

A DATA INFRASTRUCTURE FOR DIGITAL CULTURAL HERITAGE: CHARACTERISTICS, REQUIREMENTS, AND PRIORITY SERVICES

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Abstract *The European amount of digitized material is growing very rapidly, as national, regional and European programmes support the digitization processes by museums, libraries, archives, archaeological sites, and audiovisual repositories. The generation of digital cultural heritage is accelerated also by the impulse of Europeana that is fostering the European cultural institutions to produce even more digital content. Moreover digital cultural heritage content are complex and interlinked through many relations. European countries are working for the future, in order to create a data infrastructure devoted to cultural heritage research. Currently, Europe have twin projects (DC-NET and INDICATE) ongoing and a new international coordination action is under preparation to design a validated roadmap for the preservation of digital cultural content. These initiatives are contributing to smooth the way to the Open Science Infrastructure for Digital Cultural Heritage, which is foreseen in 2020.*

I. THE DIGITAL CULTURAL HERITAGE SECTOR: CHARACTERISTICS AND NEEDS

Since the early 2000s, a wide range of activities was carried out by the European Member States in the domain of the digital cultural heritage. Massive digitization activities are in progress all over Europe (as well as in the rest of the world), following the early developments at the European level¹ and the ‘Lund principles’². The creation of *Europeana*³ as the unique access point to European Cultural Heritage is a very relevant achievement. More than 20 million objects,

International Journal of Humanities and Arts Computing 7 (2013) Supplement: 29–46
Edinburgh University Press

DOI: 10.3366/ijhac.2013.0058

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www.eupublishing.com/ijhac

expressing the European cultural richness, are currently accessible through *Europeana*, and this number is expected to double within the next five years.

Memory institutions (museums, archives and libraries archaeological sites, audiovisual repositories) are digitizing their content, both for preserving it in a digital format and for granting and enlarging the access to them by researchers, students and citizens. It is esteemed that only a very small part of the European cultural heritage had been digitized until now and therefore there is still a lot of work to do. A growing number of projects for digitization is supporting the process and indeed the cultural heritage sector is going through wide transformations and changes.

Further, a huge amount of digital-born material is generate, as the result data from research, materials' analysis, digital art, bibliographies and so on. The digital-born heritage is therefore adding data and content to the digitization process output.

Because the volume of digital cultural heritage data is growing very fast, it is a priority to manage such a huge amount of data in an efficient and selective way, to make the data available to the researchers and the citizens in a European dimension, and towards a global dimension too.

The first issue addressed in the past years in Europe was to build a shared platform of recommendations and guidelines, developing common data models and services. To advance this aim, two major projects (*Minerva*⁴ and *Michael*⁵) were permitted to have the proper basis from which two branches of development started (see Fig. 1). First branch, towards citizens: the national cultural portals and *Europeana*, the flagship project of the European Union, contribute to make available digital cultural content to the European citizens. Second branch, towards researchers: since the research in the cultural heritage sector also is rapidly transforming into a data-based science, the development dedicated e-infrastructures is requested to enhance the research and facilitate the researchers' workflow.

2. THE VISION TOWARDS A DCH DATA INFRASTRUCTURE

The needs of the digital cultural heritage (DCH) sector are:

- high quality information technology management;
- enhanced access facilities
- interoperation among existing cultural heritage repositories, among cultural portals and among data from the digital cultural heritage and from the research.

The e-infrastructure for DCH is not going to be a new infrastructure, but it should be instead conceived as a new approach based on the interoperation and federation of national and regional systems, with the scope of valorizing

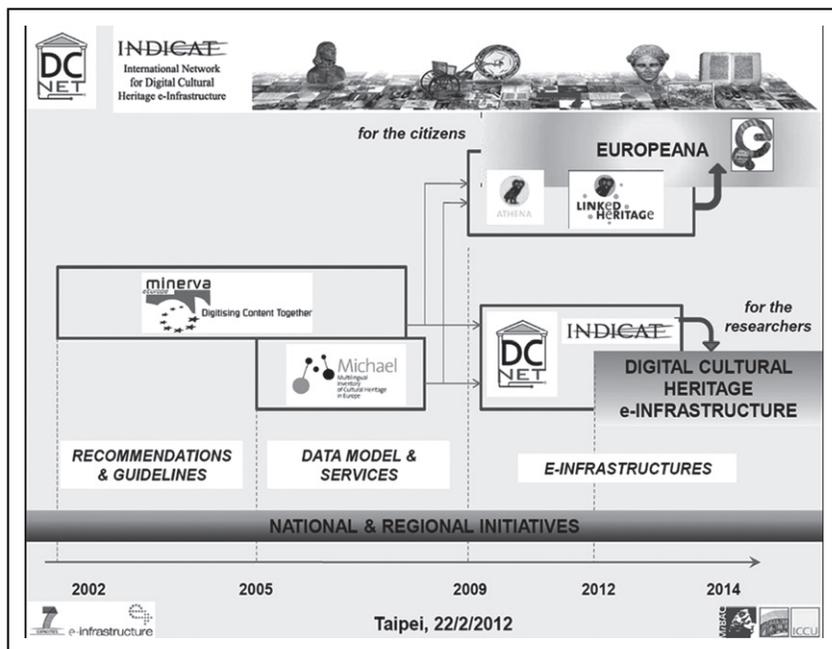


Figure 1. European projects overview.

existing resources. The keyword is interoperability among national, regional and thematic systems.

The embracing of the e-infrastructures by the digital cultural heritage community will open new scenarios of use and exploitation with impacts expected on different sectors:

- impact on the cultural heritage sector, improving storage, preservation and access services for the cultural institutions.
- impact on the research, new advanced services and applications
- impact on the economic sectors, since digital cultural content will become more usable and re-usable for education, cultural tourism, long-life learning, non-professional cultural interests and creative industry.

With regard to connectivity, it is necessary to develop further national policies able to open completely the access to the services of the National Research and Educational Networks (NREN) also to the cultural heritage institutions, since this is not yet the case in all the European member states. With regard to storage and computing, in the past years the research about high-energy physics was supported by the creation of specific e-infrastructures with powerful computing

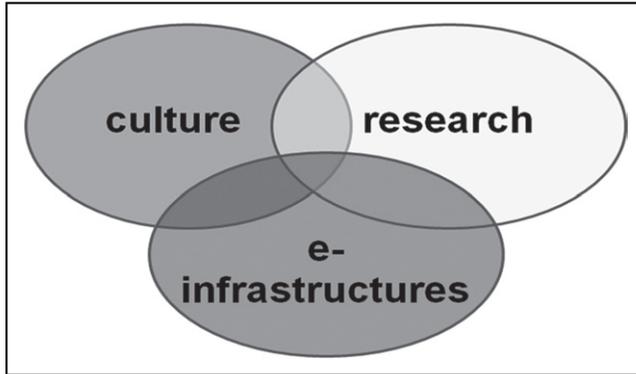


Figure 2. Cooperation and collaboration.

systems, the GRID computing, able to manage a huge volume of data. These e-infrastructures, together with authentication, authorisation, and accounting mechanisms that they offer, can well serve also the needs of the DCH sector. The emerging cloud services, both from the commercial providers and as services based on the GRID are also another important domain of investigation for the DCH sector.

The issue is indeed to establish dialogue and factual cooperation among cultural heritage institutions and e-Infrastructure providers that are not used to work together (see Fig. 2). DCH stakeholders (ministries of culture and cultural institutions at cross-domain level) need to develop further competences and to establish cooperation and collaboration with the correspondent research stakeholders (ministries of research, researchers in the humanities and in ICT applied to cultural heritage) and with e-infrastructure providers: this is the only way for reaching the ideal concept of a DCH devoted e-Infrastructure.

The work has just begun, and there are several preparatory actions currently on-going:

- To define priorities among the services to be deployed
- To consult and to advocate with stakeholders
- To engage with programme owners
- To improve awareness, including standards and who-is-whom
- To promote trust building
- To run experiments: pilots and use case studies
- To open international cooperation: e-infrastructures are operating internationally, also thanks to the EU investment on international links of the GEANT European network. Cultural and memory institutions are sharing

methods and standards for digitization. Capitalizing these results and progressing on the international cooperation is very important.

- To establish an e-culture community

All the actions discussed in the previous points should together contribute to create a motivated community of people and organizations, aiming towards a common goal that is to make available the digital cultural heritage as a continuum of information and data.

The DCH e-infrastructure should be able to serve the research in the humanities, but it should also include complementary services dedicated to the education, learning and public access. Schools could find on such e-infrastructure a major source of information and teaching material, both in the forms of articles and even data. And the availability of data is a way to stimulate the research dimension in the educational process too. Students can be able to use the e-infrastructure for their home-work and for leisure too. Also tourists, families and citizens in general can have access to an enormous quantity of high quality information: tourists can be able to plan their vacations in a more informed way, and parents can spend their time at home with the children to discover new stories about their territory as well as foreign cultures.

The development of educational, learning and public access services will be a matter for the private businesses, triggering a virtuous circle of demand and offer of technology. In this sense the e-infrastructure for the digital cultural heritage is not just an instrument for a limited number of cultural experts, but it can be open to cross-domain and multidisciplinary communities of researchers as well as to the civil society.

3. TWO INTER-RELATED PROJECTS: DC-NET AND INDICATE

In the framework of initiatives to support the development of the DCH e-Infrastructure, two initiatives are worth to be mentioned which are preparing the way for the new European program *Horizon 2020* for research, development and innovation⁶. Both projects are funded by EC FP7 e-infrastructures: DC-NET and INDICATE

DC-NET ERA-NET: Network for the European Research Area

The core objective of the DC-NET project is to establish a common awareness of perspectives, priorities, constraints and capabilities across the digital cultural heritage and e-infrastructures communities in Europe. While the use of e-infrastructures for arts, humanities and social sciences has increased in recent years, the dominant users of e-infrastructures remain the ‘hard’ sciences, notably physics, with increasing levels of bio-informatics and life sciences.

The vision of DC-NET is a seamless data and services infrastructure for the digital cultural heritage, which unobtrusively but reliably provides key services such as preservation and backup, authentication and data integrity, collaborative research environments, advanced (cross-collection, multilingual and semantic) search and retrieval, while enabling intellectual property management and authorised use of digital cultural content. DC-NET established a network of organizations and researchers, explored priorities and capabilities and endorsed a common action plan towards the DCH e-infrastructure. Full information about DC-NET are available on the project website at <http://www.dc-net.org>

Coordination and integration among the European Countries are the core of the DC-NET approach: to contribute to the Joint Programming Initiative on cultural heritage⁷, to integrate the research capabilities of the participant Member States, to identify standards, needs and solutions and to valorize the existing projects and results.

INDICATE: A concrete approach within an international dimension

The goal of the INDICATE project is to coordinate policy and best practices for the use of e-infrastructures by the DCH community in the Mediterranean region. A network of common interest composed of experts and researchers from e-infrastructures, DCH and ICT domains was established to share experience, promote standards and guidelines, seek best practices and policy harmonisation, and transfer knowledge from DCH organisations experienced with the use of e-infrastructures to those with less experience. INDICATE also carried out practical experimentation through pilots and use case studies using the policies and best practices identified by DC-NET in the areas of: preservation, virtual exhibitions, and management of geo-coded cultural content. The Paris Declaration, adopted by the INDICATE partners on the 7th June 2012 at the Strategy and Future Plans Workshop (www.indicate-project.eu) details the future priorities and commitments of the network beyond the lifetime of INDICATE. The shared vision of the INDICATE network is that within ten years, access and use of digital cultural heritage will be available to all and that collaboration with the e-infrastructures community will facilitate realisation of this vision. Full information about INDICATE are available on the project website at <http://www.indicate-project.eu>

The project involved European countries together with Egypt, Turkey and Jordan; cooperation are ongoing in China in liaison with the EPIKH Grid School, in Taiwan in the frame of the TELDAP Conference and in South America in the frame of experiments for live distributed performances in liaison with the CHAIN and GISELA projects.

INDICATE and DC-NET projects have developed in a common timeframe, with many partners in common (see Fig. 3).

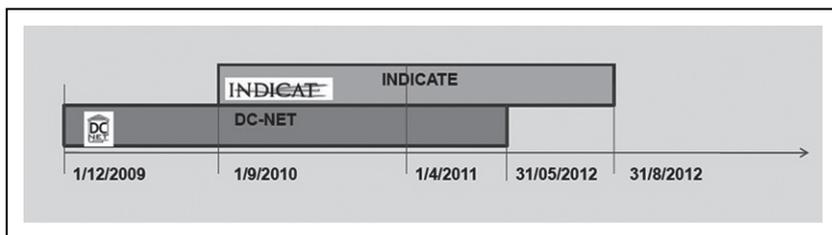


Figure 3. Timeline.

4. SERVICE PRIORITIES

The services priorities identified by DC-NET can be usefully divided into three categories:

- Services for content providers, related to the creation of online data resources;
- Services for managing and adding value to the content itself; and
- Services which enable, support and enhance virtual research communities and the activities of content consumers.

These three categories encapsulate three key aspects of digital cultural heritage.

Content providers are those memory institutions which digitise and place content online. Their work includes not only selecting and digitising the content, but also preparing metadata, building data resources such as websites, portals, digital libraries and repositories. The creation of data resources is a core task for any DCH initiative. Every DCH project needs some type of ‘database’ or online data resource, as a structure within which digital content can be placed. Important issues here include interoperability across resources, tools for searching and navigating the resources, long-term value of the resources, etc. Of great importance to content providers is effective networking and sharing of information across DCH initiatives, the building of consensus and best practice, so that content providers can learn from one another, and the development of skills within the DCH community, to enable new research to be carried out.

Managing and adding value to the content itself goes beyond simply publishing digitised material online. There are many attractive ways to enhance the data, make it more user friendly and attractive and to facilitate its re-use in education, in commercial ventures, in collaborative projects, etc. Key issues here include visualisation, geo-referencing, 3D representation and manipulation, IPR management, annotation, statistical analysis and other activities which add value to the actual content and/or make it easier to manage.

Services for virtual research communities focus more on the users of the content and less on the content itself. A major priority for the holder of

any DCH corpus is to add value to it by nurturing a research community around the material, by enabling annotation, discussion and user-contributed content. Underpinning such new facilities are requirements for user management (authentication, auditing, accountability), for tools and environments which stimulate collaboration across virtual communities of researchers, and for communications, conferencing and publishing.

4.1 Services for content providers

These services includes: services for content creation, networking services, and technical services. The creation of an online ‘location’ for the presentation of DCH materials online is a central part of any digital heritage initiative. The model applied will most commonly be a content management system, a portal system, a digital library or digital repository which has been specifically designed and built for the purpose.

Online resources have several common issues:

- In general, each online resource uses its own technical solution or blend of solutions to meet its own needs.
- Insularity in terms of searching - each online resource typically has its own search interface and algorithm. Searching across multiple resources and combining the results is technically challenging.
- Changes in location – items within online resources are typically accessed via their URL. When the resource is reconfigured, reformatted, moved or restructured, this leads to broken links and issues with access (particularly from portals and third party services).
- High cost of establishment – setting up a new online resource is a complex technical task and usually requires customisation and adaptation of the technology to meet the specific needs of the DCH users.
- Vulnerability to technical problems. The resources typically represent a very large investment by the DCH community and a strategic asset of the owners. A technical problem such as server failure could be catastrophic.
- Limitations on server capacity and processing – online resources are frequently hosted in-house or by a commercial hosting company; when the resource consumes the space or processing power allocated to it, there is a high potential for disruption when the system needs to move to a new platform.

These issues lead to the identification of the first set of priorities for the DCH research community:

- Interoperation: Such services may involve the transformation of metadata and database data sets to a particular common standard, or the creation

of mappings between the metadata and data formats of different online resources.

- Aggregation: Services which can harvest and combine material from several DCH resources are needed in order to enable multi-resource facilities to be delivered.
- Cross-Search: Services are needed which enable searching across multiple online DCH resources. This may involve the transformation of a centralised search into the local search calls for multiple DCH resources; alternatively it may build on the interoperation services mentioned above, or utilise linked data as described below.
- Semantic Search: Services which take advantage of advances in semantic web technologies, such as linked data and ontologies are needed.
- Persistent identification: Services are needed which simplify or automate the maintenance of persistent identifiers and their mapping to specific locations within DCH resources. PID services which shield external users from internal reconfiguration are needed if portals and services which build on interoperability are to be stable in the medium to longer term.
- Setup services: Facilities and tools which simplify the construction of online digital culture resources themselves are badly needed.
- Stable platforms: Infrastructure services for hosting, backup and availability of the DCH resources.
- Scalability: Services which enable arbitrary levels of scaling and growth are required, as the amount of digitised material grows and the usage levels increase.

Enabling and developing a Europe-wide virtual research community dedicated to digital cultural heritage is a high priority. There is still an urgent need for greater integration, consensus, and collaboration. The research field has tended to fragment along national and sectoral lines (museums, libraries, archives, monuments, etc.) lines; additional fragmentation has been caused by the involvement of multiple ministries in some countries, by different funding models, etc.

The following specific services have been identified by DC-NET:

- Knowledge and documentation of user needs: The end users of DCH work tend to be DCH researchers and/or members of the general public. As in other areas of IT, there is a temptation to deliver solutions which take advantage of new technologies, without first ensuring that such a solution is actually required. Developments in the broader Web, such as social networking, semantic web technologies, adaptive systems etc. all offer potential for new DCH services, however, it is essential that end user appetite for such services is actually present. Research into the interests and requirements of the end user communities is needed. This research

must be ongoing over time, as the end user priorities and expectations will themselves evolve.

- Who is who: DCH research is typically fragmented along national and sectoral lines. This can lead to repetition of research, to the re-invention of common solutions and to organisations failing to learn from the experiences of others. A key solution to this issue is to be able to identify the organisations and the individuals who are active in DCH and to summarise their particular areas of expertise and experience. A ‘directory’ or ‘who is who’ guide to Europe’s DCH community would be a valuable addition to the current situation, where contacts tend to grow organically, serendipitously and by word-of-mouth. Such a directory would need to be updated on a regular basis.
- Policies and programmes: Each country, each sector, and often each organisation will have policies and guidelines for accessing, sharing, and processing the content under its control. Such policies range from digitisation guidelines to access control and commercial re-use. Where DCH research is being envisaged, it is important for all concerned to have a clear picture of the policies that will impact on the research. An awareness of the programmes already in place and how new research initiatives can impact on those programmes is also important. It is to be hoped that ongoing efforts at consensus (including DC-NET) may help to simplify the policy landscape over time; however it remains a critical element of any successful collaborative DCH research initiative.
- Handbooks and technical reference: The experience of completed and ongoing DCH initiatives needs to be shared with new and planned projects. While all projects produce reports and deliverables, a greater emphasis should be placed on the generation of widely-applicable guidelines and handbooks which formalise and integrate the lessons learnt. The loss of knowledge when projects end is an important source of inefficiency in DCH research; measures to address this are a priority.
- Consensus building: Seminars, workshops, dissemination. While sharing knowledge and experience is very beneficial, international and cross-sectoral impact can best be achieved by face to face discussion and consensus building. The mechanisms used for consensus building are typically meetings, seminars, conferences, etc. The results can be usefully validated through dissemination events where they are exposed to, and receive feedback from, the broader DCH community.

4.2 Services for managing and adding value to the content itself:

While the core of DCH is the digital content itself, this content is indeed much more useful and appealing when it is made available for the consumers/end

users, and re-usable for educational purposes. Services that improve the content are for example geo-referencing, 3D visualization and manipulation, virtual reality and immersive interfaces, annotation linked data generation

4.3 Services which enable, support and enhance virtual research communities and the activities of content consumers:

As the research communities are becoming virtual and there is not anymore the need of being geographically local to the studied material, it is necessary to enable a wide range of new services to support the researchers' participation to the research: user authentication, group-based access control, collaborative environments, annotation services, advanced search support, visualization services. Content consumers are of course free to pick and choose the services which they will use, and those which they identify as being of greatest importance. This 'cafeteria model' enables a broad range of services to be made available, without the need to actually deliver them for all members of a (primarily undemanding) researcher community.

The previous paragraphs present the most important new or improved services for the DCH sector, which can benefit from e-infrastructures support. The following priority ordering (from the most important service, to the least important) reflect both the input of the DCH community and also the impact which e-infrastructures support can make. In addition, the amount of R&D needed to make the new service a reality must also be taken into account – 'low-hanging fruit' should be prioritised, so that tangible benefits are achieved in the short term. None of the services listed is 'low priority' – all of the services promise substantial benefit to the DCH community.

The following ordered list takes these into account.

1. Long-term preservation
2. Persistent identifiers
3. Interoperability and Aggregation
4. Advanced search
5. Data resource set-up
6. User authentication and access control
7. IPR and digital rights management

All the services identified here are important and valuable. Ordering them in terms of priority is both difficult and somewhat subjective. This list and its order combines short-term feasibility of implementation with e-infrastructures added-value and DCH strategic importance. All these services are important, and the priority order doesn't mean that the lasts are the least: it is necessary to point towards a common research action plan and therefore cooperation and

coordination among the three sectors (culture, research, e-infrastructures) is at the core of the DCH e-infrastructure.

5. NETWORK OF COMMON INTEREST

The network of common interest built by DC-NET and INDICATE combines regional, national and international levels with both bottom-up (working groups) and top-down approaches. The working groups are composed by experts seconded by their cultural, research and infrastructure organizations, and cooperation was established with other networks and projects as EPIKH, CHAIN, EUMEDGRID-Support, EUMEDCONNECT2, LINKED HERITAGE⁸ and many others.

A dialogue is also established with strategic bodies that work in Europe and abroad on DCH and e-infrastructures policies:

- –e-IRG e-Infrastructure Reflection Group
- –ESFRI European Strategy Forum on Research Infrastructures (with particular regard to the Social Science and Humanities thematic working group - SSHTWG)
- –EGI.eu European Grid Initiative
- –TERENA Trans-European Research and Networking Association
- –MSEG Member States Expert Group on digitization
- –ASREN – Arab States Research and Education Network

6. WHAT HAS BEEN DELIVERED BY THE PROJECTS AND THE LESSONS LEARNT

DC-NET and INDICATE projects cope with a common goal which is to support the cultural heritage sector to go digital and to be alive in the digital space.

The DC-NET project ended in March 2012 and its legacy consists mainly in three parts:

1. The list of *services* that are considered of major priority for the sector; this list is endorsed by a wide number of Ministries of Culture in Europe and it represents a valuable starting point for any public and private organization that intends to enter into the sector with its own offer of services;
2. A plan of *joint activities* aiming to establish a digital infrastructure for the cultural heritage, endorsed also this by a wide number of European Member States' agencies and research centres, that are now committed to contribute to its execution, contributing with funding, technologies, human resources and cultural digital content;
3. A *living network of people and organization* that meets in the frame of a range of projects and initiatives, in Europe and globally, that share a need: to develop a community, with common tools and a common understanding

of the respective skills, standards, technologies, vocations and interests. This is probably the most relevant result that DC-NET has left to the next projects and initiatives.

The main lesson learn in DC-NET is that the process to make stakeholders converging on common goals is feasible, what is much more difficult is to make them allocating the resources necessary to realize those goals. In this sense, the approach taken by DC-NET is to enlarge the basis of the actors involved in the process and through the involvement of more people and ore organization to increase the possibility to get the new projects funded.

INDICATE is ending in October 2012. Its legacy consists mainly of practical results, namely:

1. The first result is made of studies of use cases about matters that are of major interest for the sector at the moment (namely digital preservation, virtual exhibitions and geo-coded cultural content) and for each of them an analysis of how the e-infrastructures can enable the delivery of improved and enhanced services to the cultural institutions.
2. Further, INDICATE played within concrete pilots in order to demonstrate from a practical point of view what does it mean to let the cultural institutions to use the e-infrastructures. The pilots demonstrated that from a technological point of view the solutions are available, but the cultural institutions are still missing a real awareness and knowledge of what the e-infrastructure are, which is the level of security that they can offer, how to take benefit of the computing and networking power, and in general we can say that the cultural sector is not yet ready as the other sciences to take full advantage of the new technologies.
3. The third legacy of INDICATE is to have opened an international dialogue among the actors of the cultural sector on the possibility to approach the e-infrastructures for the delivery of advanced services. INDICATE worked directly with three Mediterranean countries (Egypt, Jordan, and Turkey) and established cooperation with China, South America and participated to the 2011 and 2012 editions of TELDAP Conference in Taiwan. The experience has shown that, more or less in each country and region of the world, there is still much bureaucracy that influences the operations of the cultural sector and this limits in a certain way the capability of the sector to react to innovation. However, the people in the cultural sector are eager to use the new technologies and are looking very much for experimenting innovative solutions and this can be the real engine to move the sector toward the new digital dimension.

The main lesson leant from INDICATE is that learning by doing applies also to this case and the practical experiences carried out in INDICATE have

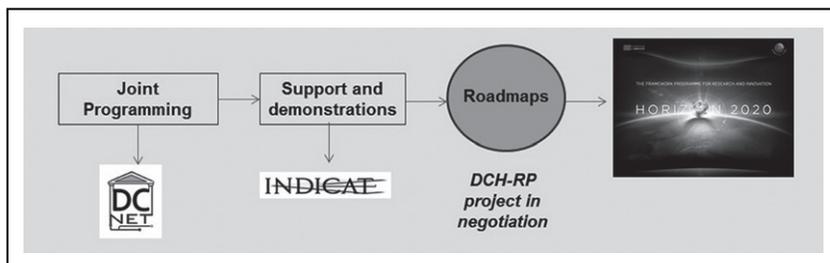


Figure 4. Towards Horizon 2020.

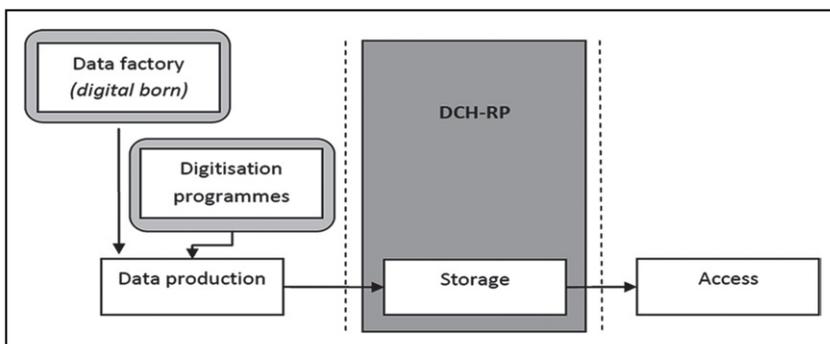


Figure 5. DCH-RP.

produced a major impact on the participating partners in terms of awareness of the meaning of a new e-infrastructure for the digital cultural heritage.

7. THE NEXT STEP: A ROADMAP FOR THE PRESERVATION OF DIGITAL CULTURAL HERITAGE

INDICATE and DC-NET are part of a wider process, which started 10 years ago among cultural institutions and this process entered in a new phase, by joining the research e-infrastructures. It is now time to start working towards an Open Science Infrastructure for Digital Cultural Heritage in 2020, and concretely to establish a roadmap for DCH that express clear work-paths, alliances and strategies (see Fig. 4). To achieve this goal, NREN and NGI facilities needs to be complemented with targeted specific services designed around well established communities. DC-NET and INDICATE started the work.

The new initiative DCH-RP Digital Cultural Heritage Roadmap for Preservation, starting in October 2012 and lasting 2 years, will continue adding more concrete results in the specific area of the digital preservation (see Fig. 5).



Figure 6. Beyond Europe borders.

The main objectives of DCH-RP are:

- to harmonize policies
- to progress with the dialogue among DCH institutions, e-infrastructures, research and private organizations
- to establish the conditions for these sectors to integrated their efforts into a common work
- to identify the most suitable models for the governance, maintenance and sustainability of such integrated infrastructure for digital preservation of cultural content

The outcome of the project is a roadmap for the implementation of a preservation infrastructure for DCH, supplemented by practical tools for decision makers and validated through a range of proof of concepts, where cultural institutions and e-infrastructure providers will work together on concrete experiments.

DCH-RP Roadmap is intended as the first instance of the Open Science Infrastructure for DCH in 2020. DCH-RP will start with its thirteen partners and will then move to the 20 ‘external partners’ from Europe, Taiwan, India, Malawi, USA and South America who have already expressed their intent to participate to the study (see Fig. 6).

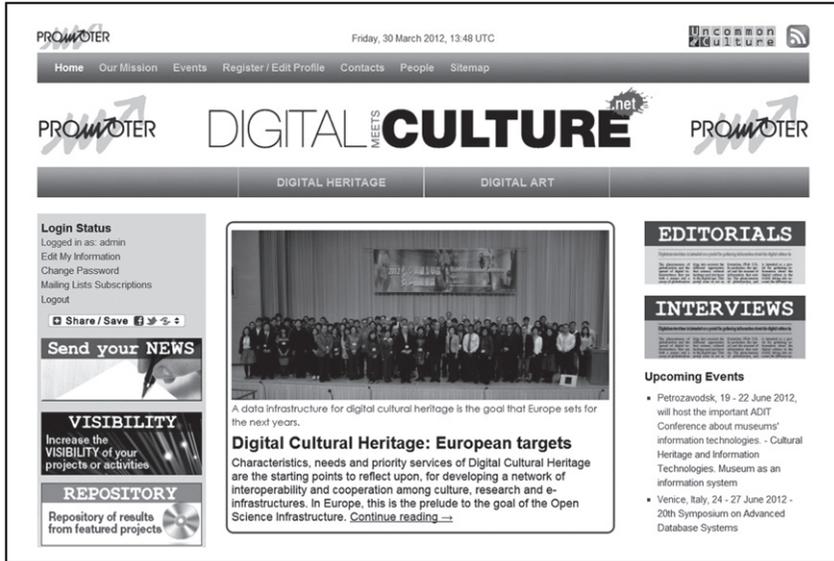


Figure 7. www.digitalmeetsculture.net.

8. DIGITALMEETSCULTURE.NET

While approaching digital solutions and technologies, the DCH sector also needs platforms to share best practices, develop cooperation, and be visible to the world. The website www.digitalmeetsculture.net contributes to this scope (see Fig. 7). It is a collaborative and communication platform open to worldwide contribution, run by company Promoter (www.promoter.it). The portal is a remarkable meeting point with a global dimension, that takes into account the different approaches that scientific, humanistic and artistic culture have to the digital age. It provides visibility to projects, with dedicated pages containing presentation of the initiatives, related articles, interviews, focused issues, contact details, auto-refreshing news (via RSS), multimedia galleries, and much more. The editorial staff is assisted by correspondents from all over the world, who cooperate to harvest news and information.

Interactivity is a key-point of the portal: like any modern communication website, users can register to the portal, thus being allowed not only to simply comment the articles, but mostly to play an active part and send events and articles, until the point of joining the staff as correspondents. The global dimension of the project is therefore sustained and implemented by enlarging the group of involved people who act as content providers, in order to open the magazine to any input.

9. CONCLUSIONS

The digital cultural heritage can benefit from the access to the e-infrastructures that exist for the research. To achieve this goal it is necessary to develop a dialogue among people and organizations who are not familiar to work together: museums, libraries, archives, ICT research centers, and e-infrastructure providers. Further, it is necessary to create a policy environment that support this dialogue, by getting together national, regional, European and international authorities, to achieve common commitment on shared goals. It is also necessary to run experiments, use case studies, pilots able to demonstrate at operative level the feasibility of a long-term vision. DC-NET, INDICATE and the future DCH-RP have started to work in this direction. The coming years will be important to continue the work.

The programmes offered by the European Commission to support this process are important. In this light the new *Horizon2020* will play a very important role. The complexity of the participation to the EC programmes remains a serious matter that could influence the delivery of impact of the projects that run with the support of such programmes. However, the width as well as the international dimension of the creation of an infrastructure demands necessarily for the public support. And in Europe, the European Commission is the primary source of funding for initiatives that go beyond the national borders.

The sense of the European-belonging is not complete and the idea of a European e-infrastructure for the digital cultural heritage is fully dependent from this sense of EU-belonging, which is still under construction . Building such an infrastructure will be more difficult than for the other sciences, and this is not due to pure technological issues, but to the real nature of culture heritage, that is where Europe is so unique, extraordinary, but also so difficult to be developed.

END NOTES

- ¹ European Council (2001) ‘European Content in Global Networks: Coordination Mechanisms for Digitisation Programmes (Lund Principles)’, Consulted January 31, 2012. Available: ftp://ftp.cordis.lu/pub/ist/docs/digicult/lund_principles-en.pdf
- ² European Commission (2002a) ‘Technological Landscapes for Tomorrow’s Cultural Economy: Unlocking the Value of Cultural Heritage’, DigiCULT Report, Luxembourg: Official Publications of European Communities, Consulted January 31, 2012. Available: <http://www.digicult.info/pages/report.php>
- ³ Europeana is the public digital library promoter by the European Union and referred as one of the flagship initiatives in the Digital Agenda for Europe. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions COM(2010)245, Brussels, 19.5.2010. Available: <http://ec.europa.eu/digital-agenda> and <http://europeana.eu>
- ⁴ MINERVA is the Ministerial Network for valorising activities in digitisation of cultural heritage. It has run as a series of projects (Minerva, Minerva Plus and Minerva EC) supported by the European Commission in the frame of the Fifth and Sixth Framework

Programme for the Research and Technological Development and in the frame of the eContent Plus Programme to support the development of a content industry in Europe. Available: <http://www.minervaeurope.org>

- ⁵ MICHAEL is the European portal that provides a unique access point to the European digital cultural collections. The portal has been implemented in the frame of two project, Michael and Michael Plus, supported by the European Commission in the frame of the eTEN Programme for the ICT Trans-European Networks. Available: <http://www.michael-culture.org>
- ⁶ Horizon 2020 is the new Programme for research, technological development and innovation that the European Commission is preparing. The Programme will run from 2014 until 2020. Available: http://ec.europa.eu/research/horizon2020/index_en.cfm
- ⁷ The Conclusions of the Council of the European Union on the 2nd of December 2008 indicated the Joint Priogramming Initiatives (JPI) as the instrument to correlate the national investment on the research on the bid societal challenges in Europe with the resources make available on the same themes by the programmes of the European Commission. A JPI has been established among the European Member States, based on a variable geometry, specifically addressed to the Cultural Heritage. Available: http://ec.europa.eu/research/era/areas/programming/joint_programming_en.htm
- ⁸ Linked Heritage is a Best Practice Network for the aggregation of content to the European digital library Europeana. Available: <http://www.linkedheritage.eu>