Cultural heritage Advanced Research Infrastructures: Synergy for a Multidisciplinary Approach to Conservation/Restoration

Reporting

Project Information

CHARISMA

Grant agreement ID: 228330

Closed project

Start date
1 October 2009

End date
31 March 2014

Funded under
FP7-INFRASTRUCTURES

Overall budget
€ 9 653 371,37

EU contribution
€ 7 600 000

Coordinated by
UNIVERSITA DEGLI STUDI DI PERUGIA

Italy

Final Report Summary - CHARISMA (Cultural heritage Advanced Research Infrastructures: Synergy for a Multidisciplinary Approach to Conservation/Restoration)

Executive Summary:
FINAL PUBLISHABLE SUMMARY REPORT

1. Executive summary

The aim of CHARISMA was to build a new user-friendly platform of existing large-scale facilities or
small/medium installations open to users and develop a set of the widest number of scientific methodologies and techniques, in order to enable the European heritage science community to gain improvement in the research for diagnostics, analysis and assessment of materials of cultural heritage, identification of artistic techniques, identification of the cause and effects of deterioration processes, and in situ monitoring during and after restoration.

Long term objectives were: improve the infrastructure relationships and counteract the fragmentation in scattered scientific communities of the wide range of activities, integrate the research capacities across Europe and beyond, capitalising on the resources and expertise to foster and enlarge the user community, diffuse awareness at the scientific and decision making level of the vision and results of CHARISMA.

Significant achieved results have been:

• The deployment of functioning access nodes of the most advanced European facilities customized to meet the particular heritage requirements for research and applications on composition and structure of works of art, the technology used to produce them, the alteration of their materials in specific environmental conditions – including museums –, the establishment of possible remedies against deterioration, etc.;
• The set up of high performance analytical equipment, for in-situ non-invasive measurements on artworks, without any movement of the artefacts from their location, permitting for a direct materials research on precious or immovable artworks, or monitoring innovative conservation methodologies during their application, even on the scaffolding at a restoration site;
• The development of structured scientific information, available in the archives and documentation departments of both prestigious museums and conservation centres, consisting of an unprecedented amount of analytical data to unlock their immensely valuable data collections, making them more widely available;
• The development of new instrumentation and methodologies for the study of artwork materials, at the surface (2D) and in depth (3D), both for laboratory analyses on microsamples and for in-situ non-contact investigations, overcoming technological barriers, improving the quality of the participating infrastructures and offering innovative technology solutions and competitive advantages for the production of new instruments for diagnostics;
• The set-up of new advanced laser cleaning techniques, exploiting high security methods that guarantee the artwork, being based on local control of the intervention through non-invasive in-situ real time monitoring;
• Establishing best practices for multi-technique analysis of samples, analytical data assessment or degradation issues;
• Providing international cooperation, education, training, users’ awareness events, and technology transfer to research laboratories, memory institutions and industrial organizations;
• Sharing knowledge on large scale EC conservation projects, adopting a progressive compatibility of individual archives and registers, establishing common approaches to the interpretation and easy exchange of 2D and 3D analytical data
Ancient and historical masterpieces are often exposed to the harmful effects of a changing environment or inappropriate restoration or handling, so that tangible cultural heritage can be intrinsically unstable. Many risks can be mitigated so long as proper knowledge of materials and degradation processes has been acquired. In fact, the detailed knowledge of the composition or structure of an artwork or an archaeological artefact is a prerequisite condition for any research in art history or archaeology as well as any action of conservation-restoration. This is crucial for decisions on proper preservation actions and undeniably requires an assessment of the foreseeable evolution of the degradation. To gain the deepest insight into the artwork properties, museums curators, conservators and heritage scientists should benefit from access to research tools of the highest level and to the most skilled teams able to take advantage of the outstanding possibilities of the corresponding micro-analytical tools.

Due to their origin and ageing, heritage materials are generally mixtures of inorganic phases (crystalline or amorphous) and organic compounds (often at the micro- and nanoscale), which require powerful analytical tools to be identified. Mapping of constituents is now essential in view of the heterogeneous nature of heritage materials at all scales: it involves not only the distribution of elemental composition, but also of crystal structures, molecular signatures, etc. A large variety of advanced techniques – portable or microinvasive – is used nowadays, from laser to synchrotron and ion beams, from microfocussed spectroscopy to full-field imaging. Regarding conservation methodologies, laser technology has recently offered new solutions to the complex problems of cleaning dirt encrusted artefacts, this in spite of the complexity of the physicochemical risks associated with the ablation of photosensitive substrates and the limited opportunities for testing on real cases.

Within this general frame, the lack of a coherent powerful platform of access to the widest number of scientific methodologies and techniques available in large scale facilities and small/medium installations, as well as the difficulty of sustaining coherent combined experimental strategies, have been in the past significant limiting factors to a rapid development of the European research.

To close this gap, CHARISMA (Cultural Heritage Advanced Research Infrastructures: Synergy for a Multidisciplinary Approach to Conservation/ Restoration) has been established as an FP7 EU-funded advanced Research Infrastructures consortium, which integrates conservation/restoration scientific activities and transnational access, whose activities, developed within the period from October 2009 to March 2014, are reported in this document.

**Objectives**

The aim of CHARISMA was to build a new, user-friendly platform based on a combination of the most relevant existing instruments, knowledge and stored data collections. The results must be capable of performing the necessary applications enabling the heritage science community answer complex questions related to i) diagnostics; ii) analysis and assessment of materials of artworks; iii) identification of artistic techniques; iv) identification of the cause and effects of deterioration processes; v) in-situ monitoring of conservation processes during and after treatments.

**Main goals:**

• Provide the best opportunity for developing research at the forefront of the field, combining advanced scientific research infrastructures with the high-level knowledge of leading technology institutes on cultural heritage.

• Couple cutting-edge research to intelligent delivery systems through interaction with end-users and experts in science applied to cultural heritage disciplines.

• Optimize the use of infrastructures through a coordinated program of transnational access, joint
research, and networking activities.

• Overcome the lack of a coherent powerful platform of access to the widest number of scientific techniques available in large scale installations and small/medium facilities, sustaining combined experimental strategies.

At the EU heritage science scale:

• Develop a common accessible platform offering users the most advanced European facilities embedded in a complementary and multidisciplinary environment involving material science and artwork conservation/restoration.

• Create a solid base for outstanding innovation in the capacity-building policies of science and technology, with expert knowledge on the most significant advances for safeguarding and protecting cultural heritage, enhancing the project openness across Europe and beyond.

• Hold a program of open workshops and training to introduce curators, research-conservators and conservation scientists to the questions involved.

• Promote a joint reflection work and share the best practice for multi-technique analysis of samples, analytical data assessment or degradation issues as well as knowledge on large scale conservation projects.

Scientific and Technological Views:

• Design and set-up innovative instrumentations, for in-situ 2D and 3D examinations of artworks, and new cleaning techniques based on laser technology.

• Improve access to databases exploiting digitalization of data and their harmonization.

• Carry out research on dyestuff identification to further elucidate the composition and behaviour of organic colorants.

• Develop patterning and orientation techniques and new methodologies for the study of organic materials and their distribution in micro-samples or directly at the surface of the object.

The challenges facing CHARISMA embrace transnational access, joint research and networking activities.

2.1 Networking

The powerful advances in research over the last few years have coincided with a growth and spread of a culture of cooperation among European scientists, with an increase in the awareness of the crucial importance of sharing of knowledge, pooling of resources, and coordination of activities over the European area. Initiatives such as the Eu-ARTECH project, funded within the 6th FP, and others as European standardisation in cultural heritage, CEN TC/346, strongly hinted at this cultural development. CHARISMA strongly contributed to improve interoperability among the institutions of the consortium and those external to it, diffusing best practices and, at a more fundamental level, knowledge of new instrumentation, methods and technologies.

During the projects years a progressive harmonization/compatibility was adopted of best protocols for multi-technique analysis of samples, following the type of object and material (stone, metal, paint, paper, polymers, etc.) or degradation issue (alterations, depositions) and in diagnosis and conservation methodology for monuments, historical buildings and sites. A uniform protocol for sharing analytical data of individual archives and registers (distributed data sets or database systems or different digital formats) was also completed.

A detailed training plan has been developed to allow the cultural heritage community to benefit from the assembled scientific excellence through the organization of training events, seminars, “hands on” workshops to diffuse deep knowledge, expertise and well established methodologies to the users /
professionals and to the public.
To coordinate the compatibility of CHARISMA with related initiatives worldwide, to disseminate information about the project, its objectives and results, spreading internal and external communication through the establishment of target audiences, have been all other goals successful accomplished, creating two-way communication channels with stakeholders carrying national responsibilities, academic, research and conservators' communities and users benefiting from project activities.
Coordination fruitful activities included:
- Share and compare the results obtained by European scientific community on focused priority areas, verify the impact of project work and grades through focused technical meetings and ensure the highest efficiency of the developed activities and verify that they correspond to the real users’ needs.
- Implement the CHARISMA web site with a relevant dedicated Welcome access section, to apply for access, define and implement, in a coherent way, unified modality of access, the outreach of new users and the site review procedure. Brochures, project Logo, project Fliers etc. were also produced.
- Monitor the success and impact of the project activities through the Extra-Mural Advisory Committee, having external feedbacks regarding the project objectives, its technical goals, milestones and deliverables.
- The delivery of the ‘Definition of quality control procedures’, so-called project reference book, a common procedural document, designed and developed to ensure a ready reference meant for the quality project assurance and the dissemination activities, including publications and presentations. For optimal use, the reference book was produced at the beginning of the project, and shared among partners.

2.2 TA Support
The CHARISMA engagement offered to European researchers and professionals, a full access service - using an easy single entry point on-line - to the most advanced infrastructures and technologies for investigations on cultural heritage.
For applying to techniques devoted to non-destructive examination of objects and samples (FIXLAB) the access was executed at two strongly integrated platforms, one in France (SOLEIL, CNRS) and the other in Hungary (ATOMKI-HAS, BNC), where Large Scale Facilities (LSF) were coupled to a set of medium scale instrumentations, completed when necessary with more conventional examination and analysis tools.
The access to the mobile equipment of MOLAB, a unique set of portable instruments and associated competences, allowed researchers to carry out their work on-site, i.e. directly in a conservation laboratory, in a museum room or even on scaffolding in a restoration site.
Basically, the equipment consisted of a new high-resolution VIS-NIR multispectral imaging device; a compact, portable XRD-XRF device, for in-situ XRD measurements on identification of crystalline solids; a miniaturised fibre-optic micro-Raman spectrometer, equipped with two lasers (532 and 785 nm) for the study of glasses and glazes, pigments and colorants; a prototypical spectro-fluorimeter for the in-situ measurements of fluorescence lifetimes in the scale of picoseconds, unique for its portability; as well as other additional compact portable advanced tools based on other chemical and physical techniques.
These services were integrated with ARCHLAB, a “facility” enabling access to the huge quantity of archived knowledge and technical data held in the most prestigious European museums or conservation institutes recognised from France, UK, Italy Spain and Netherlands (namely: British Museum, UK; C2RMF/Palais du Louvre, FR; Museo del Prado, ES; Opificio delle Pietre Dure, IT; Agency for Research in Cultural Heritage, NL, and National Gallery of London, UK. These archives assemble analytical and
technical data on paintings, sculptures, manuscripts, metals, etc., collected over many years of activities devoted to the analysis and studies for the scientific conservation and safeguard of cultural heritage. These archives have been through CHARISMA, for the first time, accessible to European scientists, engineers and technologists, together with art historian, archaeologists and conservator-restores, allowing the data held within them to be used in new ways.

ARCHLAB, MOLAB and FIXLAB therefore covered the whole range of needs from the in situ studies on artworks, to the most advanced micro-analytical laboratory techniques for bulk, surface and stratigraphic investigations, to the access to stored knowledge and technical data. Their coupling allowed users to successfully combine a wide range of analytical facilities, for non-invasive and micro-invasive measurements, taking into account the particular issues of cultural heritage regarding security, insurance and transportation. The support to this novel investigation strategy was at the heart of CHARISMA transnational access activities (TNA).

2.3 Joint research
The activity was addressed to extend the novel instrumental areas and to push their capabilities to the cutting edge of research, following the users’ requirements and the current needs of the research community, aiming at the development of:

• Portable equipment for 3D in-situ examination of artworks, for integrated absorption-fluorescence- decay time measurements on fluoescing substances in the UV-Vis range and on novel cleaning methodologies;
• Chemically oriented research for emerging innovative lab methodologies for the study of organic material distributions in cross sections or in the identification of dyes and their deterioration products/pathways, possibly as a function of their nature and provenance.

The application of multispectral imaging and spectroscopy to the study of the distribution of organic and inorganic materials in art objects was also explored;
• New methods to access and integrate existing heritage records and protocols should enable available data and knowledge to be made more readily available to cultural heritage professionals in a user-friendly, integrated and effective way, allowing direct exchange and comparison of data to be exploited.

2.4 Project’s team combined efforts (Beneficiaries List)

• The Consortium
The project beneficiaries, 22 of the most internationally well-known European institutions in the field of cultural heritage, cooperated to provide cultural institutions, SMEs, laboratories and researchers with new opportunities and technical developments with instruments, parameters and guidelines for carrying out their work, improving, at the same time their knowledge/proficiency/competencies. The list of all beneficiaries with the corresponding contact names is in Table 1, attached (S&T results – Tables).

Project Results:
3. Main S&T results/foregrounds

In the following pages, the main achievements of the project are reported with a brief description of concerned activities. For further details, see the referenced deliverable documents.

3.1 The Management
3.1.1 Project Management (WP1)  
[UNIPG (WPL), CNRS/MCC-C2RMF, NGL CNR-IFAC, NCU, Of-ADC, OCW-RCE, APRE]  

- **Project Bodies Functioning.** Two bodies were in charge of project management, helping the Coordinator:  
  i) the CHARISMA Governing Board with all beneficiaries (GB) and ii) the Steering Committee (SC) with all the WP Leaders. All rules of governance were set out in the Consortium Agreement, regulating mutual relations and rights among participants and vis-à-vis the European Commission. The CA defined decision-making procedures, methods for reviewing the technical work, the settlement of internal disputes and the distribution of the EC grant.  

  A meetings’ plan was agreed among partners to ensure that all partners took part to the program according to their role and responsibilities. A beneficiary in turn hosted the General or Interim meeting with a six-month cadence, taking care of the logistics and organisation. APRE supported the Coordinator in the definition of the agenda and in the collection of presentations by the partners. Minutes have been collected, distributed to partners and published in the Intranet website.  

- **Communication with the European Commission.** UNIPG, Coordinator, has been the intermediary for any communication between the EC and partners during the project period.  

- **Administration of the financial contribution.** The Community financial contribution was carefully managed regarding its allocation among partners, in accordance with the GA, the Consortium Agreement and the decisions taken by the consortium, informing the Commission. At the end of each period the Partners’ Financial Reports have been collected, giving homogeneity to all the information provided by the partners both in terms of content and editing; ensuring consistency between the expenses claimed by the partners and the activity performed. FAQ, general provisions governing the role and responsibilities of the partners, financial and contractual aspects were also implemented.  

- **Quality assurance.** The Steering Committee was in charge of evaluating technical progress, reviewing and assessing the project results, feedback of the results into redefinition of the project operational goals, and overall coherence. In this role, the SC was charged of project quality control and the status of each work package, ensuring the high quality of the data sets generated.  

  The so-called project reference book ‘Definition of quality control procedures’ was implemented during the first year of the project, as a common procedural document, for the quality project assurance and the dissemination activities, including publications and presentations.  

- **Communication and Reporting.** During the project, the tasks of preparing, binding and sending the periodical Reports and the generated technical documentation have been exchanged in electronic format and made available to partners. To monitor the status of the planned project deliverables, internal reports have been prepared every four months. A mailing list service has been developed. To enhance and facilitate the reporting process to the EC, a Reporting Tool system, especially produced, was stored in Intranet and rendered available to partners. Appropriate exchange of information with beneficiaries has been ensured through specific meetings. Evaluating, binding and sending the periodical Reports and Annexes was also ensured.  

- **Knowledge management.** Matters related to confidentiality and intellectual property right issues handling have been defined in the Consortium Agreement and monitored by the Steering Committee along the project.  

- **Main results achieved**  
  - The ‘Quality project handbook’, comprehensive of working tools describing the processes in place for the CHARISMA consortium, addressed in particular the issue of how to manage and monitor the project quality to develop and implement a process baseline, on which the Steering Committee monitored the
project progress, stage by stage.

- The ‘Report template and guidance’ was intended to help the project partners to prepare the project Periodic Reports, to be submitted to the Commission (M18,36,54), detailing the level of information required to WP Leaders/Beneficiaries for the description of the technical and scientific work carried out insofar. Furthermore, following the decision taken by the Steering Committee each beneficiary was required to submit to the Coordinator an Internal Intermediate Progress Reports.

- The survey on monitoring the project’ Deliverables and Milestones status on a six months basis helped for the assessment of the work due in the period. This procedure was part of the Steering Committee responsibility together with the scientific quality check, the supervision and evaluation of the project technical progress and the revision of the project results. In this role, the SC has been in charge of the project global critical path, the scientific review of the work performed by the partners, including the degree of fulfilment of the objectives of the period, and the status of each work package outputs. Eight ‘Periodic status checks reports’ were provided during the project at M6, M11, M17 M24, M30, M36, M42 and M48, before the Steering Committee concerned meetings.

- The EU Mid-Term Review, Heraklion, GR, 30th September 2011 provided an external evaluation and feedback.

3.2 The coordination activity

Three different programs have been carried out in order to merge expertise and strengthen interoperability among the consortium institutions with the aim of establishing common best practices in studies of works of art and in analysis and assessment in conservation. Participation of all partners offered the possibility to take advantage of the different competences existing within the consortium on multidisciplinary investigation of materials, deterioration mechanisms, environmental monitoring, and conservation strategies.

3.2.2 Best practice and protocols towards common standards (WP2)

[UNIPG, CNRS, FORTH, NGL (WPL), SOLEIL, CNR-ICVBC/IFAC, NCU, RWTH, ATOMKI-HAS, CPP-LMRH, BM, DI-BS, Of-ADC, OPD, PRADO, OCW-RCE, KIK-IRPA, LNEC, BNC-WIGNER, UNIBO, MCC-C2RMF]

WP2 had the overall objective of exchanging knowledge and expertise within and outside the consortium in certain key areas of mutual interest among the partners, to establish common protocols, and to increase awareness of current best practice and latest developments, with the ultimate aim of raising general standards in the field of science applied to cultural heritage over Europe as a whole.

The two tasks addressed targeted areas of current relevance and complementary to tasks in other CHARISMA joint research and access WPs. The first task concentrated on best practices, principles and protocols, the two chosen areas of focus being firstly the methodology for technical examination of paintings and painted objects (especially sample preparation and methodology for use of multiple complementary techniques); and secondly evaluation of methodology and scientific techniques for monitoring and diagnosis directed towards conservation of historical buildings and sites.

Many different methods of technical examination are now used on works of art, depending on the questions being investigated and the type of object, but also on the facilities available in different laboratories. These are in a state of continuous development and improvement. Task 1a took advantage of the fact that CHARISMA included major laboratories in this field by carrying out a survey of practice in technical examination of paintings and painted objects across Europe.
Task 1b also addressed best practice in technical examination, but instead applied to problem-solving and decision-making during large-scale conservation projects across Europe for monuments, historical buildings and sites. Working groups were formed for four main categories—stone, stained glass, metals, and wall paintings. The main achievement was the formulation of an assessment of the current state of the field, new developments and guidelines on best practice in the diagnosis and monitoring of the various materials found in historic building and sites. This took the form of a series of flowcharts indicating appropriate methodology for different materials, with additional commentary, presented in the deliverable D2.4 Estimation principles for planning and implementation of conservation projects in selected categories of monuments and historical buildings. As with Task 1a, a parallel practical exercise was organised. The workshop held at the former Cistercian Abbey of Chaalis, near Paris (24-25 Nov 2013), served as a direct means of exchanging information and opinions on the capabilities and relevance of various diagnostic techniques, in order to form a consensus on their place in the methodological flowcharts. Some of the new techniques being developed in WP9 were included in this workshop, so that potential applications of these new instruments could be explored.

The second task in WP2 was focused on a different, but also very topical, area – exchange and integration of data generated during scientific examination. This is important to allow sharing as well as archiving, and is becoming increasingly relevant as initiatives develop for online databases that allow advances in searching and re-using the information, which in the future offer the prospect of more efficient use of the data as a research resource.

Subtask 2b was more general in approach, addressing integration of the wide range of data and images and related historical metadata generated during technical study of any cultural heritage object. Importantly, it was demonstrated that although there is a common general strategy for the combination of different complementary techniques in the investigation of cultural heritage, there are neither common practices nor universal protocols for integration of the data, nor for organization of metadata. It is clear there is great potential for further development in this area, and a most significant outcome of this task was identification of actual needs and directions of common interest that could be used as a basis for formulating research priorities in this area in the future.

• Main results achieved
• The first main success of this task was a comprehensive review of current methods and new developments. Deliverable D2.1-1 was a substantial report on the results, made available on the project website. It included specifically:
  a) A detailed summary of practice among project partners for sampling methodology and practice for all types of painting (canvas, panel, wall etc.) and painted objects.
  b) A literature survey on general paint sample preparation, and needs for various FTIR techniques (synergistic with practical experiments in WP10) and promising new methods.
• The work for the second deliverable D2.1-2 in Task 2.1a built on the first deliverable by concentrating on complementary strategies for analysis of samples with multiple techniques, and on sample preparation, a subject of current interest since many newer chemical imaging methods are demanding in this respect. In addition, sampling from precious cultural heritage objects must be limited, so it is particularly valuable to establish effective methodologies, and yet this is a subject not often dealt with in the scientific literature. In the deliverable, guidelines for appropriate methodologies and the results of detailed comparisons of different mounting and polishing methods for samples were presented. The combined results form a valuable resource for describing best practice and considering future priorities.
• A highly successful complementary action was the event at SOLEIL synchrotron: Methodology in
practice: hands-on workshop on sample preparation and methodology for FTIR analysis. This allowed practical knowledge exchange to be carried out on sample preparation for FTIR, ultimately also useful for SOLEIL FTIR beamline users via FIXLAB (WP7). Samples were prepared in different ways and the effect on FTIR in various modes tested: transmission, reflectance, transfectance or ATR – in the lab or on SMIS synchrotron beamline.

- Analytical data are often generated in proprietary formats that do not allow easy interchange. The main achievement of Task 2a was a detailed review of current data standards aimed at constructing guidelines on suitable platform-independent file formats for a range of 2D and 3D data to allow sharing. The focus was on dyestuff analysis as a case study, since a practical need arose during WP10.2 for exchange of this data. The review outlined the need for software development to facilitate exchange of scientific cultural heritage data, and describes the functionality that would be required of such a tool.

- The evaluation and survey of existing software tools for data integration and documentation (inside and outside CHARISMA), described in deliverable D2.2-2 constitutes an important assessment of the general approach and specific practices or tools that are adopted for effective documentation and integration of analytical and imaging data acquired on cultural heritage materials and objects. In addition, a practical exercise on documentation and integration of the results of the WP9 round robin exercise using MediaWiki, proved useful in considering the needs and format of digital online tools for presenting analyses from multiple techniques.

Both actions well served the aims of the task, which were to exchange information on specific digital documentation practices adopted by each CHARISMA partner, to raise awareness of good practice, and to bring together a review of the approaches and protocols in use in important European laboratories for integration, visualisation/presentation and interpretation of results from multiple analytical methods, as an example of best practice and to work towards adopting common protocols to allow more effective exchange of results.

3.2.3 Scientific excellence (WP3)
[UNIPG, CNRS, FORTH, NGL, SOLEIL, CNR-IFAC (WPL)/ICVBC, NCU, RWTH, ATOMKI-HAS, CPP-LMRH, BM, DI-BS, Of-ADC, OPD, PRADO, OCW-RCE, KIK-IRPA, LNEC, BNC-WIGNER, UNIBO, MCC-C2RMF]

Scientific excellence (WP3) was pursued through focused training actions and skills development in favour of CHARISMA end-user in focused priority areas, as well with sharing in scientific and technical meetings the results obtained with the European scientific community, verifying the impact of CHARISMA. The deep knowledge on materials and their behaviour, as well as on best approaches in evaluating their conditions and the selection of the best conservation procedures, has been diffused through the organisation of training events, seminars or workshops. Aim of such events was to train and engage researcher(s) in discussion with professionals (conservator-restorers, conservation-scientists and museum curators) on the appropriate application of the most advanced and novel analytical techniques and conservation methodologies. The WP highlighted also the use of expert technical meetings to disseminate a large fraction of CHARISMA’s principal findings.

Three tasks, articulated into subtasks were foreseen.

Task 1 “Sharing of resources and oriented-training on advanced instrumentation” [Resp.: NCU]. This task had the aim to offer researchers new opportunities to benefit from immediate and direct experience with new technological acquisitions and prototypes within the consortium, enhancing the possibilities for young scientists in establishing new research programmes. Trainings were also dedicated
to professionals and new users external to the consortium on well established analytical/documentation techniques (NMR, laser-based techniques, OCT, etc.) or on the new investigation techniques and related technologies offered by prototypes. Each training event was under the responsibility of one CHARISMA partner, however, each event included other partners interested in the theme and able to cover topics and/or co-finance the course.

Task 2 Sharing knowledge and oriented-training on advanced methodologies [Resp.: UNIB]. With the aim to support a better comprehension of the potentialities of innovative advanced methodologies among researchers of institutions external to the consortium, training activities and/or exchange of visits on problem solving approaches in conservation of paintings, books, buildings, dyestuffs, organic materials, etc. using advanced analytical techniques have been carried out. As for the previous task, behind the CHARISMA partner responsible of the organisation, each event included the active participation of other interested consortium members, that actively cooperated in lecturing, preparing notes, and in other tasks, also co-financing the course, if necessary.

Task 3 Oriented-topics events [Resp.: NGL]. During the project, four technical meetings or thematic workshops on defined topics have been planned and/or organised. The objective was to verify the impact of CHARISMA work and grades. The workshops have been also an opportunity to share and compare the results obtained by European scientific community on focused priority areas in collaboration of the joint research programme. Main topics were: (i) Advances in a specific analytical field (technique applied on different materials and objects; sampling and sample preparation); (ii) Foresight studies for new instrumentation and technologies; (iii) A group of objects of one period/one style/one (painter) creator/one (painting) technique. The events have been open to internal and external experts and to the professionals and users. Three of these events led to the publication of proceedings.

- Main results achieved
  - Training courses, seminars, "hands on" workshops have been organised, to diffuse deep knowledge – expertise – and well established methodologies to the users / professionals and to the general public (see the following tables and the paragraph Dissemination activities in the Section Potential impact).
  - The highest efficiency of the developed activities was ensured, verifying that they correspond to the real users’ needs, in order to turn the assembled scientific excellence to the advantage of the cultural heritage community.
  - The results obtained by European scientific community on focused priority areas were shared and compared, verifying the impact of the CHARISMA work and grades through technical meetings and workshop. The concerned list of Training Courses on advanced instrumentation (Task 1), on advanced methodologies (Task 2), as well as of the Oriented-topics technical meetings and thematic workshops (Task 3) organised and held, is in Table 2, attached ((Final Report - Tables).}

3.2.4 Coordination of dissemination and communication efforts (WP4)
[UNIPG, CNRS, NGL, NCU, Of-ADC, OCW-RCE, APRE (WPL), LNEC]
For the achievement of the objectives of the project, communication and dissemination, constitute an important and substantial domain, being fundamental to share the information basis, to extend the participatory process of stakeholders, to attract users and project associates, and to gain fruitful feedbacks about the ongoing developments of the project.

In the first year of the project a ‘Dissemination Plan’ handbook defined the Consortium strategy for communication and foreground dissemination, identifying the specific areas in which the project results
can have influence, the different recipients and the related actions as well as the related initiatives/events to be performed throughout the duration of the project. In addition, an external evaluation and feedbacks accomplished through the Extra-Mural Advisory Committee, monitored the success, attainment and impact of the project objectives, technical goals, and milestones.

• CHARISMA Associates

Numerous expressions of interest were given to exchange expertise and to collaborate with CHARISMA from European countries external to the EU and overseas countries, including South America, United States, and Mexico.

As part of the objectives for the project in order to extend the project scenario, and following several relevant requests coming from European or worldwide organisations, the Steering Committee approved the Associate Partners by means of a Letter of Intent available on the project web. Agreements have been established with Brazilian Associations and Institutes of Conservators-Restorers, as the Associação Brasileira de Conservadores e Restauradores de Bens Culturais (ABRACOR), and the Laboratorio de Ciencia da Conservação – Universidade Federal de Minas Gerais (LACICOR). The association process was successful completed also for the University of Antwerp, BE, Pisa, Torino, Verona and the Museum of Fine Arts of Boston, US, the Institute of Protection of Cultural Heritage of Slovenia, Lubljana, SL, the Universidad Autonoma de Mexico, Instituto de Fisica, Mexico City, MX, the Victoria and Albert Museum, London, UK, and the Academy of Fine Arts of Prague, CZ.

Associate Partners gave inputs (advice, best practices, statistical data, workshop organisation, etc.) contributing with their know-how to the project’s specific workpackage targets. They benefited directly from the project’s workshops, web-based information, training schools, and so on.

• A Database Target Users

An Address Database (AD) was available to the project, starting from the list coming from the previous infrastructures’ EU-ARTECH project data. The AD implemented primarily involving the selected researchers/professionals/SMEs/labs of the cultural heritage community with whom CHARISMA members previously collaborated and currently cooperate. A high number of data have been inserted (more than 1000 records).

• Get Involved

An open invitation to link to the project was implemented through the CHARISMA web site home page (Get Involved). It consisted of a user interest check page, that invited on-line registration (name, organisation, e-mail). Registered motivated people, were included in the AD mailing list for specific dissemination activities. The section, (closed at the end of the project) allowed individuals showing interest toward the project, to receive proper information about the open access calls and CHARISMA issues (events, job announcements, breakthrough results, etc.) permitting them to propose information of news or events of interest to specialists.

• Friends EC projects & initiatives

Following suggestions of the CHARISMA EC Scientific Officer, a number of Coordinators of other EC-supported projects or initiatives in the field of cultural heritage have been contacted. Special efforts have been made to achieve active collaboration with 3D-COFORM, POPART, STACHEM, NET-HERITAGE, DC-NET, DASISH, EuNamus, ECTP FACH and DARIAH (CHARISMA became affiliate project of DARIAH).

In addition, a profitable collaboration with CEN TC/346 (developing European, EN standards for conservation) was established.

• Scientific workshops and conferences
Traditional channels of communication of the most advanced scientific achievements, such as presentations at scientific workshops and conferences, was also one of the pillars of the consortium dissemination activity.

During the project, the dissemination activities have been the subject of Coordinator and WP Leaders’ invited conferences, with the objective to distribute general information on CHARISMA - at the service of the project as a whole - raising the project awareness, diffusing its goals, and enhancing the interest of potential users. In addition, the project beneficiaries participated in many meetings and international conferences related with CHARISMA topics. At these meetings, the primary results of the project activities were presented, underlining the FP7 support of the European Commission. Complementing this, papers were written and presentations at oriented seminars and conferences were carried out. (see the List of dissemination activities).

- Periodic news, leaflets and blog

During the period, some promotional materials as well dissemination products have been designed and made available to the partners and public through the project website: some Institutional Poster, CHARISMA brochures (summarising the project activities and objectives to the general structure of the project) and leaflets (specifically referred to the three transnational access services: ARCHLAB, MOLAB and FIXLAB).

Periodic news have been published on the website, in collaboration with all consortium partners, such as CHARISMA related events, other events, and job opportunities. A partners’ blog designed and managed by OCW-RCE researchers, gave a glimpse into the project, as well as the experiences carried out throughout its development. The blog allowed the RCE CHARISMA group to record events, opinions, and ideas freely, as individual posts, with no need to define their scope.

- Main results achieved

- The ‘Dissemination Plan’ formulated in a draft form agreed among partners at the project start, identified the CHARISMA policy of dissemination actions, as well as the related initiatives/events to be performed throughout the whole duration of the project.
- The ‘EMAC evaluation report’ was a contribution of the Extra-Mural Advisory Committee to the project interim evaluation. It has been specifically constructed as an input to the Mid-Term Steering Committee evaluation with the aim of examining the rationale for the intervention, the programme implementation, and the first two years’ products and achievements.
- The EU Workshop on Research Infrastructures for Cultural Heritage and Global Change Brussels, 14 March 2012 at KIK-IRPA, was organised by the European Commission, Directorate General for Research and Innovation, in collaboration with CHARISMA;
- A CHARISMA video was released, providing a general overview of the project’s support, coordination and joint research activities, showing potential users, stakeholders and public the facilities involved and the Transnational Access opportunities. The movie is available on YouTube (https://www.youtube.com/watch?v=_MhAwxoi1zw).
- A stand managed by CNR-IFAC equipped with optical windows at the Science Festival (held in Genova, IT, on 27 Oct- 7 Nov. 2010), permitted to carry out demonstrations of the project laser cleaning research activities to the large public. A CHARISMA stand was also set up at the AR&PA Innovation initiative of the 8th Biennial of Heritage Restoration and Management (Valladolid, ES, May 24-27, 2012) organised by the Spanish Castilla & León Regional Authority, in liaison with the European Commission and Labein-Tecnalia Research Centre and with the support of UNESCO.
- The Project Final Event workshop entitled ‘Experience, Research and Innovation: a Research
Infrastructures Integrated Platform for Cultural Heritage Conservation/Restoration' was dedicated to the assessment of the project implementation through the intervention of external speakers, including a poster session and an open demonstration of the performances of the innovative instrumentations and methodologies developed.

3.3 The transnational access activity
The Transnational Access programme had the general mission to offer a portfolio of services and activities centred on the needs of the heritage science community in Europe and Associated Countries. The activity promoted the development of advanced research in the study and conservation of works of art, offering users the exploitation of unique European resources for in situ and laboratory investigations on artwork materials.

The support activities were planned to cover the needs of researchers in the different phases of research development, as: a) Information on previous studies and data (ARCHLAB); b) In-situ non-invasive measurements for the acquisition of all the possible experimental data, avoiding any contact (and therefore any possible damage) with the investigated object (MOLAB); c) Deepening of the study through micro-sampling exploiting all the most advanced state-of-the-art techniques presently available (FIXLAB).

The specific activity of the Welcome Desks, composed by representatives of the access providers, gave focused technical information to users or user groups on the experimental work to be carried out, (feasibility aspects and other concerns), and, if required, even suggested the most appropriate exploitation of the facilities (a unique or a group of facilities).

The CHARISMA TA plan represented a unique experimentation of a model of integration and cooperation among infrastructures open for transnational access, offering together an integrated service in favour of researchers in heritage science. Through the three programs of access the project delivered to the users (from experienced practitioners to primary users) not only experimental resources but also methodological approaches, compliant best practices, tools and technologies to allow researchers carry out their work in conditions otherwise impossible for them. The summary of the work developed for the whole duration by ARCHLAB, MOLAB and FIXLAB (users’ projects, access days and number of users) is in Table 3, attached (Final Report - Tables).

3.3.1 ARCHLAB - The archives of conservation institutions laboratories (WP5)
[CNRS/MCC-C2RMF (WPL), NGL, BM, OPD, PRADO, OCW-RCE]
ARCHLAB was a facility composed by the archives of laboratories of national museums, such as National Gallery of London, British Museum and Museo del Prado; or laboratories of conservation institutions such as the Centre de Recherche et de Restauration des Musées de France, FR, Opificio delle Pietre Dure, IT, and Agency for Research in Cultural Heritage, NL.

These laboratories possess wide archives on analytical and technical data on paintings, sculptures, manuscripts, metals, and historic objects of various types, regions and periods etc., collected through years of “institutional” activities devoted to the study, conservation and safeguard of cultural heritage. The data consists of documentation on the examination of constituent materials, technology, state of conservation, stratigraphy, etc. for each investigated object, including images and other technical and scientific data. Collections of samples are also available, taken from artworks and monuments during previous campaigns of study and conservation, carefully archived after investigations.

The total number of proposals received by ARCHLAB were 154 of which around 50% were selected by
the Peer Review Panel. The users were belonging to several different countries as: Austria, Denmark, France, Germany, Hungary, Ireland, Italy, Macedonia, Netherlands, Poland, Portugal, Serbia, Slovenia, Spain, United Kingdom.

The majority of projects (69%) were focused on artefacts execution techniques, 14% on history of conservation, 13% on specific conservation issues, and 4% on materials and chemical analysis. With respect to the types of artefacts, it was registered a predominance of projects focused on paintings.

Typical users were: (a) researchers that wanted to collect information concerning structure of support, materials, colours, stratigraphy, or composition of grounds in polychromies; (b) art-historians or archaeologists that wanted to carry out provenance studies or studies on ancient execution techniques, or wanted to compare collections; (c) conservators and scientists that wanted to inform cleaning and restoration data with other data collected in previous interventions on objects analogous to those on which they were working, (d) and others.

The ARCHLAB success is indicated by the scientific quality of the work developed by the users, the large number of access days offered (397 on 324 planned), the large number of users that exploited the open archives (131 on 102 planned) and by the large number of research projects that have been developed (85 on 72 planned).

• Main results achieved (some examples)
  • A successful ARCHLAB access project regarded the execution technique of the famous painting Battle of San Romano by Paolo Uccello. The painting, originally composed by three panels, is today dismembered and panels are at the National Gallery of London, the Louvre Museum of Paris, and the Uffizi Gallery of Firenze. ARCHLAB permitted the access user group (UGL restorer in charge of the restoration of the Uffizi panel) to compare the results of the technical examinations in the Uffizi (prior and during restoration) with those obtained in Paris (C2RMF Archives) on the panel of the Louvre and in London at the National Gallery (NGL Archives). The upcoming publication of a book on the restoration of the Battle of San Romano, includes a section regarding the study undertaken on the London and Paris panels exploiting the ARCHLAB facilities.
  • The CHANGE GROUND LAYERS project explored scientific data in OPD (UGL D. Hradil, CZ) comparing the measurements of ground layers of 16-18th century paintings in Czech collections to find reference localities of historical exploitation of clay-based materials. The method of using the composition and technology of preparing grounds as an indicator of the provenance of the painting. For example: one of the last paintings by Caravaggio “Beheading of Saint John the Baptist” (1608) contains a red chalk with Globigerina fossils (so called “Globigerina limestone”) in the ground which is authentic local material from Malta island where the author spent last period of his life. This is in contrast with his other works, which contain the brown clay-based ground - probably the most typical ground of North-Italian authors of the end of 16th and the first half of 17th century. The same local Maltese material was also largely used by Mattia Preti who was acting in Malta in the last period of his life. See Fig. 3.3.1 attached (Final Report - Figures).
  • Another significant example of the work developed in ARCHLAB is related to the ongoing project of restoration and collection of new documentation on the van Eyck’s Ghent Altarpiece (Ghent, Belgium). The users requested visits to the archives of the National Gallery, Museo del Prado, and C2RMF. In London (NGL Archives), the users examined the scientific reports, conservation records, infrared reflectographies, photomicrographs and X-ray radiographs relating to the Van Eyck’s paintings in the National Gallery. In the archives of the Museo del Prado, the users had access to the conservation documentation, technical data, macrophotographs, infrared reflectography, X-ray radiographs and laboratory research reports on six important paintings by van Eyck or his contemporaries. Finally, at C2RMF, in Paris, the users
examined the scientific reports, conservation records, photographs and X-radiographs carried out on the Van Eyck’s paintings located in French museums, achieving an excellent general overview of analytical results on the French panels, in a comparative approach.

The full set of projects and results obtained throughout the development of the ARCHLAB access programme, are listed and described in the deliverables D5.1 D5.3 and D5.5.

3.3.2 MOLAB - The mobile facilities for in situ non-invasive measurements (WP6)
[UNIPG (WPL), CNRS- LAMS, CNR-INO]

A large proportion of the historical patrimony consists of immovable objects that cannot be moved from their usual location, e.g. monuments, sculptures, buildings, etc. and therefore the only way to carry out non-destructive measurements on their materials is to perform in-situ measurements. Even in the case of movable patrimony, including precious paintings, ceramics, gems, manuscripts, etc., curators normally avoid moving artworks to a laboratory, because of the high risk for the integrity of the artwork posed by transportation and of the high costs of insurance.

MOLAB (Mobile Laboratory) was a facility composed by a unique collection of advanced, integrated and portable equipment, moved to the site where the users were operating. The moving experts accompanying the equipment were scientists (in a number depending on the number of different techniques involved in the work) with competences on materials and methods in conservation and technicians. At each intervention, any measurement preceded by teaching modules, where a presentation of the characteristics of the instrumental devices was given, to ensure their safe and correct use by the users.

Operators concurred: a) to assemble in-situ the various part of the instrumentation(s); b) to help in carrying out the measurements; c) to discuss the first interpretation of results with the users.

During the whole project, 126 request of access have been submitted to MOLAB (through proposals mostly requiring access to more than one facility). Of these, 50 access to facilities were executed (46 planned), corresponding to 299 days of work (260 planned) for 239 users (150 planned), a number often enlarged to other personnel of the entire hosting institution (museum, open air monuments, libraries, etc.).

The countries where MOLAB operated were 11 (FR, AT, CZ, ES, CH, NL, SL, BE, GB, PL, IE).

Typical users of MOLAB were conservation scientists or conservators/restorers (individuals or group members of public or private institutions) who were developing research to deepen the knowledge on the nature and state of conservation of relevant artefacts and/or to determine the optimal modality/condition for a programmed conservation’s intervention. Users were also scholars, conservators or scientists belonging to museums or other institutions operating in the field of artwork studies or heritage care, as well as restorers of public institutions or SMEs.

The results strongly contributed to a better knowledge of the structure and materials used by the artists, giving also specific information (alterations of materials and their locations) useful for their conservation.

• Main results achieved (some examples)

• Access projects were carried out on works of art of great masters of the European history of art. For instance: Caravaggio (National Gallery of Ireland, Dublin, IE), Van Gogh (Kroeller-Muller Museum of Otterlo,NK; Van Gogh Museum of Amsterdam, NL), Picasso (Musée Picasso in Antibes, FR; Museu Picasso of Barcelona, ES), Memling (National Museum of Gdansk, PL), Durer (National Gallery of Prague, CZ), Bosch (Academy of Fine Art, Vienna, AT), Van Eyck (St. Bavo Cathedral, Gent, BE) and others.

European, Mesoamerican and Islamic illuminated manuscripts have been also studied, as well as stones, mural paintings and glazed ceramics in monuments, such as the Real Alcazar in Sevilla or the Roman Theatre in Merida, ES. The Fig. 3.3.2 in attachment shows for example, the work of five MOLAB access
projects (Final Report - Figures).

- The results of MOLAB access project at the Musée Picasso of Antibes, FR, permitted to record significant indications on the use of Picasso enamel paints (oleoresinous house and boat paints), in combination with other types of ready-mixed, commercial paints and define the palette of the paintings of the Picasso’s Antibes period (1946), comparing these findings with receipts for painting materials available in the Museum archives. MOLAB also permitted to explore the connections amongst similar types of paints used on different works, helping to refine their chronology.

Picasso manifested continuous interest in this type of oleoresinous medium for its qualities of expediency, durability, and vivid colors, aesthetic and, in the coastal town of Antibes, superior resistance to the weathering assaults of the marine environment. The Antibes cycle represents a prime site for the exploration of the Picasso’s pioneering use of enamel paints among which the paints of the French company Ripolin gained large popularity in Europe after the 2nd World War.

- Another exemplary access project exploiting the instrumentations offered by the three MOLAB providers, on identification of painting materials, regarded the study of pigments, binding media, and ground, commonly used by Van Gogh during the last months of his life, when he was in Saint-Rémy and Auvers-sur-Oise. Measurements were carried out at the Kroeller Muller Museum of Otterlo, NL. Special aim was to attempt the identification of pigments particularly prone to fading and degradations.

Specific highlight was the identification of both pure lead chromates and co-precipitates of chromates and sulphates, with convergence of results by FT-IR and XRD. These compounds -that correspond to chrome yellow pigments of different composition, structure, and chromatic hue - are difficult to be distinguished by non-invasive techniques. The use by Van Gogh of chrome yellows composed by chromate/sulphate co-precipitates deserves particular attention from the point of view of conservation, due to the fact these pigments are particularly subject to darkening.

The full set of projects and results, obtained through the MOLAB access all along the three periods of the project, are described in deliverables D6.1 D6.3 and D6.5.

3.3.3 FIXLAB - Medium and Large Scale Facilities (WP7)

[PA: CNRS NEW_AGLAE (WPL), SOLEIL, PB: ATOMKI-HAS, BNC-WIGNER]

FIXLAB consisted of two access platforms, located in two European sites, offered by a joint group of four medium and large-scale installations, under a coherent management. The first one (Platform A) corresponding to the urban area of Paris, FR, was composed by NEW_AGLAE at the Palais du Louvre, and the Synchrotron SOLEIL in Saclay, while the second (Platform B), was composed by the two Hungarian scientific centres of Budapest (Budapest Neutron Centre) and Debrecen (Ion Beam Accelerator ATOMKI).

Through FIXLAB, EU conservation scientists, conservators, curators, art-historians, and archaeologists, applied for transnational access to advanced state-of-the-art laboratories and large installations in order to deepen their studies through appropriate and advanced scientific techniques. These studies were carried out directly on objects (when movable) or on selected micro-samples or on mock samples prepared in the laboratory, exploiting the most advanced techniques presently available in large and medium scale facilities.

To the FIXLAB facilities, users from different countries brought their objects and samples to carry out measurements of different nature as PIXE, PIGE, RBS, PGAA, Neutron Diffraction, Small Angle Neutron Scattering, X-ray Absorption Spectroscopy, and others. Most of the projects dealt with studies of pottery, glazed ceramics, paintings, enamels, bronze sculptures, stones, jewels, glasses, coins, armours, tiles,
obsidians, gildings, gold alloys, ivory artifacts, silver table pieces, garnets, and many others objects and materials.

The total number of projects executed by FIXLAB within CHARISMA were 138 (Platform A: 57 AGLAE + 18 SOLEIL; Platform B: 23 ATOMKI + 40 BNC-Wigner), a number higher than the 132 projects. Also satisfactory were the days of access: in total 703.5 (Platform A: AGLAE: 191 d; SOLEIL: 75 d; Platform B: 149.5 ATOMKI + 288 BNC-Wigner), higher than the 633 total days planned in Annex I. Finally, the total number of users who exploited the FIXLAB facility was 275, well above the minimum planned number of 192.

The service fully achieved all the planned objectives, as clearly demonstrated by the figures of the work developed and by the related numerous articles published in the international scientific literature. Considering the high number of submitted proposals and the quality of the work developed, it appears how the opportunities offered by FIXLAB have become, more and more known, diffused and exploited among the heritage science community, leading to excellent results in characterising heritage materials, interpreting degradations, understanding provenances, attempting attributions, establishing execution techniques, and, more in general, supporting the study and conservation of artifacts, in a framework of multi-disciplinary approaches and solutions.

- Main results achieved (some examples)
  - Typical case of a success application of Ion Beam Analytical facilities (New_AGLAE) by PIXE and PIGE measurements, was the analysis of the Renaissance Venetian glass artifacts, (RVEG-LM2 access Project, UGL M. Verita, IT) regarding the detailed determination of glass composition for provenance assessment, but also understanding execution techniques and alteration of materials. The establishment of an extended compositional database as a significant tool useful for comparison with the analyses of object of dubious origin in view to confirm (or reject) their Venetian origin and even establish the age of the examined object, was an important pursued result.
  - Experiments carried out at the Synchrotron Soleil explored mostly the application of FTIR and X-ray absorption spectroscopy techniques. Example of this type of study is the search of structural information about lead soaps (reaction products of lead-containing pigments and fatty acids from the oil medium) and their spatial distribution in paint layers at the micro-scale (PAinT access Project, UGL A. van Loon, NL). After selection of a coherent corpus of samples from traditional oil paintings, including a painting by Rembrandt van Rijn, Homer, 1663 (Mauritshuis) and an original painted ceiling dating from c.1650 (Johan de Witthuis, The Hague), the results of analyses were compared with data from 16 replica paint films constructed to simulate the lead soap aggregation processes. Samples from both cases showed comparable layer build-ups, composed of one or more medium-rich, overlying dark paint layers on top of a lead white-containing preparatory layer, that acts as the source of the lead to form lead soaps. The whole corpus of results provided important clues about the mechanisms regarding formation and migration of lead soaps in aged oil paintings.
  - An exemplary work has been carried out (BNC_Wigner) on the earliest known iron artefacts, dated to circa 3200 BC, found in Gerzeh, northern Egypt (Petrie’s iron beds access Project, UGL Thilo Rehren, UK). The results through the neutron facility have shown that these beads were made from meteoritic iron, and shaped by careful hammering the metal into thin sheets before rolling them into tubes. They confirmed that already in the fourth millennium BC metalworkers had mastered the smithing of meteoritic iron, an iron nickel alloy much harder and more brittle than the more commonly worked copper. This is of wide significance in archaeology as it demonstrates that metalworkers had already nearly two millennia of experience to hot-work meteoritic iron when iron smelting was introduced.
• The research on detailed composition and technological characteristics of the gilded threads used in historical Romanian textiles (IBATEX and IBATEX 2 access Projects, UGL I.Z.Balta RO) demonstrated the importance of the integration of advanced analytical methods with historical information. Since the date of manufacturing of the specific textiles of the examined collection was known quite precisely, the results obtained on the nature and technology of the gilded threads, besides the information acquired, represent an important set of reference data on historical textiles with metal threads that will be used for comparison in further studies.

In the attached Figs. 3.3.3 and 3.3.4 some images related to access projects carried out at the two platform: (A) CNRS NEW_AGLAE and SOLEIL, (B) ATOMKI-HAS and BNC-WIGNER (Final Report - Figures).

3.4 The research: techniques, instrumentation and technologies

A portal to cultural heritage knowledge has been created, to facilitates the access to the data stored in the six open archives of ARCHLAB. Two main research tasks were developed: the first was dedicated to the integration of the technical metadata associated with different types of data and databases, with the aim of developing an open gate to the Infrastructures’ archives on analytical and technical data. In the second, the processing, fusion and registration of 2D and 3D were analysed and tested and optimal methods of signal and imaging processing (WP8 Programme).

New portable instrumentation and methodologies have been designed and set up, with the goal of exploring the artwork in-situ, at and beneath the surface, in order to determine non invasively depth profiles or tomography of paint layers, to localise alterations, measure patinas or stratifications, or even determine penetration of organic consolidants into porous stones (WP9 Programme).

Among the portable instrumentation, four different innovative pieces of equipment are now disposable for the community of scientists to carry out tomographic measurements. Based on techniques of IR-Scanning Confocal Microscopy, Optical Coherence Tomography, Terahertz spectroscopy, and NMR depth profiling, these devices are able to obtain images of objects, probing regions below the surface reaching depths that cover a wide range of distances, from hundreds of microns to several millimetres. The application of Terahertz imaging opens up the possibility of revealing in-situ (i.e. in a church or in a room of a public or private building) hidden mural paintings even under millimetres of mortar. Another high performance portable device offers high sensitivity monitoring of the effect of the environment on the surface of museum objects. Finally, a compact new system for the in-situ non-invasive study of organic and inorganic fluorescent materials capable of producing, in a single, unique equipment, absorption spectra, fluorescence emission and emission decay-time (picosecond scale).

The application of laser cleaning methodologies to all material types, including cases where the use is considered “routine” has been also critically assessed. The innovations in cleaning procedures take advantage of the above-mentioned 3D diagnostic techniques. In particular, optical coherence tomography permits the monitoring of laser or traditional cleaning, in-situ, through immediate visualization of the in-depth effects of varnish removals.

A better characterization of multi-layered structures in polychromies has been pursued also by micro-invasive approaches, through advances in the examination of cross sections that allow for a link of the identification of organic materials to their location and spatial distribution within the stratigraphy, an information that is essential for the understanding of execution techniques or material alterations (WP10 Programme).

The creation of a new database of analyses and properties of colorant materials has been also pursued
and innovative instrumentation for a spectroscopic in-depth approach to the study of painting layers by infrared imaging was also developed.

The practice of frequent interchange of information and ideas among the three workpackages was particularly profitable in the work development, having all the planned research activities the common final objective of improvement of the services offered through the access programme, increase of the number of users, and the strengthening of the quality of the heritage science research.

3.4.1 A portal to cultural heritage knowledge (WP8)

[UNIPG, CNRS /MCC-C2RMF, NGL, BM, Of-ADC (WPL), OPD, PRADO, OCW-RCE]

General objective was to strengthen, complement and integrate the physical access to ARCHLAB, the unique “facility” of CHARISMA open archives, containing a huge amount of scientific and technical data. The objective was pursued providing virtual access of professional users to information on such data, through the integration of metadata coming from the archives, streamlined via a web portal in a regular, standardised, and consistent way.

Main purpose of the Web Portal was to provide information to users on the rich content of the archives available through the ARCHLAB transnational access. The model was conceived to satisfy the following requirements: i) optimal management of the information and meta-information; ii) homogeneous representation of metadata to users of different profiles, guiding them in finding the information appropriate to their needs; iii) provide advanced search functionalities to the metadata related to objects identification, technical data and technical reports. In Fig. 3.4.1 attached, the RDOTE architecture is schematized (Final Report - Figures).

The activity encompassed: i) the Integration of technical metadata, consisting of the various steps leading to the opening of the portal toward the archive contents, and ii) the processing of the acquired information (ND techniques), regarding the optimal handling and fusion of 2D and 3D analytical data provided by non-destructive (ND) methods. Special reference was done to data provided by the methods developed in the other joint research work-packages of the project.

- Main results achieved

- From the home page, the users can browse artworks, artists, institutes, techniques, places, and periods or perform queries by combining selection criteria. The portal is accessible through the site http://archives-charisma-portal.eu/

- At the project end, a portal has been developed whose web interface introduces the user to existing metadata, on the data maintained and being actively advanced in the partners' infrastructures, consisting of the content of the wide archives of analytical and technical knowledge acquired in previous studies on paintings, sculptures, manuscripts, metals, etc.

- The information provided comprised: i) identification information, consisting of basic information regarding the object, such as title, creator, creation date etc.; ii) available technical reports on the examined object; iii) data information, which describes the data available about the examined object.

- The web portal was open to users of the cultural heritage community from different disciplinary backgrounds; the achievement of this goal was supported by semantic web technologies and intelligent web services (semantic web, social network analysis, intelligent software agents) aiming at providing the user with data according to his (her) needs.

- As second task final output, the handbook provided an overview (from a unified perspective) of NTD techniques, that can be used for analysis of art objects, presenting simulations and models, in the perspective to better tackle the problem of convergence and fusion of 2D and 3D analytical data.
handbook, selected works that apply scientific and technological advances (in electrical and computer engineering, mathematics, informatics, etc.) for the analysis and documentation of artworks are put under focus and soft computing algorithms are described in a treatment rich of technical details.

3.4.2 New portable instrumentation and innovative methodologies for in-situ diagnostics and conservation (WP9)
[UNIPG, CNRS /MCC-C2RMF, NGL, FORTH, CNR- ICVBC/INOA/IFAC, NCU (WPL), RWTH, OPD, LNEC]

In-situ measurements have a high impact on the field of study and conservation of artworks. This impact goes beyond the simple technical aspects, because the introduction of portable analytical tools in the conservation practice has led to a progressive modification of the way of thinking about the best approach for the scientific examination of an art objects and even to a modification of the relationships between scientists and the other professionals in conservation (conservator/restorers and art-historians):

- the movement of the laboratory to the artwork, instead of the contrary, avoids any risk (and costs) connected with the transportation of a high-value and fragile object into a lab, opening the way to the scientific examinations of a very large number of artworks, as was never done before;
- the ability to get valuable information without touching the surface of the object makes it possible to analyze in a virtually infinite number of points all over the surface of the object, ultimately obtaining a more thorough description than in case of sampling;
- the results are obtained practically in real time, creating a new form of relationship between scientists and conservators (or curators), based on immediate group-discussion of the results; this fact does not simply reduce the time of work, but significantly improve the quality of the examination;
- the possible “non-confidence” on scientific examinations by professionals from other fields than science is vanished in front of the absolute non-invasivity of the measurements and the possibility to view and discuss immediate and evident results.

In total six new portable tools and methodologies for in situ non invasive measurements have been designed and set-up in this workpackage. Innovative methodologies for laser cleaning have been also set up.

In the following, a brief description follows of each tool and methodology. The innovative equipments and the laser cleaning methodology have been the subject of a demonstration offered to the invited authorities, stakeholders, and public, in occasion of the Final Event of CHARISMA in Firenze, hosted by OPD.

3.4.2.1 Confocal Laser Scanner near-IR Microscope.
A prototype of confocal laser scanning microscope (CLSM) has been set up for in situ non-invasive measurements on paintings. The goal was to make optical sectioning of paint layers without any sampling, with a very compact, low-cost and easy-to-use device based on confocal microscopy in the IR range.

In the first part of the project a prototype has been designed, assembled and validated by means of laboratory tests. However, this first experimentations revealed margins of improvement of the depth resolution. To this purpose, although not originally foreseen, the CLSM has been modified into a system able to work also as a time-domain confocal OCT. In attachment, the third version of the instrument, now capable to work also as a time-domain confocal OCT, Fig. 3.4.2 (Final Report - Figures).

- Main results achieved
- Substantially, the finally developed prototype can work both as a confocal CLSM, as originally planned, and as an OCT device, integrating that developed in another task of this workpackage. The whole system
is computer controlled: after the selection of the modality of operation and acquisition parameters (sampling step in the X, Y directions, acquisition rate, source amplification) the measurements are driven by means of a specifically developed software.

- The device has been tested on several cases in collaboration with OPD, leading to positive results for the non-contact 3D visualization and measurement of varnish thicknesses.
- The system is very compact and easy to be transported, therefore is also fully responding to the needs of a portable and flexible tool suitable for the in situ monitoring of cleaning during restoration.

3.4.2.2 Terahertz Spectroscopy and Imaging

Terahertz techniques are able to combine material characterization (spectroscopic mode) and time of flight imaging with penetration of optically opaque materials (non-polar, non-metallic) suitable for subsurface imaging of several objects. The Terahertz system developed in this task is able to provide images from tens of micrometers to approximately one centimeter into the inspected object and therefore is suitable to provide mesoscopic details of an object, without the need of any sampling, either in situ or in the laboratory. After the assembling of the various components, the system has been experimented for different various applications and in particular for examination of paintings.

- Main results achieved
- The optical components are contained within a box of an easy to transport size and weight, and the fiber-coupled antennas permit rapid modification of the measurement geometry to be carried out. This is particularly advantageous because facilitates in situ examinations.
- Among the various tests, particularly representative is the in situ test carried out on the mural Doom Painting at St Thomas' Church, Salisbury, UK, where the system was experimented to reveal possible under-paintings under a thick layer of mortar. The examined medieval painting is representing Christ in Majesty, dominating a scene of judgement. During the examination, below the gilded geometrical figures of the halo of Jesus, a previous gilding was found. See Fig. 3.4.3 attached (Final Report - Figures).
  A photograph of the scanned halo of Christ is shown, together with the THz image superimposed on the photograph. The lily form, made of gold is easily recognizable, while the line highlighted in blue indicates a very strong sub-surface reflection layer in the painting, clearly suggesting the presence of a hidden sub-surface metal layer. A cross section, examined via a microsampling carried out in the same area for validation of the experiment, confirmed the presence of another layer of golden leaf below the surface of the mortar.
- The performances of the developed THz system were positively tested also for the detection of wood-rings for dendrochronology and for in situ identification of pigments via spectroscopic measurements.
- All the experimental tests, both in the laboratory and in the field, demonstrated the high potential of the developed real-time, high resolution, portable THz imaging system, a device complementary to the other tools for non-invasive in situ measurements, developed in other tasks of this workpackage.

3.4.2.3 Optical Coherence Tomography

Major concept of the design of this new instrument was to dispose of an effective device capable to produce well resolved tomograms of varnishes and paint layers, that can be easily dismantled and easily transported for on-site examinations of works of art.

In parallel with the designing, assembling and testing of the instrument, a data acquisition and processing software was developed, to ensure: i) high operation speed for high resolution real time imaging; ii)
massive parallel processing of data with a Graphic Processor Unit (GPU) with use of CUDA technology.

- Main results achieved
- After the assembling of the system, several field and laboratory test have been carried out to improve the performances of the developed instrument. The list includes in-situ tests at the Museum of Fine Arts, Gent, Belgium, on the outstanding Adoration of the Mystic Lamb by Hubert and Jan van Eyck, in cooperation with KIK-IRPA in Brussels, and on La Muta by Raphael and on the Adoration of the Magi by Leonardo da Vinci in cooperation with OPD in Firenze. Several laboratory tests were also carried out on Azulejos (in co-operation with LNEC), various paintings of the 18th and 19th century, stain glass from National Museum in Wroclaw and other materials.

- All test were very positive, as in the case of the Adoration of the Mystic Lamb where the experimentation was concentrated on thickness and number of vanish layers on ten different panels and two frames, leading to detailed information on varnish stratifications. In Fig. 3.4.4 attached, one of the sections of the varnish layers in one of the panels of the Adoration of the Mystic Lamb is reported (Final Report - Figures). Satisfactory OCT examinations were also carried out on stained glass. In this case OCT can be exploited mostly for revealing corrosion and presence of internal cracks and delaminations. In the case of the collection of medieval glass from Grodziec Palace (now in National Museum in Wrocław, PL) in addition to the surface gel layer, internal delaminations have been clearly detected.

- A the end of the project, the planned objective of the research has been fully achieved and the newly set up system is working with very high performances.

3.4.2.4 Mobile Single-Sided NMR-MOUSE Depth Profiler

The NMR-MOUSE (Nuclear Magnetic Resonance - Mobile Universal Surface Explorer) is a portable device that provides single-sided non invasive depth profiling of hydrogen-containing materials (organic and inorganic) in situ. Today the NMR-MOUSE® is a registered trademark and is available off the shelf. Starting from a prototype device, the system has gone through major improvements within CHARISMA and new models developed.

- Main results achieved
- The NMR-MOUSE® measures 1H nuclei and its different models may be employed for profiling at different depths. The maximum achievable depth in the last model is 20 mm. The maximum depth resolution of 2.3 µm may be achieved, depending on the sensor. In Fig. 3.4.5 attached, some of the models of NMR-MOUSE are reported (Final Report - Figures).

In addition to the detection of 1H nuclei, a new sensor was developed suitable for the detection of 27Al and 23Na. The detection of 23Na is particularly relevant in heritage investigations due to the importance of sodium salts in the deterioration of stones.

- The NMR-MOUSE system based on the measurement of relaxation time of 1H nuclei works quite well and can be successfully employed for the non invasive study of water or organic substance penetration into different stones up to a depth of 20-30 mm. The new sensor for 27Al/23Na is working appropriately for sodium containing salts. However, the decay of crystalline sodium chloride is shorter than the dead time of the sensor, leading to the limitation that the signal from 23Na in the solid state cannot be measured. To reduce the relaxation rate, 23Na atoms need to be mobilized by dissolution in water.

- Experiments using the new sensor were performed on tuff stone of the type used for building the ancient walls in the archaeological area of Herculaneum in Italy. Non-invasive determination of the amount of mobile 23Na was carried out and Inverse Laplace Transform (ILT) has been exploited to determine the distribution of 23Na relaxation times inside the stone. The experimentation demonstrated that the system
is able to record multimodal relaxation components corresponding to sodium dissolved in pores of different dimensions.

3.4.2.5 METROTECH
METROTECH is a system that is able to monitor the surface of the work of art offering the possibility of a continuous or periodic control of its morphology, establishing topographic maps of defects, indicating location of endangered areas with local estimates from high to low deterioration risks. In Fig. 3.4.6 attached, the in situ set up of the system is shown with the real time raw data of a defect map (Final Report - Figures).

METROTECH measurements are based on the principles of digital holography and speckle pattern interferometry, which require strict boundary conditions to maximize stability of the system and minimize errors due to extraneous noise effects.

- Main results achieved
- The hardware and software development led to a final system, that is set for direct or remote operation, fully portable, pc driven, and equipped with user-friendly interface. Custom developed post-processing tools for expert analysis is also available.
- The protocol for defect detection is fast and effective with topographic maps adding lots of valuable information to the conventional maps of the conservator. The improved automation and FT and FFT analyses are now able to provide excellent results on ceramic, masonry, stones, mortars, and wall paintings.
- A considerable number of indoor sites were successfully examined either for environmental impact or defect detection, as Byzantine churches in Crete, the Dominikanon historical building, Valsamonero monasteries, St Peter Church, Eisodia Theotokou Church, Avignon monastery, and Chaalis. Museums may share similar indoor climate with climate controlled historical buildings.

3.4.2.6 An integrated System for Absorption/Fluorescence Spectroscopy
This prototype is composed by a steady-state spectrometer, working both in absorption and emission mode, integrated with a single photon counting device for the measurement of the emission decay time. The system has been conceived to permit users to work either in the time-domain or in the frequency-domain and to collect spectra on the same point using different excitation wavelengths, by means of a set of several sources/detectors.

The variability of the set up and the possibility to carry out different spectroscopic measurements on the same point is the main property of the system, relevant for the non-invasive in situ identification of luminescent materials used in works of art (mainly organic dyes and lakes and some inorganic pigments).

- Main results achieved
- Material identification obtained through comparison of the recorded data with ad hoc databases set up in the laboratory, enriched during the project development with the response of dyes and pigments provided by the project partnership.
- Several spectra of absorption, emission and decay time of emission of dyes and colorants have been recorded and are available for comparative identification. A relevant family of luminescent inorganic pigments of different colours can be also profitably studied by the new system, as zinc oxide and sulfide, and cadmium sulpho-selenides. All these pigments are largely used in modern and contemporary art.
- The prototype, in its last version, has been successfully experimented for in situ studies of ancient and modern paintings in restoration laboratories or in museums. In particular, it has been also positively
experimented in the last MOLAB intervention at the Picasso Museum of Antibes, demonstrating to be ready for effective applications.

3.4.2.7 Innovative Laser Cleaning Methodologies: Biodeteriorations, encrusted granite and paintings

To provide advances on the state-of-the-art of laser cleaning, an approach was followed based on: i) understanding which wavelength (including UV and mid-IR) and pulse-widths (including ultra-short pulses) optimize the laser-interaction for effective ablation, ii) operating in condition of absolute safety for the object employing on-line monitoring and diagnostics for material characterization.

Following these principles, a set of advanced laser systems and application methodologies have been set-up along the project, allowing hand-held delivery of laser radiation with direct control of spot dimension and laser fluence suitable for safe applications on several types of cleaning problems. Optimal parameters and methodologies have been optimised in accurate experimental trials in the laboratory and then applied on-site, according to the specific needs.

- **Main results achieved**
  - After the numerous experimentations: i) the safe removal of the lichen "Verrucaria nigrescens" and biofilms from Carrara marble sculptures has been demonstrated; ii) biodeterioration and foxing of paper artefacts has been validated; iii) laser ablation of iron-rich black films from exposed granite surfaces has been optimized; iv) laser induced phase changes and stabilisation of corroded iron surfaces were thoroughly characterized.
  - Removal of overpaintings from modern easel paintings has been also experimented and validated; LQS Nd:YAG(1064 nm, 120 ns) laser ablation has been successfully exploited for removing overpaintings disguising a portrait of a woman by anonymous, dated around 1930. See Fig. 3.4.7 attached (Final Report - Figures).

After a vain attempt of removal the overpainting using traditional solvents, which resulted to be very aggressive because of the significant content of carboxylates (metal soaps), a laser ablation validation study was successfully carried out. Raman spectroscopy, reflectance spectroscopy, optical microscopy, ESEM-EDX, and FTIR were used for characterizing the laser interaction effects on prepared samples and, subsequently, the uncovering tests directly on the artworks. The overpaintings on the portrait by anonymous were executed using chlorinated copper phthalocyanine green and Ba, Zn (Ca) based pigments in linseed oil. The presence of traces of Cr and Pb also suggested the presence of some chrome yellow. Traditional inorganic pigments such as lead white, red lead, and carbon black, and modern organic dyes (red synthetic azo pigment) in linseed oil were also identified before removal.

- An integrated validation was also achieved on a further modern painting, which was found beneath overpaintings on the backside of the canvas of a signed painting by Giacomo Balla, one of the founding members of the Italian Futurist Painters.

3.4.3 Innovative methodologies and instrumentation for laboratory research (WP10)

[UNIPG, NGL, CNR-ICVBC, BM, DI-BS, Of-ADC, OCW-RCE (WPL), KIK-IRPA, UNIBO]

New methodologies and research strategies were developed for i) the characterisation and study of deterioration of a range of organic and inorganic materials, via non-invasive and/or micro-destructive approaches; ii) improving basic understanding of dyes and lakes by systematic optimal application of existing or new emerging analytical techniques. Specific tasks of this work-package were:

Task 10.1 “Organic material identification in micro-stratigraphies” (Resp. UNIBO) devoted to the optimal application of the new chemical imaging methods, which can characterise organic materials and
determine their distribution at high resolution within the stratigraphy of a paint. Task 10.2 “Organic colorants in ancient and contemporary art” (Resp. OCW-RCE), to overcome the problems that currently hamper accurate identification of dyestuffs, producing new methodologies and knowledge useful for the study and conservation of organic colorants in art with new analytical approaches. Task 10.3 “Multispectral imaging and spectroscopy in diffuse reflectance mode and fluorescence” (Resp. Of-ADC), for acquisition and processing of images for 2D and 3D distribution of organic and inorganic materials in artifacts. The task included image-processing techniques for the non-invasive identification of inorganic and organic substances and their spatial distribution.

- Main results achieved
  - Suitable methodologies (sample preparation, instrument configuration, etc.) were defined for selective characterisation and localisation of organic components (binder, varnishes, colorants, etc) in paints or coatings characterised by a complex stratigraphy.
  - Surface Enhanced Raman Spectroscopy (SERS) was successfully experimented. for the identification and localization of organic materials (dyes and lakes) in cross-sections. Surface Enhanced Infrared Absorption (SEIRA) was also tested with success on micro extracts, in the effort to overcome the limitation of FTIR microscopy when organic colorants are present in mixture with other organic and/or inorganic compounds.
  - Immunological approaches for the characterization of proteins in paint cross-sections have been set up, to determine the distributions of proteins within the various layers of the paint when a proteinaceous binder or varnish is used. While enzyme linked immunosorbent assay (ELISA) methods have been developed for the ready and specific identification of all the main proteins commonly used by painters, as egg, milk, and animal glue, a really powerful immunochemical probe has been successfully experimented and set up, composed by gold nanoparticles (AuNPs) functionalised with a dye for Surface Enhanced Raman Scattering (SERS) detection.
  - To determine the factors that affect the overall colour obtained in preparing organic pigments from anthraquinone and flavonoid plant sources and/or in dyeing textiles, important parameters influencing the final colour in dyeing textiles were established. The large quantity of data gathered, their ordering and their final discussion, have been the subject of a booklet, entitled "Natural Colorants for Dyeing and Lake Pigments".
  - A semi-Preparative Liquid Chromatographic system was developed (Prep-LC) coupled to fraction collector for isolate individual components from madder and weld respectively, which were subsequently characterised by ESI-MS. Some of these compounds are not commercially available and not characterised previously. The availability of these standards strongly enhances the possibility of a correct and precise identification of these colorants.
  - Extraction protocols were reviewed (http://research.ng-london.org.uk/scientific/colourant/) and a selection was then optimised for both dyed textiles and paint samples for a better identification of colorant present in textiles and pigments. In fact, mild extraction well preserves the colorant’s molecules and therefore improves diagnostics. The dyes investigated were indigo, annatto, safflower red, redwood, madder, weld, unmordanted tannins and tannins on iron mordant and for the pigments, were selected: indigo, redwood, buckthorn, madder, weld and cochineal.
  - To achieve a better understanding of structural and spectroscopic properties of metal-dye complexes, in both textile dyeing and pigment preparation, significant spectral differences were emerged for the fluorescence emission of alizarin and purpurin forming complexes with Al(III). Of particular interest was the finding that the experiments in solution and powder showed strong similarities, so they can be used as
model for both cases. Theoretical quantum mechanical calculations have been also carried out. This activity opened the way for a more effective exploitation of computational tools in understanding nature and spectroscopic behaviour of the complex chemical systems that characterise heritage objects.

- 30 synthetic dyes and 30 synthetic pigments (pure materials) were selected for the research on early synthetic colorants, based on their more common use in art objects and including all dye classes. For the experimentations, wool was dyed following historical recipes and mock paint samples created. Of the techniques used (including FTIR, fluorescence spectroscopy, UV-VIS colorimetry) micro-Raman spectroscopy and HPLC-PDA were the most effective. Excellent HPLC-PDA results were also obtained for the dyes, while for pigment in some samples no response was obtained due to poor solubility.

- Working from an existing system based on the cube corner technology of the IR-CUBE platform, an IR spectrophotometer system was developed using monochromatic illumination from 200 to 5000 nm, a Michelson interferometer and a Focal Plane Array detector (FPA- InSb camera) operating in the 1000-5000 nm range. The system allows images to be recorded of areas of a few cm2. The images obtained are in accordance with those acquired using another system, but the time needed for a single measurement is of few seconds, while the previous system acquisition times amounted of around half an hour.

- A methodology for producing device-independent, standardised, comparable and reproducible images has been developed to allow the necessary correction/calibration transformations to be consistently applied, with the aim to facilitate the comparison and interpretation of the resulting images. Traditionally, the acquisition of multispectral images has been highly set-up dependent, making cross-comparison between different laboratories and researchers very difficult. A series of standardised experimental setups and acquisition protocols for both luminescence imaging methods and a range of related broadband reflectance imaging techniques have been developed and presented in the form of a user manual (see https://www.thebritishmuseum.org/pdf/charisma-multispectral-imaging-manual-2013.pdf). New versions of user-friendly software tools/workspaces were also created (see https://www.britishmuseum.org/files/charisma-bm-workspace.ws and https://www.britishmuseum.org/research/research_projects/all_current_projects/charisma/technical_imaging.aspx ).

Fig. 3.4.8 attached (Final Report - Figures).

Potential Impact:

4. Potential impact and the main dissemination activities and exploitation of results

4.1 General impact

Cultural Heritage represents a fundamental bond in Europe, due to its uniqueness relative to other regions of the world. Actions for its conservation and preservation are crucial in shaping the European Research Area and undeniably require an assessment of the foreseeable evolution of its degradation. The social dimension of the Heritage Sciences field has not been fully explored, nor has its position in the European strategic technological area. Moreover, the conservation and preservation of our heritage imposes important socio-economic burdens on the European science & technology system. National and regional funding remains largely uncoordinated leading to lacks of efficiency and lowering of the competitive position of the European heritage researchers.

High-level advanced CH research infrastructures, integrated, networked and accessible to research teams from across Europe, pillars of an ambitious ERA-vision, can play an essential role in this framework as fundamental tools for improving the quality of the scientific and technological research undertaken in the EU.
The contribution of research infrastructures to European competitiveness is universally acknowledged, and the I3 instrument play a fundamental role in the involvement of users in the operation of research facilities provided that some conditions are verified, as:

• The setting-up of a highly experienced trans-facility board to coordinate access and interactions with the participating infrastructures.
• Provision of services by experts with a strong experience in the field.
• The full guarantee that the usual selection process of proposals are compatible with the specific needs of the user communities involved.

The strong involvement of the large-scale facilities participating in the CHARISMA project, integrate all these new approaches within the organisations and obviates the need for the end-user and the requirements for the heritage sciences community. The new instruments developed for the CH field are certainly a good model for communities with similar constraints and instrumental needs, such as environmental sciences, on a longer-term basis.

The CHARISMA consortium presents itself as a unique distributed and high-performance infrastructure facilitating complex analyses as required for academic and industrial research, while providing access to the latest technologies necessary to conduct advanced research for users, independently of the user location and of the resources. Its distribution amongst 11 European countries reflects its European scale, if not larger as the initiative takes into consideration European associate states along with extra-European countries. As an example, the success in jointly operating the two FIXLAB platforms, one in Western Europe and the other in Eastern, should be of great importance for European Heritage Sciences, especially regarding the dramatic door this approach may open towards the Eastern Europe cultures, including Russia, Central Asia and Middle-Eastern countries. In this way CHARISMA played an important role in extending the CH vision towards countries of exceptional culture in line with the pre-figuration of the future EU political challenges.

4.2 Impact on heritage sciences

The Consortium created a bridge between the Humanities and specialists in advanced material analysis, turning challenging experiences into creative encounters. The cross-disciplinary sharing of scientific approaches with knowledge of culture is of great benefit to both fields. The setting-up of European Distributed Facilities within CHARISMA, recognised by the users community as one unit, structured by a common dissemination policy and a strongly enhanced exchange of technical expertise, is a key requirement for a continuous strengthening of the awareness of the importance of the interdisciplinary encounters between the world of art history and archaeology and that of science. During its implementation, CHARISMA has pioneered the use of:

• The coupling of “hard” and “soft” infrastructures through the implementation of an ambitious e-portal which prefigures a concept of “mixed-access”, truly adapted to ARCHLAB approach. This approach associates real and virtual access to the large quantity of data present in the archives of prestigious European institutions (museum and academic institutions devoted to research and safeguard of cultural heritage) completing the offer made by CHARISMA to users;
• The platform concept, grouping “fixed” facilities with an in-depth practice of heritage research conducted by partners, and proposing a highly experienced service in order to take the best benefit from the joint use of such sophisticated investigation techniques, and optimise the usage of the European medium and large scale facilities;
• The MOLAB “portable tools” with their success story, related to the novelty to bring a scientific laboratory
inside the museums and conservation institutions, that has achieved a very high visibility in the international research and application communities working in Cultural Heritage. The EC recognized the need to stimulate the creation of an integrated European heritage research community and to promote the building up of extended expertise in cultural heritage, in order to maintain the European research in this important area at a global competitive level.

A relevant scientific and structuring impact of CHARISMA regards the activation of new user groups, as well as of associated partners, followers of the implementation of the CHARISMA activities. Enhanced support for access to a wide range of advanced analytical techniques offered by a unified set of distributed infrastructures opens new interests and extends new fields for research. In this context, the research activity was clearly geared towards the improvement of the quality of the services that can be offered through access.

The access to equipments offered by CHARISMA includes both access to large-scale facilities and, as deemed necessary for the study of artwork materials, access to a unique set of portable high-performance instrumentations, many of which are prototypes, that allow measurements to be carried out otherwise impossible without sampling from the object or its transportation to a laboratory. Coupling of mobile instrumentation and large-scale facilities is then the best option for extending to the entire work of art the localised interpretation arising from micro-samples which, although giving in-depth characterisation of materials, unavoidably give information with a limited statistical relevance. The combination allows minimum invasive intervention on the work with maximum extraction of material information.

The requirements for studying these heterogeneous materials involve the coupling of many distinct approaches (ion beam analysis techniques, synchrotron X-ray spectroscopy, neutron sources, lasers, chromatography techniques, etc.). This is in line with the current major development of micro-imaging techniques, using microprobe, near-field or full-field approaches. The integration of data coming from different sources was a major issue at the distinct participating facilities, which strongly benefit from approaches, where the need to couple elemental, chemical, structural and morphological data lies at the heart of many research activities such as, for example, the distribution of distinct organic substances in cross sections or the assessment of the nature, and state of conservation of a dye on the basis of its chemical composition.

On the other hand, through the various TNAs worked in CHARISMA and the development of joint research, the partners intended to make available to users efficient access to new frontier performance instrumentation, destined to increase the diagnostic capabilities of the distributed infrastructure in particular with reference to in-situ analyses. The monitoring of the structural modifications of works of art in response to environmental conditions is a key-step in programming preventive conservation measures (METROTECH). The in-situ non-invasive identification of organic colorants with fluorescence methodologies (triple measurements of absorption, emission, and decay time of fluorescence) represents a significant advance in technologies offered to researchers for diagnostic analyses. Outstanding advances are offered also by the development of portable equipment for CLS, OCT, NMR, THz. All these techniques are capable of creating 3D images corresponding to the layers beneath the surface of the object under study, reaching variable depth from micrometers to millimetres. These results are expected to open the way to unprecedented performances, such as the imaging of reflective painting materials beneath several millimetres of plaster or the detailed control of the execution of conservation treatments, such as laser cleaning, monitoring their effect on-line, at the same moment that they are carried out.

4.3 Impact on society
Learning the particular history of an artwork and how it was made, knowing how the potential degradation through exhibition to the public may threaten its durability, discovering how much society could lose in neglecting an artwork, are new exploratory ways for revitalising public interest in visiting museums. In particular long-term alteration issues are directly interconnected with environmental research activities, therefore promoting a novel way to disseminate these key scientific questions within European Society. In addition, this domain is of great interest at the economical level, first of all for the cultural market, which is mainly sustained by basic confidence in the durability of artworks. Secondly, many famous places in Europe attract visitors, a fact that implies long-lasting benefits for the European economy and international visibility.

CHARISMA could reinforce the confidence of cultural charities and foundations in investing in the preservation of artworks. Coupling research and conservation on well-known artworks with a scientific contribution may be of great interest for appropriate support programs and guarantee their input to the work carried out within the European project. Finally, the international attractiveness for young researchers and new users from overseas countries constitutes a leading aspect for our heritage sciences community. CHARISMA contributes to enhancing a political culture in Europe based on mutual respect and high-level competencies. Associating Heritage sciences experts from cultural institutions (conservation scientists, conservators, restorers) with specialists from Physics, Chemistry and Environmental sciences, in a fast moving scientific context, is a key aspect for CH Research.

4.4 CHARISMA spread character
In addition to the support activities and the joint research plans, an important feature of CHARISMA will be its openness. A main ambition will be to provide an open setting, where an heritage science international forum, impacting on policy and practice, can be developed and updated. The activities generated by the project (e.g. professional technical events, training preparation, link with associated partners, conference and workshop organisation, presentations for a general audiences etc.) will not be mirrored by the project himself, but they will be enlarged. To establish lasting connections and cooperation among interested research institutions in Europe and beyond, enhancing the interest and visibility of the European heritage research out of the borders of Europe will open new ground for international cooperation.

At project level, foresight information and communication concern collecting and presenting project activities, experiences, results to potentially interested users: they have been all aimed at increasing an effective knowledge-sharing with the public at large. In this process, detailed in the networking WPs, various tools were used, the website, and besides, publications, presentations in international events, press and news releases, documentation, expositions, conferences, videos, etc.

4.5 Main dissemination activities
In order to develop a helpful dissemination plan – a WP4 Steering Committee task - the CHARISMA Plan was drafted at the very beginning of a project, containing the activities to be continuously carried out until the project’s end (and possibly afterwards). The Plan indicated those activities to be devoted to ensure that the developed goal and results could be externally spread and exploited, both during the completion of the project and after its conclusion, through the dissemination of the final outcomes in the most suitable environments. The results and impact of the project efforts rest not only in the effectiveness of dissemination activities, but also in the possibility of their use. In fact, while the first is essential in order to attain the objective of making the project understandable
and visible, the latter aims at assuring the conditions to take advantage of it. The Evaluation report of the Extra-Mural Advisory Committee, envisaged at the middle of the project duration and providing information and feedback, helped the discussion to adapt and focus the dissemination plan or devise alternative strategies.

The three networking WPs were devoted to these issues. The structure of dissemination and communication effort, planned in WP4, provided a wide range of activities sustained by WP2 and WP3, such as international cooperation, education, training, users’ awareness and technology transfer events to research laboratories, memory institutions and industrial organizations in the heritage field, based on the main objective of the action, the contents and the targeted recipients.

- Technical training events

A series of training sessions have been carried out, primarily destined to advanced CHARISMA users.

- Training on Mobile Nuclear Magnetic Resonance (28–29 April 2011, Aachen, DE) Dedicated to learn and practice the basic steps for art conservators that enabled the course participant to perform NMR analyses for investigating canvas paintings, violin bows, mummies, wall paintings etc. with the most advanced mobile NMR equipment. Technical insights on the practical use of the NMR-MOUSE (MOBILE Universal Surface Explorer) device and related data processing were provided. Training materials have been produced for use in the educational course.

- Training on advanced laser-based techniques in art conservation, diagnostics and analysis (Heraklion, GR 18–22 June 2012). To provide an intensive, high-level training course to scientists and technicians on the fundamentals and applications of laser-based technologies used in art conservation, diagnostics and analysis. The following topics were identified: analytical laser spectroscopy (LIBS, LIF, Raman, THz); laser restoration: methodologies and real-case interventions; optical coherence metrology in structural diagnosis; and imaging and mapping: spectral and non-linear microscopy imaging.

- Training on application of Optical Coherence Tomography (OCT) to structural analysis. (27–28 June 2013, Torun, PL). The course was structured as lectures combined with hands-on sessions. Topics regarded traditional and innovative applications of OCT in archaeometry and conservation such as easel paintings, Chinese glaze, faience, historic wood, historic glass and reverse painting of glass. Hands-on training was carried out on easel paintings, jade and porcelain, and stained glass.

- Training on spectroscopic techniques (invasive and non invasive) (27–29 June 2010, Ravenna, IT). Lectures combined with hands-on sessions on the role of spectroscopic techniques (XPS-SIMS, portable NMR, XRF-XRD, LIBS, μ-FTIR, μ-Raman, and others), concerning paintings, metal artefacts, mosaics, ceramics, and glasses. A methodology of use of a sequence of different analytical techniques was applied to a real case study (series of paper painted mosaic replicas).

- Training on the technology of lakes preparation and dyeing textiles from botanical/animal source dyestuffs. (22-23 March 2011 Munich, DE; 30 November – 2 December, 2011, Brussels, BE). The first course “Back to the Roots - Preparation of Historical Lake Pigments” to better understanding of the nature, preparation, and use of historical lake pigments, relevant for paintings and polychromies. Participants learned to prepare lake pigments from selected red and yellow dyestuffs (madder, brazilwood, cochineal, lac dye, weld and Persian berries) according to historical recipes. Practical experiments were accompanied by theoretical presentations on the historical background of lake pigments, case studies, as well as chemistry and analytical identification of these pigments. In the second event “Dyeing with Natural Organic Colorants” the type and use of natural organic dyes for textile dyeing in preindustrial times, as well to provide a deep knowledge about the interpretation of historical recipes and practical dyeing technology was discussed.
• Training on stone conservation (7-18 May 2012, Lisbon, PT; 10-21 September 2012, Torun, PL; 27 May - 7 June 2013, Amsterdam, NL). The training scheme of lecture’s main topics was stone artifact’s characterisation, their deterioration phenomena devising also suitable conservation methodologies, according to the modern conservation concepts based on diagnostics and innovative materials. Special insights were dedicated to the role of water and acid rains in the deterioration mechanisms of outdoor stone artifacts, as well as to the various aspects of biodeterioration. Restoration and maintenance strategies using the most advanced intervention techniques were extensively treated. Besides the presentations, visits to case studies were also organized.

• Oriented topic events
The events were an opportunity to share and compare the results obtained by the European scientific community on focused priority areas, such as the advances in a specific analytical field (techniques applied on different materials and objects). Novel methods for sampling/sample preparation; foresight studies for new instrumentation and technologies; approaches to studies of groups of objects relating to one period / one style / one (painter) artist/ one (painting) technique.

• Caravaggio’s Painting Technique at OPD (17 September 2010, Firenze, IT) on the fourth centenary of the death of Caravaggio and coinciding with the exhibition “Caravaggio e caravaggeschi a Firenze” (22 May – 17 October 2010). The latest scientific studies of paintings by Caravaggio were presented to a wide international audience. Relevant aspects of recent restorations, new findings on materials and techniques, and general observations on the applied scientific methodologies were discussed.

Over 300 specialists in conservation science, technical imaging, art history and curatorship, as well as invited students, attended the presentations over 2 days by world experts in Leonardo technical studies. The cross-disciplinary audience heard comprehensive studies of materials/techniques, integrated with art-historical research, including new outstanding discoveries on the practice of painters in the workshops of the Italian Renaissance. It was also an opportunity to assess latest practice in examination of paintings and drawings.

• New techniques for the non-invasive investigation of the surface and subsurface structure of heritage objects at NCU (25–26 June 2013, Torun PL).
The core topic was the latest developments and practical applications of non-invasive techniques to investigate the surface and sub-surface structures of cultural heritage objects. The lectures focused on the application of optical coherence tomography, terahertz spectroscopy and imaging, combined time-resolved and steady-state fluorimetry, single-sided NMR tomography and IR scanning confocal microscopy.
The workshop gathered 81 participants (researchers, scientists, conservator-restorers, art historians, and archaeologists).

• The Renaissance Workshop: Material and Techniques of Renaissance Art at BM (10–11 May 2012, London, UK). The workshop aimed at exploring how technical examination of Renaissance artefacts can shed light on their materials and manufacturing techniques, as well as on the prevailing European
workshop practice in the fourteenth to sixteenth centuries. 260 participants included art historians, curators, conservators and scientists from universities, national research agencies, museums and private companies attended the workshop. Proceedings published D. Saunders, M. Spring, A. Meek (Eds), The Renaissance Workshop: The Materials and Techniques of Renaissance Art, Archetype. ISBN: 9781904982937. In the attached Fig. 4.5.1 covers of the published proceedings and posters of some of the organised events are reported (Final Report - Figures)

• Foresight events
Two other public events on foresight heritage sciences on “new instrumentation/technologies” for conservation and on advanced studies of “materials and techniques” along the history of art (paintings, sculptures, ceramics, glasses, etc.) for the identification of future trends, and to promote the new applications of innovative instrumentation and methodologies studies, were also planned and held. The choice of the most promising topics were originated by proposals related to the technologies and their applications to CHARISMA activities and results.

• Workshop on ‘Diagnostics in Cultural Heritage’ at the Accademia dei Lincei (17-19 November 2011, Rome, IT) dedicated to the presentation and discussion of the most advanced experimental devices and methodologies for the study and monitoring of artworks. The event was also part of the initiatives of the International Year of Chemistry 2011 (IYC 2011) and was co-organised with the Accademia dei Lincei. The programme included diagnostics in ancient, modern and contemporary art, diagnostics in conservation of books and diagnostics for the study and conservation of archaeological heritage. A final session was devoted to the demonstration of applications of the portable non-invasive tools used within MOLAB, with open discussion on their performances.

The workshop registered 91 participants, mostly from universities, national research agencies, institutions of the ministry of culture, and private companies of diagnostics and restoration, including art-historians, conservators-restorers, scientists, journalists, and also public.

• ‘Experience, Research and Innovation: A Research Infrastructure Platform for Cultural heritage Conservation and Restoration’ - CHARISMA Final Event. (4-5 March 2014, Firenze, IT) The organisation of the CHARISMA Final Event, led by UNIPG, APRE, and CNR-IFAC, was developed in collaboration with all partners. The event was hosted by OPD, while all the WP Leaders were involved in presenting results and chairing the various sessions, as well as in the preparation of 20 posters illustrating the activities and the main results of the project. Demonstration stands were also organised by Task Leaders.

Main aim was the presentation of the activities and results of CHARISMA by emphasising the achievement of significant innovation in the heritage study and conservation, along with the disclosure of new research perspectives. The program included presentations in the Sant’Apollonia Auditorium, along with posters, bookstands, and videos’ exhibitions in the adjacent rooms, open during the whole event. Furthermore, visits to a series of stands set up at the OPD laboratories in Fortezza da Basso were also foreseen. These stands were specifically dedicated to the demonstration of performances of the instrumentations and methodologies developed within the joint research programme of the project, as: THz imaging, portable Optical Coherent Tomography, NMR-MOUSE depth-profiling, Optical Fiber Fluorescence/Absorption triple spectrometry, Optical Coherent Interferometry, FT-IR Imaging, and Laser Cleaning.

The persons in charge of the research introduced the instruments, then demonstrations were carried out on the outstanding artworks currently in restoration at the Opificio delle Pietre Dure.
Some pictures taken during the CHARISMA Final event in Firenze in Fig. 4.5.2 attached (Final Report - Figures).

**Trade Events & Exhibitions**

Following specific invitations, CHARISMA presented the first WP9 prototypes and other project results in a comprehensive way at public events, increasing the potential for the uptake of the results.

A professional stand equipped with optical windows at the Science Festival, held in Genova, IT, on 27 Oct- 7 Nov. 2010, was dedicated to the public demonstration of project laser cleaning activities managed by CNR-IFAC.

A CHARISMA stand was also arranged by UNIPG, NCU and APRE, at the AR&PA Innovation initiative of the 8th Biennial of Heritage Restoration and Management (AR&PA Biennial), held in Valladolid, ES, on May 24-27, 2012. The exhibition was organised by the Spanish Castilla & León Regional Authority, in close liaison with the European Commission and Labein-Tecnalia Research Centre and with the support of UNESCO. See in attachment the Fig. 4.5.3 where some pictures of the CHARISMA Stand at Valladolid are shown (Final Report - Figures).

All these initiatives were substantial occasions to give positive hints to the research of young and senior scientists and to the diffusion of good analytical practices and common strategies. In addition, exchange of visits among consortium partners and permanence of researchers in participating institutions have been put in action under the supervision of the SC, for variable periods.

Summarising, the main activities of the networking WPs were:

- Defining the term dissemination, within the project context, stressing out the significant importance of this activity particularly to reach the project aims;
- Producing and defining the most effective works and materials for the dissemination that are best suited for the planned goals, target groups and deliverables;
- Defining the term exploitation, within the project context, to take full advantage of the consortium at the whole;
- Identifying the project purposes, the internal and external available results, both from the project context, and from the single work-packages in order to make clear to internal members and potential interested parties and collaborators what can be exploited and in which way;
- Defining the potential external stakeholders of the project in terms of target communities, giving a clear vision of the audience for dissemination and exploitation activities;
- Capitalizing on existing collaborations and liaisons with established networks of higher cultural institutions or professional renamed associations as well as wider Cultural Heritage environment.

**4.6 CHARISMA visual identity**

- **The project logo**

The project logo has been designed by UNIPG with the support of the APRE graphics group exploiting a fresco of Piero della Francesca. To create a strong CHARISMA community identity and brand, all dissemination material, web, video, leaflets, deliverables doc, etc. was designed to be consistent with the adopted CHARISMA logo. It has been used the slides model, that was exploited in the material distributed during scientific meeting and conferences at national, European and international level. In the attached figure 4.6.1 the CHARISMA logo is presented (Final Report - Figures).

The ‘CHARISMA style’ was then adopted by the Editor-Working Group (Editor-WG) for flyers, presentations etc., and published on line through the web (Intranet) to help consortium members in giving the project a stable image.
Leaflets, communication materials, are shown and posters and roll-up, in in Figs. 4.6.2 4.6.3 and 4.6.4.

- CHARISMA videos
For the occasion of EU Workshop on Research Infrastructures (March 2012) a CHARISMA dissemination video produced by APRE and UNIPG examining the material received by project’s partners, was appreciated and presented for the first time.

The movie, available on YouTube (https://www.youtube.com/watch?v=_MhAwxoi1zw) provides a general overview of the project’s support, coordination and joint research activities, and focuses the Transnational Access opportunities and the facilities involved.

The TV magazine of the European Commission, FUTURIS, introducing EU Research Projects, broadcast in seven languages and available to European and International audiences for 20 times a week (102 countries worldwide – including Japan), has dedicated (04/11/2013) a specific movie to CHARISMA activities, entitled ‘Art detectives team up’. The video included short interviews with the Coordinator, the WP7 Leader, and some transnational access user’s group leaders.

The project coordinator, explained how the technology helps artists: “New advanced technology allows us to dig really deep into the nature of art objects. We can understand its structure, the evolution of the creative process used by the artist. We can also get new information about when the work of art was created. And all this with an accuracy we couldn’t even begin to imagine before now.” Fixed research facilities are often too big to relocate. When they are, it is up to the art to go on the move.

The WP7 Leader scientist at C2RMF, emphasised the importance of host institutions getting everything right: “Hosting European researchers means that they travel here with their works of art. Sometimes the transportation prices and cost of insurance are breath-taking. So we, as host institutions, can’t let anything go wrong. We can’t afford to start organising such a huge effort and not deliver because of a technical failure.” The objects are placed on an unique particle accelerator, devoted exclusively to the study of works of art. The French hosts need to make sure everything is ready for their European colleagues.

The movie is visible at the following link: http://www.euronews.com/2013/11/04/art-detectives-team-up

In Figs. 4.6.5 and 4.6.6 some images from both videos are reported.

- Press and broadcasting
During the project life press and TV most significant interests were the following.


LE MONDE The most diffused newspaper in France. Issue of December 4th 2010: an article was dedicated to the excellent results obtained through the FIXLAB (AGLAE) transnational access on gold and garnet objects of the Staffordshire Treasure, a regal treasure the VII century, outstanding British archaeological discovery of 2009.

INTERNATIONAL PRESERVATION NEWS The review (ISSN 0890 - 4960) is a publication of the International Federation of Library Associations and Institutions (IFLA) The Editor is IFLA-PAC, at the Bibliothèque Nationale de France, Paris, FR. An article (issue n. 50 of May 2010) ‘New Synergies for a Multidisciplinary Approach to Conservation: MOLAB Activities within CHARISMA’ the Coordinator presented the project and MOLAB activities as initiatives aiming to create a solid base for outstanding
innovation in the capacity-building policies of science and technology for the safeguard and protection of the European cultural heritage [http://www.ifla.org/files/pac/ipn/50-may-2010.pdf]. An image of the AGLAE laboratory is in the cover of the special issue.

CHEMICAL & ENGINEERING NEWS
A weekly magazine published and diffused allover the world by the American Chemical Society, with large diffusion in Europe, U.S. and Asia. C&EN editors and reporters cover science and technology, business and industry, government and policy, education, and employment aspects of the chemistry field. In the Vol. 88, Issue 38, of 20 September 2010, a full article entitled “Drive-by Conservation” was dedicated to the scientific non-invasive examination during the HOPPA Access Project carried out by a French users’ group (UGL: Roland May) through MOLAB-UNIPG at the Picasso Museum in Antibes, FR.

WIRED IT The Italian edition of the US review that deals with technology and how it influences the culture, economy, politics and daily-life. Issue of February 8th 2011: an article entitled “Micro-restauri per grandi capolavori” describes the activity of MOLAB in Italy and Europe.

KERMES A popular Italian quarterly review dedicated to conservation and restoration, largely diffused in the world among conservator-restorers. Issue of October 2010: a chronicle is given on the MOLAB intervention at the Picasso Museum of Antibes, FR.

TV SLOVENIJA 1 The most important domestic public service broadcast channel of Slovenian TV. Two TV reports were given within the transmission "Kultura ob 22h" on the MOLAB interventions in Ljubljana, SL, by UNIPG and CNRS-LC2RMF (Project CARPACCIO-II) for the study of paintings of Carpaccio: 1- UNIPG; 2- CNRS-LC2RMF.

THE NATIONAL GEOGRAPHIC CHANNEL The channel produced three documentaries relating to the discovery and conservation, together with the research on the Staffordshire Hoard, undertaken at AGLAE through FIXLAB (Project STASH1 and STASH2),

E-CONSERVATION MAGAZINE In the on-line conservation journal, Issue No. 19 (2011) pp. 21-24, the article ‘Back to the Roots’ - Workshop on the Preparation of Historical Lake Pigments’ by M. Griesser described the CHARISMA ‘‘Back to the Roots’ last Workshop. Available at [http://www.e-conservationline.com/content/view/993].

In the Issue n. 23 (2012) A. Karatzani, wrote a review of Back to the Roots - Workshop on Textile Dyeing with Natural Dyes, organised by KIK-IRPA. Dowloadable at [http://www.e-conservationline.com/content/view/1051]

In the issue n.24 (2012) pp. 9-14, the article The Renaissance Workshop: The Materials and Techniques of Renaissance Art’ by H. Glanville described the CHARISMA last workshop. Available at [http://www.e-conservationline.com/content/view/1087]

C&EN CHEMICAL & ENGINEERING NEWS The weekly magazine published by the American Chemical Society, with diffusion in Europe, U.S. and Asia (covering science and technology, business and industry, government and policy, education, and employment aspects of the chemistry field) [http://pubs.acs.org/cen/about] The magazine published news on 4 of the MOLAB interventions of the
5. The project website

One of the first achievements of CHARISMA was the establishment of a website with both a public as well
as a restricted section. In order to maximize the effectiveness of the communication flow, to the CHARISMA Website has been given a flexible, networked structure. The website was based on a freely available content management system (CMS), Umbraco open-source, in full compliance with the W3C web standards. It allowed the coordinator and WP Leaders (i.e. the Steering Committee) to edit and update directly the content. The project participants suggested how to adjourn it with up-to-date information about ongoing activities and results (deliverables, publications, relevant events, news, etc.). The website URL was connected to the main search engines and directories on the web (i.e. Google, AltaVista, Yahoo, and so on). All beneficiaries contributed by providing images (big images) for the development of the home and following pages.

5.1 Public web pages
The public part, with open access from the home page through specific tool buttons, included an overview of the project; the list of the facilities giving access; the consortium partners with contact information; the composition of the Steering Committee (Contacts) providing name, address and email address; the announcement the access calls; the relevant public news and events, such as scientific conferences, and the press releases, which may have been of interest for project participants. Some of snapshot of the project web attached in Figs. 5.1.1 5.2.1 and 5.2.2 (Final Report - Figures).

5.2 Restricted sections
A protected Consortium’s area was used (limited login) for internal, confidential communication enabling interaction between CHARISMA members on the activities of the project. A document sharing application has been developed, offering a useful platform to partners to share documents and files. Useful documents will be stored as well (templates, EC guidelines, reporting tools and guidance, etc.) on Document Library. An ad hoc access has been provided by using usernames and passwords. The Intranet was structured on different interlinked sites:
• The principal one, the CHARISMA Consortium Area Site, mainly used as documents archive and managed by the Coordinator and accessible by all participants (the Governing Board and Steering Committee members and Team Leaders). Not only official documents of the project like Grant Agreement, Consortium Agreement, GPF etc. but also relevant material as Guidelines, Project Logos and Templates, CHARISMA Meetings (Agenda, Minute, Presentations, etc.) , were available. The specific Section called Reporting was used by all participants, permitting everyone to contribute to the preparation of Periodic Reports avoiding e-mail exchange and overloading. It was a general principle that documents should rather be uploaded and then announced by e-mail.
• The WP1-10 Sites were used as autonomous working areas; each WP site was managed by the respective WP Leader and restricted to the specific WP participants, although the WP Leader had the possibility to invite additional members. The My Sites personal box, listed all sites of which the user was member, providing quick access to each of them.
• A short guide also produced intends help the CHARISMA People to facilitate a quick Start for easy internal Sites navigation.

6. Measures for use and dissemination of results

6.1 Consortium agreement rules and confidentiality
At the time where museums everywhere are grappling with what is culturally appropriate for data sharing, access to collections and reciprocal agreements, intellectual property (IP) appears as a guarantee of success for the scientific knowledge management. Despite the fact that IP claims surrounding CH issues can engender exclusionary practices, or unjustifiable restrictions or knowledge flows, concerns over sharing the benefits of research and unauthorised or commercial exploitation of knowledge, images, stories and designs will persist and fuel debates.

The vast implication and repercussions of increased flows of ideas and information in our increasingly global and digital knowledge economy is of concern to the CHARISMA partners especially because IP issues arise between researchers and institutions or among stakeholders and information gatekeepers at the intersection of public domain, cultural knowledge and research.

There is clearly much at stake regarding: i) open scientific knowledge vs ownership of knowledge; ii) restrictive vs inclusive modes of resolution; iii) rights of knowledge holders vs knowledge users; iv) legal definition vs customary definition of IP as well as the legal challenges of new technologies such as digital repositories.

In this context CHARISMA partners are particularly concerned with the practical implications of flows, restrictions and appropriations of knowledge about the data handling, how these affect their access to researchers and other stakeholders, how they are defined and used and how fair and appropriate use and access can be achieved to benefit of all stakeholders.

In addition to this awareness solicitation, the CHARISMA IP rules that have been prepared down within the Consortium Agreement, retained fundamental procedures associated to specific ones regarding confidentiality, ownership and exploitation of knowledge, as well as results and exploitation of results and copyrights.

In developing and executing the WP8, WP9 and WP10 joint research activities, it is critical to understand the role of intellectual property and its possible impact on research and technology obtained, for a subsequent adaptation and/or further development. The principal quandary is to ensure that research innovations are issued in a timely manner and that promising directions for use are identified swiftly.

In this context, the publication of scientific results originating from the joint actions of the consortium have been made as per the usual custom and practice of the CH scientific community, with the prior consent of all laboratories having contributed to results. All publications borne the statement: “The research leading to these results is partly funded by the EU Community’s FP7 Research Infrastructures programme under the CHARISMA Project (Grant Agreement 228330)”.

WP9 and WP10 research plan was the most sensitive, considering the expected new technology instrumentations. In Plan of use and dissemination the possibility to transfer the technology (‘Products’, ‘Methods’ and ‘Experiences’) to ultimate users, i.e. to instrument’ producers, has been considered following the guidance IP rules set out in the Consortium Agreement.

The users benefiting of access activities were also subject to IPs local rules of the partnership holder of the CHARISMA open facilities. In planning and conducting WP5 access activities - in which a massive pre-existing knowledge data owned and often not protected by the host Institution were open to CH professional communities - several well-known IP key points were examined and taken into account, including, among others, the confidentiality of information, the proprietary nature of materials, the property issues associated with the collaborations processes (user/host institution), and/or the research tools. The Consortium Agreement rules prevented the confidential information and data and a specific NDA (Non-Disclosure Agreement) was envisaged for the visits’ scientist analysing scientific data not already published.
6.2 Project output and outreach

• Scientific publications relating to the activity of the project
The following cumulative tables show all publications and dissemination actions from the beginning until after the end of the project, thus demonstrating the added-value and positive impact of the project.

• Contacts
The website, as a dissemination and communication efforts activity (WP4), is co-ordinated by APRE.
WP4 Leader:
Diassina Di Maggio APRE Director
Agenzia per la promozione della Ricerca Europea Via Cavour, 71 - 00184 Roma, Italy - www.apre.it Phone +39 06) 489 399 93 /Fax +39 (0) 06 489 025 50 E-Mail e-mail: segreteria@apre.it ; charisma@apre.it

Related documents

![final1-project-final-report-oo.pdf](final1-project-final-report-oo.pdf)

Last update: 17 April 2015
Record number: 158866

Permalink: [https://cordis.europa.eu/project/id/228330/reporting](https://cordis.europa.eu/project/id/228330/reporting)

© European Union, 2022