessibility. The user needs to be able to find online material easily and to search and use it. Appropriate services allowing the user to discover and work with the content are necessary. This implies structured and quality description of the content, both the collections and the items in them, and support for its use (e.g. annotation).

Digital Preservation

All digital material – digitised works as well as ‘born digital’ material – has to be maintained in order to keep it available for use. Such materials are at increasing risk of getting lost or becoming inaccessible because of a number of factors: deterioration in the quality of the recording or storage media; technical obsolescence in

hardware and software which renders file unreadable; and the sheer volume of information and dynamic content.

The basic challenges for digital preservation are similar to those for digitisation:

- ❖ *Financial challenges:* The real costs of long-term digital preservation are not clear. Due to the limited resources available, choices will have to be made as to which material should be preserved.
- ❖ *Organisational challenges:* Who decides and who is responsible for preserving what?
- ❖ *Technical challenges:* How to preserve high volumes of rapidly changing distributed information and to improve its cost-efficiency and affordability.
- ❖ *Legal challenges:* As digital preservation depends on copying and migration, it has to be considered in the light of IPR legislation. Other challenges are related to the legal deposit of material.

Building the European Digital Library

Key issues for the European Digital Library therefore are:

- ❖ **Choice of materials:** The selection process should be ‘bottom up’. Libraries and archives which own the materials should decide what is included as part of their own strategic development plans and available resources.
- ❖ **Meeting user needs:** The needs of the user should be central. Development will be demand-driven, but it is also important to take a longer term and visionary view of what the user will get from the library in the way of services.
- ❖ **Leveraging public/private partnerships:** At present, digitisation efforts in the Member States are progressing rather slowly. Public/private partnerships or private sponsorship can be a useful means to complement public funding and help accelerate digitisation.
- ❖ **European value:** Financing digitisation is mainly a responsibility of the Member States. EU programmes can contribute where there is most European added value, for example by helping to aggregate digitised material across borders.
- ❖ **Intellectual property:** Under current legislation only public domain works (where there is no longer copyright) can be made freely available to the public online. Hence, only works with specific rights clearances will be accessible through a digital library.



> Digitisation: Populating the Digital Landscape

For some time, the capture of Europe's cultural heritage in digital form has been recognised as vital in exploiting the opportunities brought by the new digital world.

Digitisation of cultural and scientific collections – books, pictures, films, museum artefacts, etc – contributes to their conservation and preservation. It also creates new educational opportunities and can drive growth in sectors such as tourism, media and creative industries. It provides a rich basis for the development of new content and services, a key policy objective under i2010. And, not least, digitisation offers citizens improved access to their local and community heritage.

Working Together for Digitisation

Considerable efforts and resources are being invested in digitisation projects across Europe. But these activities are highly fragmented and many financial and organisational obstacles remain which jeopardise their success and economic sustainability.

As a first step towards EU-wide coordination of digitisation programmes and policies, Member States started working together under the Lund Action Plan, named after a landmark meeting of national experts held in Lund, Sweden in April 2001. The actions being followed range from bottom-up involvement of cultural institutions, for instance in spreading best practice, to top-down policy initiatives. A group, known as the National Representatives Group (NRG), has been set up to monitor progress in the Member States and to exchange good practices.

Since November 2005, work has continued under an updated action plan – the 'Dynamic Action Plan'. The new action plan focuses on six areas:

- ❖ Providing **strategic leadership** in a dynamic and changing environment in which rapid technological and economical developments are taking place.

- ❖ **Strengthening coordination and forging stronger links** between Member States' digitisation initiatives, EU networks and projects.
- ❖ Continuing efforts in **overcoming fragmentation and duplication** of digitisation activities and maximising synergy.
- ❖ Assessing and identifying **appropriate models, funding and policy approaches** to sustain development and long-term preservation strategies.
- ❖ Promoting **cultural and linguistic diversity** through digital content creation.
- ❖ Improving **online access** to European cultural content.

Many of the elements for effective digitisation programmes are already in place. The challenge now is to build on these, through technological advances and new business models, to make them more sustainable and user-oriented.

Smoothing the Way for Digitisation in Europe

Implementation of the Lund Action Plan and its follow up is being supported through the FP6 projects **MINERVA** and **MinervaPlus**, which have created a network of European ministries from the EU and other countries. The MINERVA network provides national representatives with a forum for open discussion on the harmonisation of digitisation policies and for exchange of best practices. A series of working groups has been set up to address specific thematic issues. These include benchmarking, identification of good practices and competence centres, interoperability and IPR, inventories of digital content, and issues relating to quality and user needs.

MINERVA, on behalf of the National Representatives Group, issues regular progress reports on the Lund Action Plan and its follow up. It has also published a Good Practice Handbook covering good practices in digitisation across ten areas.



Facilitating access to digital music

Making digitised material accessible is a complex process, requiring the acquired media content to be structured and metadata and controls to be attached to facilitate searching and retrieval. This is particularly true for sound signals, which are often composite and can be described with a number of descriptors: noise, speech, music.

The **MEMORIES** FP6 project will design new tools for indexing, searching and retrieving audio content. The application will provide archivists with a flexible and effective tool for information indexation in audio resources and support the development of audio databases. Operators will be supported in attaching ontology and semantics to the content and benefit from an innovative facility of source separation. The system will use the Open Archival Information Systems (OAIS) reference model, an ISO standard for open databases.

The indexation technology developed by MEMORIES will help to turn huge amounts of archival audio data into valuable knowledge that can eventually lead to the creation of products that may finance digitisation of analogue audio material held by the institutions. Outlets for the smart search engine could emerge in fields such as education, broadcasting or telecommunications.

Also concerned with audio archives, **EASAIER**, another FP6 project, aims to make digital sound archives more user-friendly. It will offer enhanced access through the integration of speech and music processing, cross-media retrieval and interactivity tools. The system will be designed with libraries, museums, broadcast archives, and music schools and archives in mind. However, the tools may be used by anyone interested in accessing archived material, amateur or professional, regardless of the material involved. Furthermore, it enriches the access experience by enabling the user to experiment with the audio materials in exciting new ways.

Focusing on the needs of blind musicians, **CONTRAPUNCTUS** sets out to create an online library to enhance access to digital Braille scores. Among other solutions, it will develop a common XML-based format for digitisation and storage of Braille music data.

> Online Access for All

The value of libraries in the digital era lies not only in their own resources but also in their role as gateways enabling access to other collections.

For several years now the European Commission has been working to help cultural organisations, particularly archives, libraries and museums, develop the technological infrastructure, applications and skills to ensure that Europe's cultural heritage can be both preserved and easily accessed in the information age.

Topics addressed by projects under the Sixth Framework Programme include: digital library services, improving access to digital content, digital preservation, digitisation and restoration of audio-visual and film heritage, and Coordination Actions.

New Services for Digital Access

BRICKS, an FP6 integrated project, is working with museums, libraries and other organisations to develop new services. Essentially, BRICKS is about improving the state-of-the-art in digital libraries to the point where the technology can support sustainable, added-value services.

One of the key aims is to create a community of organisations – mainly libraries, museums, and technology providers – around an open digital library platform. BRICKS currently has 50 member organisations, but is growing, and for the time being supports seven languages, although more can be added later. Many users are very small and can benefit from the network's shared resources and experience base.

The results will comprise an infrastructure capable of running independent software units ('bricks'), together with application services targeted at specific user communities.

For instance, one pilot application, Living Memory, allows museum visitors to annotate a museum collection of photographs with their memories, using innovative multimedia tools.

The consortium is already looking for ways to fund the roll-out of the service across Europe once the current research phase is completed.

> “Educating users is a big part of this project – technology without content and without users is nothing.”

>> Silvia Boi, BRICKS Project



The Local Link

Local cultural institutions, such as public libraries, museums and archives, are essential contributors to European digital heritage. They have to be mobilised to make best use of existing technologies and to contribute to the creation, use and delivery of local cultural content to meet specific local information and learning needs. They also face enormous barriers in adopting and benefiting from research results.

Europe's **CALIMERA** project worked to raise awareness of these issues at local and regional levels. It created a huge network of professionals, policy-makers, researchers and suppliers across 43 countries within the European Union and its neighbours.

Its core concern was what the new digital technologies mean for the end-user of cultural services: in short, ordinary citizens of all ages and backgrounds with all their variety of needs and interests. One of the most visible results has been a series of 23 guides for practitioners on digital service issues, from lifelong learning to social inclusion, which are available in over 30 languages.

> “Cultural institutions need to understand usability. People are used to getting all sorts of information and products online, through interfaces they like to use, so we have to provide similar services in the cultural heritage sector”.

>> Rob Davies, Scientific Coordinator, CALIMERA



Multi-Lingual Access to Digital Cultural Heritage

A spin-off project of the MINERVA initiative, known as **MICHAEL**, is launching a multilingual service that will enable people to find and explore European digital cultural heritage material using the internet. **MICHAEL**, which is supported under the eTEN programme, will provide simple and quick access to the digital collections of museums, libraries and archives from different European countries. The service uses an innovative open source platform that will be equipped with a search engine.

By 2007, the **MICHAEL** platform will be capable, through a European-level portal linked to a network of national ones, of discovering digital collections that are dispersed across Europe. For example, students and researchers will be able to use it to discover information about European collections that might previously have been difficult to find. The services will also support cultural tourism, the creative industries and other interests.

Originally covering France, Italy and the UK, the initiative is being extended to eleven other EU countries under a follow-on project, **MICHAEL-Plus**.

Also concerned with multilingual access, the IST project **MultiMATCH** aims to enable users to explore and interact with online cultural heritage content, across media types and language boundaries. It is developing a multilingual search engine specifically designed to access, organise and personalise presentation of cultural heritage information from websites for multiple languages.

Resources for eLearning in Europe

Multilinguality is also an issue for digital libraries of educational content, much of which remains monolingual or monocultural. To enhance the accessibility, use and exploitation of learning repositories across borders is therefore among the objectives of the eContentplus programme. Two eTEN projects are also tackling this issue.

Services to improve access to multilingual e-learning resources are the focus of **eRMIONE**, with a specific emphasis on the cultural heritage domain. It will offer teachers and students a wide range of contents and training courses, coming from cultural and education actors from all over Europe. Teachers will be able to build cross-cultural courses and follow virtual classrooms composed of students from across Europe. Learners will be able to access European-focused courses, contents and virtual classrooms anytime, anywhere and at their own pace.

EURIDICE is validating the business models involved when plugging in copyrighted material into the open educational context. The **EURIDICE** service is a specialised digital library offering 10,000 scanned historical documents from European archives and libraries (see www.euridice-edu.org). The service offers educational institutions wide sources of unique, premium and mostly unpublished historical sources, complemented by an e-learning methodology, retrieval technologies, multilingual thesauri and integrated delivery platforms. Service is targeted to the educational institutions, especially in the humanities.



> Digital Preservation

Alongside digitisation and online access, preservation of digital media is emerging as one of the key issues for the European information space.

The issues are two-fold. Firstly, there is the preservation of existing “analogue” (non-digital) resources so as to ensure their survival for future generations. The situation is particularly acute for audio-visual media (old films, tapes, photos, etc.), which are not as durable as printed works. Secondly, we need to preserve the increasing amounts of data and content that are being created in digital form. These are the heritage of tomorrow and their preservation and reuse will be a cornerstone of the future memory of our societies.

The fast pace of change in the technological landscape makes ensuring long-term access to this material problematic. Storage media may degrade, technological developments make systems obsolete, and information can be rendered inaccessible by changes in encoding formats. Hence, the long-term preservation of digital media so as to maintain them in an accessible and usable form is a major issue for policy-makers and for research.

Preservation Factories for European Audio-Visual Collections

The 20th century provided a new kind of heritage through audiovisual technology. Key events were recorded, and audio-visual media became the new form of cultural expression and an expansion of humankind's memory. These historical, cultural and commercial assets are much more fragile than conventional artwork (paintings, paper documents, monuments, etc.) and are at serious risk from deterioration within the next 20 years.

Institutions traditionally responsible for preserving audio-visual collections (broadcasters, research institutions, libraries, museums) now face major technical, organisational, resource and legal challenges in taking on the migration to digital formats and preserving already digitised holdings.

Previous European projects, like PRESTO, developed efficient preservation technology for broadcasters, and demonstrated that the cost of digitisation could be reduced considerably through a semi-automated assembly-line approach.

> “Listing all the known characteristics of types and years of video tapes is rather like listing wines, they’re so individual!”,
>> Didier Giraud, Project Manager, PrestoSpace

PrestoSpace, an FP6 Integrated Project, takes this concept further by aiming to develop and launch actual facilities and services for audiovisual preservation. The project will start these “preservation factories” by preparing the business plan, contacting potential investors and working with commercial partners to set up the actual services, which will exploit the technological and industrial results.

Although large broadcasters have already begun to digitise their huge holdings, with very high costs and using complex technology, there is a clear opportunity for an integrated, low-cost, semi-automated solution that is affordable by small-to-medium sized collections. The services will be tailored to the realities of the wide variety of audiovisual collections in terms of their business models, storage and software costs, and human resources costs.

End-to-End Support for the Preservation Lifecycle

The FP6 project **CASPAR** addresses the need for end-to-end support across the preservation lifecycle. It has set out to build a pioneering preservation environment for scientific, artistic and cultural information, based on existing and emerging standards. In particular, it will implement the Open Archival Information Systems (OAIS) reference model, an open standard for databases.

Work will include the development of key components and a framework to characterise and store information, together with access services to enable it to be queried, browsed and retrieved intuitively, all exploiting the potential of semantic web technologies.



Particular attention is being paid to issues such as standardisation, authentication, accreditation and digital rights management, which are seen as critical for the operational implementation of digital preservation services.

Of particular importance is the breadth of user communities and types of digital information against which CASPAR will be tested: science, performing arts and cultural heritage, all of which have data ('things meant to be processed'), as well as documents of various types ('things meant to be read'). The testbeds produced will be embedded in operational systems within the CASPAR consortium, and should be easy to integrate into many other operational systems.

Also concerned with the preservation lifecycle, the **PLANETS** integrated project is researching an end-to-end production environment to integrate preservation functions and services into organisational workflows and processes. Services will be developed that enable users to define, evaluate and execute preservation plans. Another focus is methodologies, tools and services that allow users to automate analysis of digital objects so as to establish significant properties. Innovative preservation solutions will be developed to ensure object properties are maintained during rendering.

An interoperability framework will seamlessly connect tools and services across a distributed network. All the solutions will be validated in real-world testbeds.

Ultimately, the project will enable organisations to improve decision-making about long-term preservation. With this new knowledge they will be able to ensure long-term access to their valued digital content, and control the costs of preservation actions through increased automation and a scaleable infrastructure.

A Common European Approach to Digital Preservation

Digital preservation is not only an issue for cultural institutions. Commercial organisations, the public sector and individual users too are at risk and need to take action to protect their digital resources.

DPE sets out to improve coordination, cooperation and consistency in current activities to secure effective preservation of digital materials across all types of organisations. To this end, the project will help to pool the complementary expertise that exists across the academic research, cultural, public administration and industry sectors in Europe.

It is an FP6 Coordination Action and builds on the work of the FP5 project ERPANET.

Work under the project, which targets both citizens and specialist professionals, will raise the profile of digital preservation and disseminate best practices. It will support skills development through training packages and promote auditable and certificated standards for digital preservation processes. DPE will also help coordinate research and exchange, and develop a roadmap for future research. The overall result will improve the shared knowledge base on the long-term management of digital material.



> Digital Repositories for eScience

Managing the Data Deluge

One of the main problems faced by scientists today is that they are drowning in data. As scientific problems become more complicated, and the models and instruments they use to study them become more complex, so the amount of data is increasing rapidly – in some cases at exponential rates. This explosion in scientific data creates new challenges in how the data is stored, retrieved, analysed and manipulated.

This is not just a problem for the scientists. Given the importance of research in science and engineering for innovation, our ability to find answers to these questions will directly impact Europe's competitiveness. Hence, scientific digital repositories are of growing strategic relevance to Europe's objectives, under the i2010 strategy, to build a Single European Information Space. Europe has the opportunity to be in the front line of international developments in this field.

The Scientific Process and the Role of Digital Repositories

The collection of data, and its integrity, is inherent to the scientific process. The full cycle of science includes the acquisition and measurement of raw data, the development of models and technology to control physical phenomena, etc. In certain areas of science (e.g. radio-astronomy, environment, medicine), new technologies and instrumentation serve as "data factories", able to produce limitless amounts of data that need to be shared by researchers, often at different locations.

Over recent years Europe has invested heavily in eInfrastructure – ICT-based research infrastructure – as tools to support scientific collaborations. High-speed communication networks, distributed storage, and sharing of computational resources and data processing allow scientists to tackle the full scientific process in an innovative and more effective way. The development of eScience in Europe strongly depends on the availability of these pan-European infrastructures.

What is missing, however, is effective ways of sharing and transferring knowledge. We need to move beyond the network and grid layers, which are already deployed, to create a new data layer within the European eInfrastructures. This can only be addressed by a coherent strategy towards developing European Digital Repositories, federating and providing added value to national and discipline-based repositories.

Building Common Access to Scientific Data Repositories in Europe

To build common access to European scientific results requires a wide-ranging series of roadmaps covering technical, legal and organisational areas, national plans, and users.

These roadmaps for the future pan-European infrastructure also provide valuable information at the national and institutional level.

The majority of content will be sourced at the institutional level. Institutions (universities and research institutes) throughout Europe should be encouraged to set up institutional repositories and to encourage their researchers and authors to deposit their material. International and subject-specific repositories also need to be integrated in a way which best serves the needs of researchers. Europe also has a rich landscape of national initiatives that will foster broad access to scientific repositories. The adoption of metadata standards should be encouraged at all levels.

In the short to medium term, demonstrator/testbed projects should be undertaken to demonstrate trans-national access. These could address themes such as excellence (like Cream of Science, in the Netherlands), discipline (such as mathematics) or region. They would be based on existing, national digital repository infrastructures and would act as a catalyst to further deployment, as well as exploring common issues. Such testbeds would demonstrate the concept of the 'knowledge infrastructure' within the European context. The projects DILIGENT, DRIVER and EURO-VO-DCA are currently performing this pathfinding role (see box).



Pathfinders for a European Knowledge Infrastructure

A series of demonstrators and testbeds organised under IST projects serve to demonstrate the potential of a European knowledge infrastructure for eScience.

The **DILIGENT** project, for example, is creating a collaboration testbed for eScience communities. Researchers will use this knowledge infrastructure to manage a network of shared resources (e.g., archives, databases, software tools) and to create digital libraries on-demand. For instance, a virtual research group will be able to dynamically create a digital library that satisfies its needs by specifying a number of requirements on the information space and on the services. This new, cost-effective operational model should broaden the diffusion of digital libraries considerably. The testbed is being demonstrated in two scientific domains: environmental e-science and cultural heritage.

Also building a testbed for a future European knowledge infrastructure is **DRIVER**. It aims to demonstrate successful interoperation of the data network and knowledge repositories as integral parts of the e-infrastructure for research and education in Europe.

One research community that depends heavily on eInfrastructure is astronomy. **EURO-VO-DCA** is a specifically European implementation of a virtual observatory. It will produce a unified virtual data and service resource (a data and service grid) with the ability to perform complex data discovery and manipulation tasks across the whole range of astronomical research topics. Virtual observatories are transforming the way astronomers approach research, and EURO-VO-DCA is part of a world-wide community-based initiative.

Exploring the Potential of Digital Repositories

A series of other projects are exploring the potential of digital repositories and aiming to raise awareness within user communities.

BELIEF, for instance, aims to be a focal point for research infrastructure communities and initiatives. It raises awareness of eInfrastructure and facilitates knowledge-exchange between experts and potential users, from both research and industry worldwide. Information is readily accessible to community members through the BELIEF Digital Library, which provides a central repository for eInfrastructure information.

Focused on the life sciences, but extendable to other sets of complex digital data, the **ORIEL** project provided the research community with tools to navigate through an increasingly intricate information landscape and to manage large collections of multimedia data. New search tools help scientists to navigate the exponentially growing amount of raw and derived digital data produced by genomics and bio-informatics research. They do this by improving the semantic cross-referencing between information present in scientific literature, in large, complex molecular datasets and in (multi-dimensional) images (see www.oriel.org).

In archaeology, the **TNT** project has developed a new interactive inventory and online catalogue which is being used by scientists to probe the secrets of Neanderthals. The TNT database today includes 60% of the major excavation sites, 800 human fossil items from 35 archaeological sites and 200 specimens provided by third parties cooperating with the project. The results include NESPOS, an online service for professional studies (<https://nespos-live01.pxpgroup.com>); a suite of tools for 3D visualisation and annotation; and ARCH Channel, a multimedia popular science portal (www.archchannel.de).

> Towards a European Approach

The i2010 Digital Libraries initiative foresees a variety of actions to help Europe's efforts towards world-class digital library services. The foci are in three areas: policy actions, better coordination, and co-funding for research and deployment actions. These three interlinked pillars are being mobilised to deliver the digital libraries flagship project of i2010.

Joining Up Policy

A first Communication (adopted by the Commission on 30 September 2005) outlines the vision underlying the i2010 Digital Libraries initiative. It analyses the challenges for bringing out Europe's full cultural and economic potential and proposes a first set of actions to help overcome the present fragmentation of efforts in Europe.

An online consultation was launched together with the Communication, through which stakeholders were invited to provide their views on several questions and key issues for realising the digitisation and digital libraries initiative. The results have been an important input for a Recommendation on digitisation and digital preservation.

Another policy priority is scientific information. This is an area with its own specificities and dynamics in view of the need to handle and store huge quantities of digital data, and the rapid growth of publications only available in digital form. This raises complex issues of strategy, policy and practice regarding the creation, management, curation and controlled access to such data, in order to make it available and valid to generations of future researchers.

A Communication foreseen for late 2006 will set out the specific challenges for digital libraries of scientific and scholarly information including the role of the supporting infrastructure and the actions to be undertaken at European level.

Mobilising Stakeholders through Better Coordination

A high priority is given to the work of the national libraries, archives and museums, which are predominant actors and committed to contributing to a European Digital Library.

A High Level Expert Group on digital libraries has been set up to advise the Commission on how to best address the identified challenges at European level.

The Commission will increase its efforts to stimulate European co-operation on digitisation and digital preservation. The aim is to give a new impetus to the digitisation process in the Member States, to avoid duplication of effort, and to encourage take-up of good practices. The new Dynamic Action Plan on digitisation can have an important function in this respect, dealing with a number of technical aspects. The use of quantitative indicators within the Lund-context would help to measure progress throughout Europe.



Co-Funding: Leveraging Research and Deployment of Digital Services

Organising and funding the digitisation of cultural collections and digital preservation is primarily a responsibility of the Member States. There are, however, areas where considerable European added value can be achieved, and where work at European level has started some years ago. This work will now be stepped up and complemented by new activities.

At Community level, the new R&D Framework Programme (FP7) and eContent^{plus} programmes will be mobilised towards actions with a European interest and scale on digitisation, digital preservation and accessibility of cultural and scientific content. Applied digitisation of cultural heritage is an objective in cooperation projects under the Culture 2000 programme. The Regional Funds already co-fund digitisation initiatives in some of the Member States and could further contribute to digitisation.

eContentplus is a multi-annual Community programme to make digital content in Europe more accessible, usable and exploitable. Within the eContentplus programme, €60 million will be available (2005-2008) for projects improving the accessibility and usability of European cultural and scientific content. Achieving interoperability between national digital collections and services and facilitating access and use of cultural material in a multilingual context will be core objectives.

Making Europe's cultural and scientific heritage more accessible through the use of new technologies will continue to be a focus for EU research funding. Under FP7, the Commission intends to increase the research effort on digital preservation and access to cultural content, including by way of specialised Centres of Competence. Similarly, in the context of the Capacities Specific Programme of FP7, special attention will be given to the deployment of repositories of scientific information.

Consultations with stakeholders undertaken in preparation for FP7 highlight a number of trends and issues to be addressed through future research.

Firstly, there are clear trends around digital library services:

- ❖ The need to make services more user-centric – research should focus on communities of users (and social software), and on understanding user behaviour and needs.
- ❖ Mass digitisation – further research is still needed to drive down costs.
- ❖ Semantic indexing of content – research is needed to make content understandable and usable, multilingually and multiculturally.
- ❖ Creating large-scale 'digital library laboratories' - where research can be trialled and validated through real-world environments.

In digital preservation, research should aim to address key technological problems such as:

- ❖ More cost-effective approaches for ingestion and characterisation
- ❖ Scalability of computing and storage resources (distributed architectures)
- ❖ Heterogeneity (formats, platforms, objects, data semantics) across space and time
- ❖ Anticipate the context of future access and reuse of preserved information.

For the longer term, there is scope for more visionary research such as:

- ❖ Exploring new approaches to individual and collective memory preservation; links to human and machine cognition; and
- ❖ Extending the multidisciplinary of the research effort.

In digital repositories, future research efforts will focus on the data layer, building on the current grid middleware and broadband network layers. This scientific data layer will have to address, in an integrated way, the challenges posed by the deployment of European repositories of scientific data. These include the need to exploit synergies amongst different communities, to federate existing resources and to ensure interoperability. The operational experience gained in deploying pan-European infrastructures, based upon validated models, can be used to implement a pan-European strategy for this new eInfrastructure layer.

> Projects List

FP5 = Fifth Framework Programme; FP6 = Sixth Framework Programme; eTEN = eTEN Programme; eContentplus = eContentplus Programme

PROJECT ACRONYM	PROJECT TITLE	PROJECT WEBSITE	PAGE
BELIEF	Bringing Europe's Electronic Infrastructures to Expanding Frontiers (FP6)	www.beliefproject.org	13
BRICKS	Building Resources for Integrated Cultural Knowledge Services (FP6)	www.brickscmmunity.org	8
CALIMERA	Cultural Applications: Local Institutions Mediating Electronic Resource Access (FP6)	www.calimera.org	8
CASPAR	Cultural, Artistic and Scientific Knowledge Preservation, for Access and Retrieval (FP6)	www.casparpreserves.eu	10
CONTRAPUNCTUS	Preservation and Unification of New and Existing Braille Music Digital Sources for a New Access Methodology (FP6)	www.punctus.org	7
DELOS	A Network of Excellence on Digital Libraries (FP5)	delos-noe.iei.pi.cnr.it	3
DILIGENT	A Digital Library Infrastructure on Grid Enabled Technology (FP6)	www.diligentproject.org	13
DPE	Digital Preservation Europe (FP6)	www.digitalpreservationeurope.eu	11
DRIVER	Digital Repository Infrastructure Vision for European Research (FP6)	www.sherpa.ac.uk/projects/driver.htm	13
EASAIER	Enabling Access to Sound Archives through Integration, Enrichment and Retrieval (FP6)	www.easaier.org	7
EDL	European Digital Library (eContentplus)	www.europeanlibrary.org	3
eRMIONE	E-Learning Resource Management Service for Interoperability Networks in the Interoperability Networks in the European Cultural Heritage Domain (eTEN)	www.ermione-edu.org	9
EURIDICE	European Recommended Materials for Distance Learning Courses for Educators (eTEN)	www.euridice-edu.org	9
EURO-VO-DCA	European Virtual Observatory (FP6)	www.euro-vo.org/pub/	13
MEMORIES	Design of an Audio Semantic Indexation System Allowing Information Retrieval for the Access to Archive Content	cordis.europa.eu/ist/digicult/memories.htm	7
MICHAEL	Multilingual Inventory of Cultural Heritage in Europe (eTEN)	www.michael-culture.org	9
MINERVA & MINERVAPLUS	Ministerial Network for Valorising Activities in Digitisation (FP5/6)	www.minervaeurope.org	6
MultiMATCH	Multilingual/Multimedia Access to Cultural Heritage (FP6)	www.multimatch.eu	9
PLANETS	Preservation and Long-term Access to our Cultural and Scientific Heritage (FP6)	www.planets-project.eu	11
ORIEL	An Online Research Information Environment for the Life Sciences (FP6)	www.oriel.org	13
PrestoSpace	Preservation towards storage and access. Standardised Practices for Audio-visual Contents in Europe (FP6)	prestospace.org	10
TEL	The European Library (FP5)	www.europeanlibrary.org	3
TEL-ME-MOR	The European Library: Modular Extensions for Mediating Online (FP6)	telmemor.net	3
TNT	The Neanderthal Tools (FP6)	www.the-neanderthal-tools.org	13

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Information Society Policy Link initiative

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http://ec.europa.eu/information_society/activities/policy_link/

Digital Libraries initiative

http://ec.europa.eu/information_society/activities/digital_libraries/

Europe's Information Society: Thematic Portal

http://ec.europa.eu/information_society/

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