UNIVERSITÀ
DEGLI STUDI
FIRENZE

cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

Fondazione Florens
Per i beni culturali e ambientali - Firenze

THE SAFEGUARD OF CULTURAL HERITAGE

A CHALLENGE FROM THE PAST FOR THE EUROPE OF TOMORROW

Edited by Marco Fioravanti and Saverio Mecca

Università degli Studi di Firenze
COST - Cooperation in Science and Technology
Fondazione Florens

COST STRATEGIC WORKSHOP

July 11th- 13th, 2011
Florence, Italy

The Safeguard of Cultural Heritage : A Challenge From the Past for the Europe of Tomorrow : COST strategic workshop, July 11th 13th, 2011 Florence, Italy / edited by Marco Fioravanti, Saverio Mecca. – Firenze : Firenze University Press, 2011.
(Proceedings e report ; 80)

http://digital.casalini.it/9788866550624

ISBN 978-88-6655-058-7 (print)
ISBN 978-88-6655-062-4 (online)

Fondazione Florens
via de' Tornabuoni, 1
50123 – Firenze
info@fondazioneflorens.it
www.fondazioneflorens.it

Supported by

Università degli Studi di Firenze
Firenze University Press
Borgo Albizi, 28,
50122 Firenze, italy
http://www.fupress.com/

Printed in Italy

COMMITTEES

THE SAFEGUARD OF CULTURAL HERITAGE

STEERING COMMITTEE

Prof. Agostino Paravicini Bagliani Honorary President of the Union Académique Internationale aisbl (CH)
Prof. Luigi Dei University of Florence (IT)
Prof. Marco Fioravanti University of Florence/COST Action IE0601 (IT)
Prof. Magda Antonioli Corigilano Bocconi University (IT)
Prof. Xavier Greffe Sorbona University, Paris (FR)
Dr. John Havermans, TNO Team ConserveringsTechnologie, Delft (NL)/COST Action D42 Chair
Prof. Mario Santana Quintero International Center for Conservation - University of Leuven (BE)
Prof. Saverio Mecca University of Florence (IT)
Dr. Tone Marie Olstad Norwegian Inst. for Cult. Her. Research/COST Action IE0601 (NW)
Prof. Bas Pedroli Director UNISCAPE
Prof. Vincent Serneels Univ. of Fribourg, Fribourg, Switzerland (CH)
Dr. Thierry Goger, Transport and Urban Development (TUD), COST Office (BE)
Dr. Caroline Whelan, Matreials, Physics and Nanosciences (MPNS), COST Office (BE)

ORGANISING COMMITTEE

University of Florence
Prof. Marco Bellandi Pro-vice chancellor Knowledge Transfer
Prof. Elisabetta Cerbai Pro-vice chancellor Scientific Research
Prof. Carlo Sorrentino Delegate Communication
Prof. Anna Benvenuti
Dr. Emiliano Degl'Innocenti
Dr. Isabella Gagliardi
Prof. Marco Fioravanti
Prof. Mauro Agnoletti
Prof. Marco Benvenuti
Prof. Pilario Costagliola
Prof. Alberto Del Bimbo
Prof. Carlo Alberto Garzonio
Prof. Grazia Tucci
Prof. Luciana Lazzaretti
COST Action IE0601
Prof. Luca Uzielli Chairman of COST Action IE0601
Prof. Dr. George Jeronimidis University of Reading, United Kingdom
Dr. Roman Kozlowski Polish Academy of Sciences, Poland

UNIVERSITÀ
DEGLI STUDI
FIRENZE

cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

Fondazione Florens
Per i beni culturali e ambientali - Firenze

THE SAFEGUARD OF CULTURAL HERITAGE

Welcome Address

Monica Dietl
COST Director

Welcome to the proceedings of the COST Strategic Workshop, 'Safeguard of Cultural Heritage: A Challenge from the Past for the Europe of Tomorrow' held in Florence, Italy, from 11 to 13 July 2011.

Hosted by the City of Florence at the prestigious Salone dei Cinquecento in Palazzo Vecchio with welcome addresses given by the Florence Deputy Mayor, the Rector of the University of Florence, the President of Florens Foundation and the Vice-President of the Tuscany Region - the opening sessions set the scene for a truly outstanding event.

Safeguarding our European cultural heritage has become a major societal challenge aiming towards the development of a true European identity. The programme of this COST workshop was designed to specifically address those issues, and highlight the scientific research being carried out in Europe in the field of cultural heritage. Gathering over 150 scientists from COST and non-COST countries, the event also attracted a strong participation by early stage researchers (ESR), a core theme of the COST mission.

Plenary sessions on *Strategies and Research Policies for European Cultural Heritage* embraced the topic of future research and policy in the field of Cultural Heritage head on, with contributions from the Italian Ministry of Education, University and Research, the European Science Foundation (ESF), UNISCAPE, and COST Action representatives. Subsequent science and technology sessions on topics relevant to humanities and social sciences; information and communication technologies; natural sciences; architecture; economics; and tourism revealed the complexity of the challenge of safeguarding cultural heritage and the need to bridge the relevant research disciplines.

In this context, COST Actions have and continue to play a key role in supporting Cultural Heritage. The need for transdisciplinary cooperation and training of young scientists to strengthen the European research arena in the field of cultural heritage is a recurrent theme. Several networks on the topic have already been established through COST Actions including Application of ion beam analysis to art or archaeological objects, (COST Action G1); Ancient landscape and rural structures (COST Action G2); Artwork conservation by Laser (COST Action G7); Non-destructive analysis and testing of museum objects (COST Action G8); Wood Science for Conservation of Cultural Heritage (COST Action IE0601); Chemical Interactions between Cultural Artefacts and Indoor Environment (COST Action D42); Built Heritage: Fire Loss to Historic Buildings (COST Action C17); Medieval Europe - Medieval Cultures and Technological Resources (COST Action IS1005); Women Writers in History - Toward a New Understanding of European Literary Culture (COST Action IS0901); Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf (COST Action TD0902). These networks demonstrate that COST is one of the most powerful instruments for supporting the development of Cultural Heritage research activities within Europe.

Only a close multidisciplinary cooperation will ensure that our cultural heritage will be accessible for future generations, a challenge COST is fully committed to.

Giovanni Gentile
President of Florens Foundation

Some months after the end of the first *International Week of the Cultural and Environmental Assets*, the *Florens Foundation*, the backbone of that extraordinary event, was back again as a partner of the University of Florence on the occasion of a very important high-level workshop which had at its core the present situation and future development of Research and Education activities in the field of Cultural Heritage.

We are also very proud of our newly started cooperation with COST (*Cooperation in Science and Technology*), an organisation focusing on the implementation of specific programs for the promotion of research cooperation and coordination through four-year theme-based projects in Europe.

And after all, it couldn't have been different: the interest for the best regional and national resources, the internationalisation, the development of cultural networks and the sharing of ideas and resources are all crucial elements of *Florens'* agenda and *focus*, that is, the cultural heritage, the landscape and the environment, the management of museums and collections, the knowledge and the skills, the popularization of culture, the new forms of creativity and handicraft production, the didactic interdisciplinarity, the interconnection between economy and culture and the internationalisation.

Nowadays, Florence, Tuscany and Italy itself are in urgent need of targeted actions and cooperation projects and they also need to activate interchange networks and share knowledge. But above all, they must play a central role within Europe, influencing the most important decisions on cultural policies, i.e. on the definition of investments and aids for Research and Education activities in the field of Cultural Heritage.

We had already started our cooperation with the University of Florence thanks to *Florens2010*, which let us reach significant objectives that were appreciated by different points of view: both by specialists and the general public as well as by the major international *opinion makers*. Our tight cooperation has led us to promote very intense study initiatives and high-level scientific conferences.

This year, the *Florens Foundation* has been actively involved in the effort of organizing the next International Forum and all parallel events that, during *Florens 2012*, will liven up the city, presenting it to the world as a hub for a global reflection on the destiny of cultural and environmental heritage.

At the present time, the best results come from the sharing of objectives, strategies and cultural ambitions, encouraging the exchange between "knowledge" and disciplines, promoting the cooperation between public and private activities, devoting our commitment to the preservation of our territory and supporting the excellent local efforts, that are also represented by the young students and researchers of our universities and centres for research and education.

These and other support, improvement and internationalization activities will be carried out by the Foundation in

order to enhance the quality of life in our city and boost the competitiveness of our cultural and manufacturing potential both on the national and international level.

Nevertheless, there can be no education, growth and innovation without a broader and more extended cooperation with the many research and creative communities and panels throughout the world. The internationalization of development and research processes, the intercultural exchanges and the development of more open and multidisciplinary networks are crucial elements for the development of groundbreaking social and cultural contexts. Our main goal is the renovation of the "brand" Florence in order to present it as an attractive city not only for its extraordinary historical and artistic heritage and the quality of its hilly landscape, but also for the innovation of both its institutions and entrepreneurial initiatives.

The *Florens Foundation* firmly believes in the development of the projects that the University of Florence is carrying out in the field of Cultural Heritage and we think it's crucial to synergistically promote the many excellent initiatives of this University. In this way, we aim to pursue our goal of internationalizing our city, that can and must be presented to the world as an ideal meeting, study and research hub for cultural and environmental heritage, an engine of economic development for a new *"Golden economy"* that can gain new energy from these preconditions and recover from this deep crisis. A crisis that is certainly not about ideas or ideals, let alone motivation.

FOREWORD

Marco Fioravanti
Workshop Coordinator

THE SAFEGUARD OF CULTURAL HERITAGE

On behalf of the Organising Committee of the Workshop on "The Safeguard of Cultural Heritage: a Challenge from the Past for the Europe of Tomorrow", it is my pleasure to welcome this final version of the workshop proceedings.

The workshop has been organised with the contribution of three different Institutions such as COST, University of Florence and Florens Foundation. Within the COST, the Action IE0601 - "Wood Science for Conservation of Wooden Cultural Heritage" - has performed an important role in carrying out the Workshop, both conceiving the idea and supporting its organisation.

COST Strategic Workshops are instruments typically dedicated to launch new fields of research and or relevant topics. The present Workshop has been proposed in order to achieve the following aims:

- To stimulate the discussion process and awareness on the importance of the safeguard of Cultural Heritage, and for highlighting its Cultural, Social and Economical importance.
- To support the strengthening of an ERA in the field of Cultural Heritage, and to establish research topics to be suggested as possible programmatic lines of the 8th FP.
- To inform political stakeholders on the necessity to support research and European co-operations in the field of Cultural Heritage.

Over 150 participants, with 60 invited speakers, have attended the workshop and discussed the different topics contained in the four main sessions.

One of the most important outcomes of the workshop has been the one related to the importance of Cultural Heritage, in its tangible and intangible aspects, for preserving identity and promoting social cohesion. On July 22, only 10 days after the end of the workshop, Norway experienced a harrowing terrorist attack that have dramatically evidenced the importance of these topics for our common future. This book is dedicated to the memory of the victims of that tragedy.

ABOUT COST

THE SAFEGUARD OF CULTURAL HERITAGE

COST- the acronym for European **CO**operation in **S**cience and **T**echnology- is the oldest and widest European intergovernmental network for cooperation in research. Established by the Ministerial Conference in November 1971, COST is presently used by the scientific communities of 35 European countries to cooperate in common research projects supported by national funds.

COST supports COST cooperation networks (COST Actions) with EUR 30 million per year and brings together more than 30 000 European scientists involved in research with a total value exceeding EUR 2 billion per year. This is the financial worth of the European added value which COST achieves.

A "bottom up approach" (the initiative of launching a COST Action comes from the European scientists themselves), "à la carte participation" (only countries interested in the Action participate), "equality of access" (participation is open also to the scientific communities of countries not belonging to the European Union) and "flexible structure" (easy implementation and light management of the research initiatives) are the main characteristics of COST.

As precursor of advanced multidisciplinary research COST has a very important role for the realisation of the European Research Area (ERA) anticipating and complementing the activities of the Framework Programmes, constituting a "bridge" towards the scientific communities of emerging countries, increasing the mobility of researchers across Europe and fostering the establishment of "Networks of Excellence" in many key scientific domains such as: Biomedicine and Molecular Biosciences; Food and Agriculture; Forests, their Products and Services; Materials, Physical and Nanosciences; Chemistry and Molecular Sciences and Technologies; Earth System Science and Environmental Management; Information and Communication Technologies; Transport and Urban Development; Individuals, Societies, Cultures and Health. It covers basic and more applied research and also addresses issues of pre-normative nature or of societal importance.

Chemistry and Molecular Sciences and Technologies

COST Chemistry aims at coordinating research in molecular sciences and related technologies in Europe. Using COST, European chemists have developed the largest framework for European co-operation for this central basic science that links to physics, material science and biology for the benefit of industries, universities and society.

The COST Chemistry Molecular Sciences and Technologies Domain, created in 1992 as the Chemistry Domain, has been developed around the following key areas:

• Coordination chemistry oriented especially towards biological and environmental effects

• Chemistry for new medicinal applications (new metal complexes, contrast agents, natural compounds diagnostics and therapies)

• New molecules, materials and processes based on talysis and biocatalysis
• Supramolecular chemistry and biochemistry (nano chemistry, nanomaterials and membranes)
• Chemistry under particular and extreme conditions (surfaces and interfaces, high pressure chemistry, supercritical fluids, microwave chemistry)
• Theoretical and computational chemistry
• Prebiotic chemistry and chemistry of the origin of life
• Sustainable/green chemistry

At the beginning of 2006, 20 COST Chemistry Actions with their 113 Working Group projects were operational involving some 3500 scientists working in 1100 research teams from 31 COST countries.

Materials, Physics and Nano-Sciences

The Domain is home to material science, covering from conception through production, characterization, examination, evaluation, fabrication, joining to actual application and service, including related databases, simulation tools, standards and inspections. The Domain covers the full range of materials on length scales down to the nano-meter and atomic range, including surface modifications and the corresponding change in physical properties. The Domain supports exploratory basic research as well as applied research in physics as a key to understanding the laws governing the behaviour of matter and energy. The following examples illustrate aspects of research in this Domain. The scope of the Domain is not restricted to these activities but will adjust to changes arising from novel ideas within European research community.

New developments in industrial technology and technology driven projects requiring the synthesis of new material. In this context, materials science, physics and nano-science or combinations thereof will be supported from this domain. Especially physics underpins many industries and technological processes; it contributes to the synthesis of new materials and to a broad variety of new devices based on the progress made in areas such as optics, plasma physics, surface physics, materials simulation and others.

Emerging Technologies for energy supply, telecommunication biotechnology and related sectors which trigger innovative progress in conventional sectors such as power technology, transport, aerospace, lighting, and monitoring or the establishment of completely new technology areas. Cultural Heritage: The sciences contributing to this Domain are part of Cultural Heritage as they answer the most fundamental scientific questions related to the ageing of various kinds of objects of art. Therefore the Domain is also responsible for Actions in Cultural Heritage focusing on restoration and conservation of ancient architecture, built environment and artefacts. Multidisciplinary Research: Materials science and, to an even larger extent, nano-science are multidisciplinary research fields, therefore this Domain maintains active interaction with other COST domains on all relevant issues such as, for example, environment, global warming and social aspects of nanotechnology. By recognizing the huge potential of nano-sciences in such different areas the Domain encourages multidisciplinary actions and cooperates closely with the other Domains. Therefore, new ideas and initiatives are welcome as well as all ideas with high interdisciplinary elements and close links and overlaps with other Domains.

Individuals, Societies, Cultures and Health

This Domain supports the development of knowledge and insights for citizens, democratic debate and decision-making in the public, private and voluntary spheres. The following examples illustrate aspects of potential research topics in this Domain. The scope of the Domain is not restricted to these activities.

The development and behaviour of individuals and groups: Mind, cognition and complexity; Language development; Learning; Creativity; Socialisation; Identities and Attitudes; Gender; Vulnerability and resilience; Decision-making and risk-taking, etc.

Social, Economic, Political, Cultural, Historical and Technological Structures and Processes, and how these persist and/or change: Economic development; Governance and citizenship; Social cohesion; Poverty and inequality; Health and wellbeing; Public safety and security; Human impacts on the environment; War and conflict; International and inter-group relations; Risk and regulation; Institutional and organisational frameworks; management; Health systems and policies; Families and parenting; Inter-generational relations; Education and skills development; Labour markets; Work and Leisure; Welfare regimes; Demographic change and migration etc.

Cultural Diversity and a Common European Future: Languages, literatures, music and art; Regional/national histories and European history; Media and communication; Values continuity and change; People and landscapes/cityscapes; Locational and spatial variation; Cultural heritage; Cultures of food and drink; Philosophies of humans, nature, science and society; Everyday cultures, etc.

Inter-disciplinary topics linking social science/humanities perspectives with the natural, medical and engineering sciences are particularly welcomed by this Domain, provided that the social science/humanities aspect is predominant.

Transport and Urban Development

The Domain aims at fostering international research networking activities of scientists and experts dealing with transport systems and infrastructures, urban land use and development, architecture and design, and civil engineering issues. The focus is on multi- and interdisciplinary approaches and the aim is to cover both basic and applied research activities including technical and technological developments and their changeovers that are relevant to policy and decision making processes. A significant concern is devoted to activities exploring new research needs and developments.

The domain is by definition cross-sectoral and multidisciplinary, encompassing a wide range of scientific expertises within the transport and land use planning, design, and management activities with a special emphasis on the strong interrelationships among the relevant policy fields as well on all aspects related to sustainable development. The domain activities should be innovative and complementary to other European programmes in the relevant fields.

The following non-exclusive examples illustrate aspects of actual research in this Domain. The scope of the Domain is not restricted to these activities.

- Sustainable transport and urban planning policy
- Design of transport systems and development of urban infrastructure
- Urban architecture and civil constructions: planning and design
- The management of the transport systems, infrastructures and urban structures

INDEX

INTRODUCTION

Marco Fioravanti
A NEW VISION OF CULTURAL HERITAGE Reflections after the workshop 19

THE SAFEGUARD OF CULTURAL HERITAGE: A CHALLENGE FROM THE PAST FOR THE EUROPE OF TOMORROW 23
Extended Summary

Keynotes
Carsten Paludan-Müller *Cultural heritage - and the politics of conflict, poverty, peace and prosperity"* 32
Marc Caball *Individuals, societies, cultures and health* 33
Piero Baglioni *Science for the conservation of the cultural heritage* 35
Mario Santana-Quintero *Centering the role of documentation in conserving our built heritage* 36
Philip Cooke *Innovation, creativity, green economy* 37

Session 1 **THE HUMAN DIMENSION IN CULTURAL HERITAGE** 41

Rapporteur **Agostino Paravicini Bagliani** *The Human dimension in Cultural Heritage* 43

1.1 Cultural identity, landscape and intangible heritage 47
Agostino Paravicini Bagliani *Medioevo europeo. Medieval studies and technological resources* 47
Graham Fairclough *21st century lifestyles: landscape, heritage and urban identity* 50
Pavlina Misikova *Potential of co-operation of the pan-european platform on cultural heritage and landscape* 54
Jean-Paul Métailié *"Facing the landscape": how cultural heritage is took in account in natural parks of the french pyrenees* 57
Bas Pedroli *Landscape – mirror of our culture. An interdisciplinary challenge safeguarding landscape values* 59
Amedeo Amedei, Rosa Valanzano, Mario Milco D'elios, Gianfranco Gensini, Donatella Lippi
Florence and medical humanities: intangible heritage of mankind 62
LaGeS *Public space as cultural heritage* 64
Margherita Azzari, Camillo Berti, Paola Zamperlin *Wettus-wetlands atlas of tuscany* 65
Magdalena Bielenia-Grajewska *The role of cultural heritage in shaping symbolic corporate linguistic identity* 66
Tommaso Martino *The history of emotions and the safeguard of cultural heritage* 67
Carolina Capitanio *The historic urban landscape of Florence. Critical survey and redevelopment of the urban landscape* 68
Fabio Lucchesi, Martina Angeletti, Francesco Monacci, Giovanni Ruffini, Nunziella Toscano
Persistence and metamorphosis in the settlements in Tuscany 70
Luigi Zangheri *Remarks on landscape* 71

1.2 Arts, architecture & archaeology on material heritage 72
Alasdair Ross *Tourism and recreation versus protecting cultural landscapes and heritage in the scottish highlands* 72
Claire Mcilroy *The history of emotions: preserving europe's cultural heritage through interdisciplinary research collaboration* 74
Gert Melville *Medieval monasteries and religious orders as laboratories of innovation for modern times* 76
Camilla Mileto, Fernando Vegas *The role of restoration of heritage in the future europe: recovering the cultural landscape as an identity sign* 78
Ray Bondin *Heritage is a financial asset* 80
Paul Mironneau *History at museum, museum faced with history: a debate upon emotions* 81
Guido Vannini, Michele Nucciotti *Light and public!* 83

1.3 Written heritage, libraries, archives and other collection of social documents 86
Cristina Blanco Sío-López *Preservation and valorisation strategies through digital humanities: the case of the CVCE's enhancement of research and education in european integration studies* 86
Simon Tanner *Preserving the past, imaging the future: how democratising access and generating measurable changes to people's lives is affecting preservation strategies for cultural heritage* 89
Worthy N. Martin *Thematic repositories of cultural heritage – case studies to inform future research and development* 92
Toby Burrows *Organizing digital resources for cultural heritage research* 95
Wendy Scase *Medieval manuscript heritage: digital research challenges and opportunities* 97
Cristina Dondi *The integration of provenance data for the reconstruction of the dispersed european book heritage* 100

Nicoletta Maraschio *Languages: our present and our future* 103
Margherita Azzari, Irene Calloud, Paola Zamperlin *ARCES project - digital archive of italian scientific expeditions and colonial cartography* 106
CLIEO centro di linguistica storica e teorica: italiano, lingue europee, lingue orientali 107
Marco Biffi *The center for theoretical and historical linguistics: italian, european and oriental languages (CLIEO)* 108
Angela Frati, Stefania Iannizzotto, Vera Gheno *Accademia della Crusca* 110
Patricia Engel *Common strategic framework for future eu research and innovation funding consultation* 112
Worthy N. Martin *Safeguard of cultural heritage: a challenge from the past for the Europe of tomorrow* 117
Massimo Moneglia *Spoken language archives at the lablita lab of the university of Florence. Projects and resources* 120
Gabriele Rossi Rognoni, Donatella Mitolo *Recovery and conservation of musical heritage: the music of grand prince Ferdinando de' Medici* 122
Mirella Loda, Silvia Aru, Diego Cariani, Cristina Lo Presti *Public space as Cultural Heritage* 123
Simone Magherini *AD900: writers' papers online* 125

Session 2 **SCIENCE FOR CONSERVATION OF CULTURAL HERITAGE** 127

Rapporteur **Lars I. Elding** *Science for conservation of Cultural Heritage* 129

2.1 CONSERVATION METHODS AND MATERIALS SCIENCE 135
Lars Ivar Elding *Preservation of the Vasa warship* 135
Matija Strlic *NIR spectroscopy for visualisation and modelling of damage* 138
Luca Uzielli *The material sciences applied to conservation of wooden cultural heritage: future perspectives* 140
Philippe Colomban Ladir *The on-site Raman analysis of cultural heritage artefacts, paintings, rock art, pottery, glasses,..:* drawbacks and success! 143
Federica Acciai, Francesca Donnarumma, Antonio Frandi, Lucia Liccioli, Massimiliano Marvasi, Giorgio Mastromei, Irene Padovani, and Brunella Perito *Characterization of black fungi isolated from deteriorated areas of two famous marble statues* 146
Linda Cocchi, Paola Mazzanti, Luca Uzielli *The trittico di San Pietro Martire by Beato Angelico: a panel painting deformation behaviour* 149
Michela Grimaldi *Selection and characterization of biosurfactants for the bio-cleaning application to surface deposits on stone artwork* 150
Irene Natali, Martina Naldini, Emiliano Carretti, Piero Baglioni, Luigi Dei *Nanocomposite systems composed by teos and CA(OH)2 nanoparticles for the conservation of architechtonic surfaces* 151
Irene Natali, Federica Marinelli, Emiliano Carretti, Piero Baglioni, Luigi Dei, Lora Angelova, Richard G. Weiss *Low impact polymeric aqueous sistems for the cleaning of painted surfaces* 152
Mariangela Potenza, Giuseppina Sabatino, Francesca Giambi, Luca Rosi, Luigi Dei and Anna Maria Papini *Diagnostics of egg-based paintings in cultural heritage: an innovative combined dot-elisa and uplc-based amino acid analysis approach* 153
David Bourgarit *On the utility of experimental simulation towards the understanding of ancient technological processes: the example of brass cementation* 154

2.2 ARCHAEOMETRY: METHODS AND GEOMATERIALS 158
Vincent Serneels *The archaeology of iron production* 158
Aurelio Climent-Font *Lustre ceramics. A sophisticated decoration process unravelled with the contribution of IBA techniques* 160
Vivi Tornari *The outcome of two EC projects (FP5 LASERACT and FP6 MULTIENCODE) in new instrumentation of laser coherent metrology for on-field implementation, documentation and originality applications. New applications and perspectives for cultural heritage research, education and training, market exploitation and everyday practices* 162
John Havermans, Rob van Hees, Annemie Adriaens *The future for safeguarding the past: 'networks for conservation science'* 163
Cristiana Lofrumento, Marilena Ricci, Luca Bachechi, Emilio Mario Castellucci *Spectroscopic analyses on rock art paintings from east central Ethiopia* 167
Elena Pecchioni, Emma Cantisani, Fabio Fratini, Raimondo Quaresima *Ancient and modern mortars: knowing the past to plan the future* 170
Elena Platania, Cristiana Lofrumento, Marilena Ricci, Maurizio Becucci, Emilio Mario Castellucci *Micro-invasive textile sample treatment for sers analysis* 173
Antonella Salvini, Giacomo Cipriani, Marino Malavolti, Rosangela Oliva, Piero Baglioni, Marco Fioravanti, Giuseppina Di Giulio *Design and synthesis of new consolidants for their use in wood conservation* 174
Uzielli Luca, Cocchi Linda, Dionisi Vici Paolo, Goli Giacomo, Mazzanti Paola, Gril Joseph, Colmars Julien, Jullien Delphine, Marcon Bertrand, Dureisseix David,Rémond Romain *Experimental studies on the wooden support of the "Mona Lisa"* 177
Carlota M. Grossi *Future climate and pollution pressures on stone heritage* 178
Koen Janssens *Optimizing conservation and valorization of cultural heritage by means of MAXRF: an x-ray based method for sub-surface analysis of painted cultural heritage artefacts* 181
Giovanni Pratesi, Fabio Sciurpi *Microclimatic monitoring for artefact conservation in natural history museum of Florence* 184

2.3. NOVEL NON-DESTRUCTIVE TECHNIQUES FOR DIAGNOSTICS (PLENARY WITH SESSION 3) 185
Rinaldo Cubeddu, Daniela Comelli, Austin Nevin, Alex Brambilla, Gianluca Valentini, Lucia Toniolo *Spectral and time resolved laser induced fluorescence imaging as a diagnostic tool in cultural heritage* 185
Motoyuki Sato *New challenges of ground penetrating radar for archaeological survey* 189
Luciano Alparone, Marco Benvenuti, Pilario Costagliola, Francesca Garfagnoli, Sandro Moretti, Elena Pecchioni, Silvia Vettori, Mara Camaiti, Leandro Chiarantini *Hyperspectral instruments as potential tools for monitoring decay processes of historical building surfaces* 192
Jacopo La Nasa, Sibilla Orsini, Francesca Di Girolamo, Francesca Modugno, Ilaria Bonaduce, Maria Perla Colombini *Characterisation of synthetic varnishes and paint materials by analytical methods based on pyrolysis and mass spectrometry* 195
Ilaria Bonaduce, Maria Perla Colombini, Marianne Odlyha, Mikkel Scharff, Rene Larsen, Dorte Vestergaard Poulsen Sommer, Elin Dalin, Terje Grøntoft, Susana Lopez-Aparicio, David Thickett, Guillermo Andrade López, Ana Tabuenca García, Antonio Ortega, Stephen Hackney, Joyce Townsend, Peter Vandenabeele, Antje Potthast, Ute Henniges, Octaviana Marincas, Colette McDonagh, Dorota Wencel, Philip Bowe, John J.Ackerman, Paul Bellendorf, Johanna Leissner, Alexandra Schieweck, Karin Drda-Kühn *New challenges of ground penetrating radar for archaeological survey* 196
Costanza Cucci, Andrea Casini, Marcello Picollo, Marco Poggesi, Lorenzo Stefani *Hyper-spectral imaging for diagnostics on polychrome artworks: state-of-the-art and recent advances of the research based on the IFAC-CNR hyper-spectral scanner* 197
Riccardo Fanti, Deodato Tapete, Giovanni Gigli, Nicola Casagli *Terrestrial laser scanning for advanced analysis on historic hilltop sites affected by geohazards* 199
Andrea Fiaschi, Luca Matassoni, Giovanni Pratesi, Gilberto Saccorotti *Microtremors: from the buildings to the objects* 202
Marcello Picollo, Costanza Cucci, Kaori Fukunaga *Terahertz imaging methodologies applied to the investigation of artworks* 204
Massimiliano Pieraccini, Matteo Fratini, Carlo Atzeni, Michele Betti, Gianni Bartoli *Assessment of vibration reduction on the Baptistery of San Giovanni in Florence (Italy) after vehicular traffic block* 207
Marco Scaioni, Elisabetta Rosina *IRT-photogrammetric procedure for 3D rendering* 209
Deodato Tapete, Nicola Casagli, Riccardo Fanti *Diagnosis of deterioration in cultural heritage sites: promising perspectives for monitoring at different scales by radar interferometry techniques* 210
Ugo Zammit, Fulvio Mercuri, Noemi Orazi, Marco Marinelli, Stefano Paoloni, Folco Scudieri *Active irt applications to the cultural heritage analysis* 213

Session 3 **TECHNOLOGY AND ICT FOR CONSERVATION OF CULTURAL HERITAGE** 215

Rapporteur **Stefano Francesco Musso** *Information communication technologies and conservation of Cultural and Architectural Heritage* 217

3.1 ARCHITECTURAL CONSERVATION AND TRADITIONAL KNOWLEDGE SYSTEMS 221
Donatella Fiorani *Diagnostics for restoration. Scenarios, issues, and an exemplification* 221
Stefano Musso *Innovation of conservation of architectural heritage* 223
Marielle Richon *Innovative systems for the conservation, development and management of local knowledge systems* 226
Alberto Giretti *Knowledge technologies for the enhancement of the cultural heritage* 228
Massimo Coli, Giorgio Lacanna, Emanuele Marchetti, Maurizio Ripepe *Geo-seismic charcterisation of outstanding cultural heritage monuments: first applications at Firenze, Italy* 231
Letizia Dipasquale, Natalia Jorquera Silva *Learning from local seismic cultures, as a strategy for reducing the risk of cultural heritage* 232
Letizia Dipasquale, Natalia Jorquera Silva, Saverio Mecca *An interdisciplinary approach to a cultural and architectural heritage: earthen dome architecture in Syria* 233
Luca Giorgi, Pietro Matracchi *RISEM – seismic risk in momumental structures. The San Gimignano case* 236
Alberto Giretti *Securart. Large scale management of cultural assets* 238
Giuseppe Lotti, Ilaria Serpente *Design for the global south: a Mediterranean perspective* 239
Giuseppe Lotti, Saverio Mecca *Local and indigenous knowledge safeguarding and innovating: the INN-LINK-S research center* 242
Marco Masera *Energetic issues for the architectural heritage domain* 244
Saverio Mecca *Cultural plasticity and sustainability of traditional building cultures: earthen architecture as model* 247
Saverio Mecca *Web-based codified and tacit knowledge management and conservation of vernacular architecture heritage* 250
Andrea Fiaschi, Luca Matassoni, Giovanni Pratesi, Gilberto Saccorotti *Microtremor: from the container to the contents* 252
Luisa Rovero, Ugo Tonietti *Criteria for the use of composite materials in the consolidation of historical heritage* 253
Valeriano Sandrucci, Enrico Vicario *Combining ontologies and social networking in the collection of cultural heritage information resources* 255

3.2 GEOMATICS AND MULTIMEDIA TECHNOLOGIES 257
Lysandros Tsoulos *The role of geomatics in safeguarding cultural heritage* 257
Mario Santana Quintero *Safeguarding the significance and integrity of architectural heritage: the role of recording, documentation and information systems* 259
Fabio Remondino *Digital 3D recording for heritage documentation and preservation - latest developments and perspectives* 261
Alberto Del Bimbo *Multimedia technologies for cultural heritage* 264

Francesco Algostino, Laura Bucalossi, Alessandro Conti, Alessia Nobile *Mare nostrum: a heritage trail along the phoenician maritime routes and historic port-cities of the Mediterranean sea* 265
Fabio Anfossi, Giulia Bebi, Flaviano Fanfani, Giovanni Pratesi, Valentina Bonora, Daniela Cini, Alessandro Conti, Lidia Fiorini, Grazia Tucci *Experiences of natural heritage 3D surveying and physical reproduction* 268
Daniela Cini, Alessia Nobile *The 3D digital content production for virtual archaeology: models for conservation archives and models for interactive exhibitions* 270
Alessandro Conti, Lidia Fiorini, Marco Pagliai *3D survey for the knowledge and conservation of the Pratolino Park* 273
Valentina Dante, Naida Di Nino, Luigi Mussio, Alice Pozzoli and Fiorella Gaudio *3D gis modeling for safeguard of cultural heritage* 276
Gabriele Fangi *The spherical photogrammetry for cultural heritage* 278
Nora Lombardini, Valentina Bonora and Nadia Guardini *The survey of the dome of the basilica of St. Vitale in Ravenna* 279
Vito Cappellini *2D – 3D ch images for ict systems* 282
Elisabetta Rosina, Marco Scaioni *IRT-photogrammetric procedure for 3D rendering* 283
Elisabetta Sonnino, Antonio Iaccarino Idelson, Marco Callieri, Matteo Dellepiane, Roberto Scopigno, Matteo Fabbri *The Madonna of Pietranico: a testbed for advancing computer-aided restoration methodologies* 286
Grazia Tucci, Valentina Bonora and Francesco Algostino *Building the virtual memory of the holy sepulchre in Jerusalem: metric survey and 3D modeling* 287
Grazia Tucci, Alessia Nobile, Maria Riemma, Valerio Tesi *The Basilica della Madonna dell'Umiltà in Pistoia: 3D survey and study of geometry and structure of the dome* 290
Grazia Tucci, Valentina Bonora and Alessia Nobile *How can geomatics help?* 293
Grazia Tucci, Francesco Algostino, Valentina Bonora and Daniela Cini *Cultural heritage between 3D digitization and 3D reproduction* 294
Elisabetta Rosina *An observatory on innovative techniques for moisture detection in historical masonry* 296
Francesco Fassi, Carlo Monti *The main spire of Milan's cathedral. Survey, modelling and thinking in 3D* 298
Nora Lombardini, Cristiana Achille, Francesco Fassi *Training and research. The study for protecting the archaeological area of the Sanctuary of Diana beside the Nemi Lake* 301
Nora Lombardini *The necessity of knowing the different strategies of conservation for the inspiration of cultural progress* 304

Session 4 **SOCIETAL FUNCTION OF CULTURAL HERITAGE** 307

Rapporteur **Magda Antonioli, Fiorenza Belussi, Fernando Alberti** *Societal function of cultural heritage* 309

4.1 CONSERVATION, ENHANCEMENT OF HERITAGE AND CULTURAL TOURISM 313
Luis Cesar Herrero Prieto *Measuring economic value and social viability of cultural heritage and institutions* 313
Francesca Cominelli and Xavier Greffe *Why and how should intangible heritage be safeguarded?* 316
Francois Colbert *The marketing of cultural heritage: some topics to be explored* 319
Magda Antonioli Corigliano *Sustainable cultural tourism in european urban systems – state of research and policy recommendations* 321
Francesca Imperiale *Environmental and cultural system (ECS), "Lands of Lupiae", "Natural areas, archeology and culture in Apulia on the Messapia coast"* 325
Elena Livi *ITC and museums: the role of web sites in creating knowledge* 327
Barbara Sibilio *Policies and management of the heritage museum in the different perspectives of value: methods and tools of measurement and communication through ICT* 330
Ludovico Solima *Agenda for museums: the next future* 332

4.2 CREATIVITY AND INNOVATION FOR INDUSTRIES 334
Fernando Alberti *Cultural heritage, tourism and regional competitiveness* 334
Joan Trullèn *Knowledge city strategy: the case of Barcelona* 337
Fiorenza Belussi *Business models and networks of creativity in historical industrial districts and low-techsectors* 338
Anne Lorentzen *Experience economy* 341
Lisa De Propris *Cultural and creative industries: a research agenda* 344
Allen J. Scott *Cognitive-cultural capitalism and the urban process* 347

4.3 BRIDGING CULTURE, SOCIETY AND CREATIVE SPACES 349
Masayuki Sasaki *Urban regeneration through cultural creativity and social inclusion in Japan* 349
Sharon Zukin *Preserving urban cultural heritage: authentic local shopping streets* 351
Annarita Lapenna *The inter-milieus city* 353
Luciano Pilotti *Urban ecology and cultural heritage values* 356
Jose' Prada *Urban regeneration and social cohesion. Using cultural heritage for urban regeneration against shrinkage: the case of Aviles, Spain* 360
Chris Younès *Regeneration of inhabited milieux* 362

ATTENDANCE LIST 364

A NEW VISION OF CULTURAL HERITAGE
Reflections after the workshop

Marco Fioravanti
Scientific Coordinator of the Workshop

Cultural Heritage is formed by all material and immaterial evidence of the cultural identity of a population. Within this definition in Europe, like in any other part of the world, many values determine a complex relationship between objects, symbols, personal and collective identities. Materials, monuments, buildings, architectural and archaeological heritage, are all framed in their history, local, cultural, urban, territorial context, in the landscape that represents one of the strongest expression of the many European cultural identities.

In this respect each preserving attempt should consider both material and immaterial aspects in their whole complexity, as it has happened during the last years, when the contribution of scientific disciplines to this field has largely grown up, and the knowledge of a work of art is not anymore restricted to humanists.

According to some Authors the origin of the modern Conservation Science is dated back to the tragic flood that wasted Florence and Venice in 1966 and that imposed the search for new conservation methods. Since that time the progress of conservation science with strong involvement, together with the traditional humanistic science, of physic chemistry and material science in the preservation of material Cultural Heritage has been constantly improved. Europe other then an important repository of different expression of Cultural Heritage has became leader in the conservation science and both these aspects should be considered also for their potential economical role in the relationships with the new East economies, were the demand of both these services is quickly increasing, and where conservation philosophies has been quite different for thousand of years.

In this respect Conservaton Science should be supported in order to develop new, and more accurate, predictive models for understanding degradation processes of Cultural Heritage and also for the comprehension of technological issues related to production of historic artefacts.

Determination of ageing processes and ageing rates of heritage materials are fundamental parameters for strategic decisions on their long-term preservation. Satisfactory methods to determine the rates of degradation processes in various materials are still not available but urgently needed. There is also the need to gather reliable data records in order to measure changes of such systems. Monitoring implies that we must use our sophisticated methods and technologies to obtain measurements of materials at different spatial and temporal points, to make comparisons among results and, hopefully, build-up consistent predictive models of evolutionary trends.

However there is no doubt that the challenging relationship between the so called "Information Communication Technologies" (ICT) and the disciplines that, for their statutory duties, deal with the knowledge and the care of the material and immaterial depot of Cultural Heritage, represents one of the most interesting acquisition in Conservation Sciences. By means of the so called "virtual reality" it is nowadays possible to image "virtual field trips"(in part already realized), conceived to visit museums, monuments or archaeological sites, without moving and that can radically change our sense of time and space. We shall no longer talk only of virtual reality, but now also of "augmented

reality" where it will be possible to imagine exhibition spaces in which various kinds of attentive sensors stare and immediately identify the directions of visitors' eyes and then offer, in different forms and media (increasingly engaging and friendly) a selection of information available on what has attracted their attention.

The great potentiality of ICT applied to preservation of Cultural Heritage could be largely improved launching and supporting coordinated actions concerning the development of comprehensive vocabularies, procedures and methodologies for documentation of Cultural and Architectural Heritage in Europe, which considers the aspects of data gathering, processing, dissemination and archival, always ensuring a strict link and coherence with a rigorous knowledge of the artefacts involved (and of their current status). The Creation of a European digital repository of Cultural Heritage resources (possibly based on open-source software, at least in ideal terms), could ensure the archival and transmission of the Patrimony to future generations and it could also allow to prevent the fragmentation and duplication of information, avoiding a painful loss of the invested resources.

Furthermore the training and the technology transfer for development of competences in survey and in Cultural Heritage documentation in Europe should be foster, by promoting wide and strong networks of collaboration between the industry, the universities and the governmental or non-governmental bodies involved in this field.

In this perspective Cultural Heritage can contribute to create competitive advantages and innovation in Europe. Fostering creativity could open up a space for rejuvenating historical industrial districts and low-tech sectors, through both new applications of science and research activities to old low-tech firms localized in historical systems, and the introduction of innovative business models in traditional sectors. The shifting from conservation to the economic enhancement of arts and culture highlights the role of the human factor and the creative class and put creative cities side by side with cultural cities and industries as the main protagonists of the knowledge economy's development.

These new perspective of enhancement of Cultural Heritage must not overlook the primary importance of its traditional aspects, even some emerging questions on the sustainability of "cultural tourism" could be no longer lived out. If on one side tourism represents an economical asset, also able to support the safeguard of cultural assets and sustains the vitality of the cultural sector, on the other it could pose excessive physical pressure on sites and infrastructure, and endanger the social texture of the sites, e.g. by displacing residents due to the "tourism invasion" of historical centers.

Apparently it seems that the concept of Cultural Heritage is loosing its traditional internal coherency, to become more and more complex and articulate. Nowadays the essence and notion of Cultural Heritage is literally exploding into a variety of meanings and connotations, gradually moving from focusing on tangible objects (e.g. supports of written culture, visual arts, tools and objects, physical supports, physical context of cultural production, and anything related to the physical context of cultural production) to include intangible heritage (oral cultures, local traditions, performance strategies, musical traditions, mnemonic systems, cultural nets and interactions) and the interactions between these two aspects. The need to widen the conceptual dimension of Cultural Heritage, in order to include new contexts, objects and perspectives suggested the urgency to put together, in a new common-space experience, sensibilities and intuitions coming from a wide range of disciplines.

What will be the effect of these contaminations between different fields of knowledge is very difficult to be forecasted. Most certainly object and analytical methods are not unchangeable: changing the methodological lens of investigation, the object reveals itself in a different way. Examples in this sense can be represented by IR reflectography applied to the studies of paintings, or those established between ontology and medieval manuscripts - insomuch that a new revolution has been announced – where the informatics ontology seems able to open the way to new humanistic ontologies.

But there is one more reason that supports the need of an interdisciplinary approach to the studies on Cultural Heritage and is that Cultural Heritage, in many of its expressions, contains elements typical of complex systems. This complexity implies a dynamic character of the evolutional behaviour of these systems that can be understood *ex post* but that could be difficult to foreseen *ex ante*, and that concern either processes of material degradation as well as social dynamics.

A regional or urban economy is a complex adaptive system, to which private or governmental policy that have been based on models of certainty and predictability, being not able to read the unforeseeable novelty which embraces the core evolutionary biological principle of continuous mutations, are often resulted inappropriate instruments of management. This error, on the contrary, has been avoided in landscape conservation, where the most recent achievements are looking for tools that are non-prescriptive and non-controlling, as befits landscape's plural, personal and fluid character. They do not provide new regulations to stop change, because they concern matters for which continued change is an inevitable characteristic. And also in material science, if we had well understood, that in materials aging are recurrent some phenomenas that often maintain many of the adaptive behaviours of the living matter, and which behaviour is always non linear and difficult to predict, probably our conservation works would have been more successful than it has been sometimes in the past.

The management of this complexity require new instruments, new methods, new ontologies, and, probably, the born of new disciplines. It is responsibility of the present generation of scientists to make this process as fast as possible at any level: in the university teaching, in developing new scientific journals, in sustaining across fertilization between knowledges and strongly supporting, i.e. in the case of COST, trans-domain actions and activities.

Finally, there is a further important element that should be mentioned considering the importance of Cultural Heritage preservation. Cultural Heritage, in its tangible and intangible expressions, is also a repository of tacit and traditional knowledge which chain of transmission, after thousands of years, has been interrupted. Transmission rebuilding could be achieved establishing new tools that should be able to re-connect scientific knowledge with traditional ones. In this attempt of establishing new ontology, a great help could come from new technologies like those of the semantic web. The preservation of these knowledges and skill is absolutely necessary for preserving not a nostalgic and marginalized view of the past, but because they can promote creativity and development.

Creativity and development, personal and collective identities represent fundamental values for promoting and preserving social cohesion, one of the main problems for the Europe of today and of tomorrow, and in this respect cultural heritage can play a strategic and fundamental role, also by means of the safeguard of the linguistic heritage, that could allow to each one the possibility to express his thoughts in his mother tongue, that is, in his mental land, where the delicate union between word and concept has been realized.

If we will not able to hold together the sciences concerning human being and the sciences daughters of the human intelligence, we run the risk of losing the unity of the human being in itself. We needed of a new Renaissance, going back to the experience of the deep unity of all the existent. This one represents probably the most important message that Cultural Heritage can send to Europe and to the World: recover sense and perception of complexity.

Marco Fioravanti (1961) - Associated professor of *Wood science and technology* at the University of Florence. His academic background is in Forestry Science with a PhD in Wood Science at Florence University. Conservation of wooden cultural heritage has been one of his main subjects of interest since the end of 80's. Researches have been carried out on the physical and mechanical behaviour of wooden panel paintings and wooden sculptures, on conservation of historical wooden musical instruments, and on waterlogged archaeological wood.

THE SAFEGUARD OF CULTURAL HERITAGE: A CHALLENGE FROM THE PAST FOR THE EUROPE OF TOMORROW
Extended Summary

Credits *Anna Benvenuti, Emiliano Degl'Innocenti, Isabella Gagliardi, Pilar Costagiola, Marco Benvenuti, Stefano Musso, Saverio Mecca,Luciana Lazzeretti, Marco Fioravanti*

The Human Dimension of Cultural Heritage

During the last decades, the concept of Cultural Heritage has lost its traditional internal coherency, to become more and more complex and articulate. Nowadays the essence and notion of Cultural Heritage has literally exploded into a variety of meanings and connotations, gradually moving from focussing on tangible objects (e.g. supports of written culture, visual arts, tools and objects, physical supports, physical context of cultural production, and anything related to the physical context of cultural production) to include intangible heritage (oral cultures, local traditions, performance strategies, musical traditions, mnemonic systems, cultural nets and interactions) and the interactions between these two aspects.

The need to widen the conceptual dimension of Cultural Heritage, in order to include new contexts, objects and perspectives - often traditionally unrelated from a scientific and academic point of view - suggested the urgency to put together, in a new common-space experience, sensibilities and intuitions coming from a wide range of disciplines.

In this cross domain perspective there is the need to expand our capacity to define, describe, identify and understand new Cultural Heritage objects and contexts (i.e.: audio-visual material, multimedia, digital resources) embracing often underestimated repositories such as the digital Cultural Heritage, generally at risk of being lost to posterity (the digital world will quickly become larger than ability and resources needed to preserve all its information).

The reconsideration of the role of Cultural Heritage led to a new understanding of its potential, that is not only directed towards preserving the past, but it is also influential for the inspiration of cultural progress: in this perspective anything that has a connection with the urban, rural or other forms of civilization should also be considered as a strong focus of attention.

Definition of Cultural Heritage

It seems then necessary to establish a clear, updated and shareable definition of Cultural Heritage, recognized as considerably enlarging - involving language, texts, music, images, medieval manuscripts and handwriting, early printed books, buildings and landscapes, but also light, spirituality, mythologies, memory, emotion - and needing more and more levels of investigation (i.e., not limited to both material and immaterial). The notion of European cultural heritage (as well as the European history) emerged to be characterized by the concept of *difference*: multi-languages, multi-cultures, multi-religions. These features should influence the entire scholarly approach on European cultural heritage.

The concept of cultural heritage needs to be constantly rethought, also in connection with the concept of culture itself: there is no fixed hierarchy between different elements of the European cultural heritage – landscape, archaeology, written culture, etc.

Although the concept of European cultural heritage is a constantly changing, one element seems to remains constant: the necessity to apply a diachronic perspective, outside of which the concept of *heritage* seemed to loose its power.

Research topics in the Humanities

In the Humanities the present trends and needs of research, and the potential development of macro (and cross-domain) areas of research, involve (among the others) cultural identities, landscapes and intangible heritage as well as written heritage, libraries, archives and other collection of social documents.

In this perspective a closer connection between landscape and heritage appeared to be an urgent task, simply (but not only) because landscape has to be considered a cultural product, reminding us that «the past is in the present» and that it has to be analysed also on an immaterial level as a factor of lifestyles, identity and memory.

In this field Programming Initiatives are needed to serve policy with appropriate knowledge. Understanding landscape transformation, assessing baselines for global change and regionalising the rural-urban conflict should help to safeguard landscape as a common good. Innovative integrated research approaches will need to support the structural evaluation of principles underlying change and continuity, a global synthesis of long-term landscape development, and a comparative analysis of regional type areas.

One of the other major field of the European cultural heritage is represented by the written heritage, libraries, archives and other collection of social documents, for which the creation and the connection of large data base and advanced digital tools will be one of the most important challenges for the scientific community in the next decades.

Reconstructing libraries (also using virtual environments) will give to the immense librarian European heritage a more integrated 'landscape'. The creation of thematic Repositories will allow the integration of various categories of information; and will enable the presence of multiple interpretations. Because written medieval culture was so diverse and deeply interconnected, modern ontology frameworks and semantic tools seemed to be a perfect means to interrogate this millenary European heritage. Common standards, ontologies and other technological tools will allow old and new linguistic, textual and iconographical database to elaborate in real time new questions, new themes, and new conceptualizations.

A new reflection will also be necessary (and has already begun) in order to analyse the impact of the huge amount of digitized information to our life. Human sciences are since long time familiar with Semantic Web, Linked Open Data, e-Humanities Services, Virtual Centres, and digitized enterprises, but - quite surprisingly - this does not mean that we have to face a «*Data Deluge*». Only a small amount (< 5%) of relevant objects in national libraries have been digitized so far. There should be no interruption in such enterprises, so important for a real democratization of the accessibility of European cultural heritage; on the other hand new questions and problems concerning preservation and conservation, leading to a new interaction with scientists from different disciplines (technicians of materials, chemistry and physics, but also historians, philosophers and ICT engineers) will arise. In this perspective the individuation of new cross-domain experts, training courses (e.g. computing in the humanities and e-humanities), scholarly methods and related technologies could lead to a significant shift of paradigm.

Scholarly research and cultural heritage are inseparable and they need to be more and more supported by technological tools and resources, that are indispensable in order to assure new questions, new fields of research, new possibilities of integration and de-fragmentation of disciplinary traditions.

Science for Conservation of Cultural Heritage

Because of this complexity Cultural Heritage can be viewed under very different perspectives and approaches, perhaps as many as the different branches of humanistic and scientific disciplines interested about. But this is not merely a semantic issue. Rather, it implies that Cultural Heritage represents the field of a complex, interdisciplinary research.

Complexity and interdisciplinarity

This means that different scientific branches applied to the safeguard of Cultural Heritage need to mutually cooperate in order to optimise the results of their efforts. For example, artefact's deterioration can be seen from different perspectives and according to the different expertises of scholars involved in the research. Let us to recall Florence flood in 1966 - a dramatic episode – which opened the way to the thoughtful application of conservation and restoration sciences to Cultural Heritage. The severe damages suffered by Florence's Cultural Heritage represented a major challenge for scientists to find suitable tools to save masterpieces apparently gone lost forever: so it started one of the largest restoration projects of our times. After a short time it became soon clear that, in order to optimise restoration procedures an exhaustive diagnosis of the damage was needed through the analysis of artefact's material substrate and the nature of alteration agents, including microorganisms which often play a basic part in materials alteration. In other words, newborn science applied to conservation of Cultural Heritage very soon became a "complex", multifaceted research field, including several disciplines.

Start-up of new predictive models

Another key point is certainly represented by the need of new, and more accurate predictive models for understanding degradation processes of Cultural Heritage and also for the comprehension of technological issues related to production of historic artefacts[1]

Determination of ageing processes and ageing rates of heritage materials are fundamental parameters for strategic decisions on their long-term preservation. Satisfactory methods to determine the rates of degradation processes in various materials are still not available but urgently needed. "Deterioration" is a complex process, depending not only by the nature of heritage materials but also by both the effect produced by conservations environments and by climate parameters. Extensive adoption of new environmental policies in industrialized countries (e.g., the use of unleaded fuels and catalytic converters), are deeply changing the processes of Cultural Heritage alteration in urban contexts in the last years. Flexible predictive models are thus required in order to better evaluate proxies for damage, climate parameterisation and damage functions. (cf. the concept of "heritage climatology" developed by P. Brimblecombe and co-workers).

All materials on Earth naturally undergo irreversible changes: deterioration ineludibly occurs and has to be managed, measured and monitored.

The introduction and the integrated use of sophisticated surveying techniques, will allow establishing "*a baseline record for the detection of changes over time that potentially threat the heritage integrity*". If it is true that predictability of high dimensional complex systems is framed with many difficulties (as said Philip Cooke in his keynote talk, "*life cannot be predicted*"), there is the need to gather reliable data records in order to measure changes of such systems.

[1] As in the case of metal, wooden or ceramics artifacts where the application of experimental approach to the understanding of their production in the antiquity, might help to reconstruct socioeconomic patterns and the organization of production itself.

Monitoring implies that we must use our sophisticated methods and technologies to obtain measurements of materials at different spatial and temporal points, to make comparisons among results and, hopefully, build-up consistent predictive models of evolutionary trends. Notwithstanding well-done monitoring campaigns in the Cultural Heritage field are acknowledged, *"the rapid rise in new digital technologies has revolutionized the practice of recording heritage places. Digital tools and media offer a myriad of new opportunities for collecting, analyzing and disseminating information about heritage sites" (Mario Santana-Quintero).* That is: the job is not done yet! There is an increasing role played by novel, non-destructive techniques to diagnostics and monitoring of Cultural Heritage, in addition and in conjunction with digital technologies. The technological development of instruments, methods and benchmarks for Cultural Heritage monitoring will be a cornerstone in the Cultural Heritage management in the next future.

A second generation of conservation scientists?

In the last 40 years many scientists from different branches of science (chemists, physicists, geologists, biologists etc.) dedicated themselves to the safeguard of Cultural Heritage. If the need for an interdisciplinary work is not fully understood, however, there is the risk that individual expertise, often highly specialized, will not succeed to catch the complexity of the scenario and meet the final target, i.e., the conservation of Cultural Heritage. In order to fulfil the need for a multidisciplinary approach to conservation issues, European countries should favour the development of an entirely new, second-generation of conservation scientists with a composite scientific (and humanistic) background. A successful knowledge transfer from university laboratories or other research institutions to those responsible for the cultural heritage will most certainly in the future necessitate increased recruitment of scientifically educated and trained museum staff, as well as an improved university education at advanced level in natural sciences and technology directed towards the cultural heritage area. European countries host a number of scientific centers that are leaders at an international scale in various fields of Science applied to Cultural Heritage. One of the reasons for this scientific primacy is surely the European wealth of Cultural Heritage. In principles, therefore, Europe has the potential to be at the forefront in the preparation of this second generation of conservation scientists.

Apparently at the moment there is not much interest to develop and promote this new professional figure (a conservation scientist capable to act as a "Cultural Heritage manager") in most European countries. Without the provision of suitable job opportunities (in the Academy as well as in other public and private enterprises) to this "second generation of conservator scientists", in the next future the research in the Cultural Heritage field will merely become an academic exercise.

Information Communication Technologies and conservation of Cultural and Architectural Heritage

The challenging relationship between the so called "Information Communication Technologies" (ICT) and the disciplines that, for their statutory duties, deal with the knowledge and the care of the material and immaterial depot of our Cultural and, more specifically, Architectural Heritage, represents one of the most interesting acquisition in Conservation Sciences.

After at least two millennia of reflection on what "reality" is, or if there is indeed "a reality outside of us", with the revolution of the so called digital age (of which we still do not fully understand the meanings, implications and possible developments) this fundamental question knows new and unexpected developments. We no longer talk only of "virtual reality", in fact, but now also of "augmented reality". They imagine (and in part already realized) "virtual field trips", conceived to visit museums, monuments or archaeological sites, without moving and radically changing our sense of

time and space. In other cases someone imagines exhibition spaces in which various kinds of attentive sensors stare and immediately identify the directions of visitors' eyes and then offer, in different forms and media (increasingly engaging and friendly) a selection of information available on what has attracted their attention. Comfort and efficiency may so well hide the abdication of any critical thinking, the pre-ordained control of the possible ways for the fruition of the Heritage we are discussing about, with potentially very sad implications for human beings and behavior. They are new and fascinating frontiers of research, no doubt full of developments potentially useful to humans. They can certainly help even our efforts toward the preservation of the Heritage lying on condition, however, that the construction of new "virtual realities" or of autonomous "augmented realities" is not at the expense of a perhaps uncertain "factual reality" that surrounds us and to which even the Heritage belongs, in its perishable materiality. Although, in ontological and epistemological terms, this statement can be and has been repeatedly challenged.

Problem statement

The current application of ICT to Cultural Heritage has evidenced some problems and, in particular, a series of lacks here briefly recall:

- llack of a comprehensive and common vocabulary, standards, and procedures in documentation of cultural heritage, in terms of content, geometry, texture and semantics;
- lack of instruments' specifications and benchmark to compare performance of technologies in documenting cultural heritage;
- lack of metadata and repositories for archiving digital information deriving from Cultural Heritage resources;
- lack of competences, specifically for documentation of cultural heritage and, most important, the risk that the only competences on the field are those belonging to the ICT world, with no evident and effective relationships with those who are more strictly related to the artefacts to which the ICT solutions should be applied;
- fragmentation of cultural heritage information and dispersion of the already acquired ones (by different subject and within separate research activities) on the same objects;
- lack of clear objectives when multimedia is used to raise awareness of cultural heritage, because it is very different to use them to promote and engage the public, or as a documentation tool for the physical protection of its own
- feeble control of the quality of the information and the data that are normally used within some ICT "tools" or "products", especially if they are devoted to dissemination of cultural knowledge to the wider public.

All these "negative" aspects can cause a lack of consistency of any product conceived and realized for a real safeguard of our Cultural Heritage. In order of over passing the above-mentioned difficulties some needs (or suggestion) might help:

Needs

- need of clearer and deeper links between the ICT applied to Cultural and Architectural Heritage (considered in its material consistency) and the physical conservation of the various artefacts belonging to it. This would be, in fact, a fundamental condition to really save, together with their material bodies, also their immaterial values and meanings, according to the most updated theoretical and ethic international elaborations on this topic (see the several charters, documents and declarations form UNESCO, ICOMOS and ICCROM);
- need for a stronger and more evident link between the competences and the professional skills, within ICT applied to Cultural and Architectural Heritage and those involved by the design and realization processes of the conservation and maintenance interventions;

- need of more profound and rigorous collaboration between the experts in ICT and those that are more involved in the knowledge and care of the artefacts that are fundamental component of the Heritage which the first ones are working on (or around);
- need for a stronger integration, in terms of funding policies, of the several researches approved by EU Commission and developed by various Research Bodies, on one side and the real actions that can be developed, starting from their results, for the real protection of the artefacts entrusted to our care. This means, in other words, that we need a clearer way to link and to support the two side of the common field: that of the concrete safeguard and tutorship of our Heritage and that of the ICT applied to it, in terms of study, monitoring, management, evaluation and enhancement (or "*mise en valeur*").

Recommendations

For all the recalled reasons, the following recommendation can be suggested:

- Launching and supporting coordinated actions on the development of comprehensive vocabularies, procedures and methodologies for documentation of Cultural and Architectural Heritage in Europe, which considers the aspects of data gathering, processing, dissemination and archival, always ensuring a strict link and coherence with a rigorous knowledge of the artefacts involved (and of their current status).
- Assessing and define the boundaries of multimedia applications and documentation for safeguarding Cultural Heritage, avoiding the risk that their use can be resolved in itself, as an auto referential or, even worst, auto sufficient goal that may provoke a detriment of the final safeguard and protection of the Heritage itself.
- Developing low-cost approaches to Cultural Heritage documentation, to allow a really diffusion of the tools we can imagine and realize at the service of the Heritage and on behalf of a true enhancement of the public consciousness of the values it has and can have, even more, for our future.
- Fostering the training and the technology transfer for development of competences in survey and in documentation of Cultural and Architectural Heritage in Europe, by promoting wide and strong networks of collaboration between the industry, the universities and the governmental or non-governmental bodies involved in this field
- Creating of a European digital repository of Cultural Heritage resources (possibly based on open-source software, at least in ideal terms), to prevent the fragmentation and duplication of information. This could in fact provoke a painful loss of the invested resources and, further, a dangerous lack of effective results for a sort of diminishing of the comprehension of our general goals on the part of the public opinion. Such a repository should also ensure the archival and transmission to future generations of which we take care.
- Promote a stronger support for actions that clearly can relate ICT applied research for Architectural Heritage and monuments, with research carried out in the field of conservation of real and related policies. This is essential to prevent the risk that the efforts and resources human, technical and economic conditions that are used in this crucial area, may run out of themselves, while the actual artefacts, we're talking about and we want to care, disappear, for lack of care and maintenance, or for wrong actions.
- Allocate sufficient resources, for all the mentioned reasons, to training activities, in cooperation with Universities, local authorities, professional bodies and with industry to create "new competences" in the fields of analytical and diagnostic studies, of planned conservation and maintenance, in designing some rigorous conservative interventions on historic buildings and, last but not least, in monitoring and management of Cultural and Architectural Heritage Systems, after any intervention.
- Provide sustainable solutions for improving the archives interoperability and the growing social dimension of the

cultural heritage. The integration of digital archives requires new sustainable technologies that are able to implement effective solutions, providing knowledge that are much easy to learn, use, communicate and whose application cost less.

- Promote the social web dimension and sustain the challenges of being able to manage folksonomies, that are candidates to be the future of our shared knowledge, as the technologies are evolving from the vision of a distributed intelligence, emerging from a multiplicity of pair-wise, local interactions, and resulting eventually in self-stabilizing semantic infrastructures.

Societal function of Cultural Heritage

The start of this millennium sees profound changes marked by the setting up of new technological, productive and consumption paradigms and by a pervasive, increasing sense of uncertainty. Old and new economies coexist in the same competitive scenario, and the effects of globalisation are progressively leading to an urbanised vision of the world. China and India's economic achievement and the recent economic and financial crises are questioning the effects of globalisation, and the value of the territorial and social dimensions of economic strategies is being rediscovered, particularly as regards the role of human factors and local and virtual communities.

Culture and arts have the power to connect people. The countervailing of social exclusion, the generation of new clusters of high-valued productive activities and jobs, and the pursuing of an inclusive urban society are important targets to which they can significantly contribute.

The shifting from conservation to the economic enhancement of arts and culture highlights the role of the human factor and the creative class and put creative cities side by side with cultural cities and industries as the main protagonists of the knowledge economy's development.

Conservation, enhancement of heritage and cultural tourism

Cultural Heritage can be seen as both "*a productive resource*" and "*something that forms the basis of people's identity as well as providing a source of inspiration for their creativity*". In this sense, culture fits very well into the current knowledge economy paradigm as "*cultural skills support creativity",* whilst, on the other side, the societal function of cultural goods can be significantly affected by economic growth and development.

The highlighted interdependency thus adds a dimension of complexity to both research and policy-making, as regards in particular:

- The measurement of its economic value, which due to the public good nature of cultural heritage cannot rely on good market valuation techniques but rather on simulations of "real-world transactions" capable of revealing individual preferences for both direct consumption and passive use values.
- The analysis of the behaviour of consumers of cultural heritage along the three questions "Who? Why? And How?". Underexplored issues in marketing science and practice particularly regard the understanding of the meanings attached to by visitors to their aesthetic experience, of the role of social ties in the decision-making process and in the mechanisms of appreciation of art works of cultural heritage.
- The safeguard of the intangible component of cultural heritage. This is made of "knowledge, skills and practices which found the individual's and the community's identity and dignity", and whose reproduction entails the transmission and enrichment of tacit, informal capabilities.
- The sustainability of cultural tourism. If on one side, tourism economically supports the safeguard of cultural assets and sustains the vitality of the cultural sector, on the other it may also pose excessive physical pressure on sites and

infrastructure, and endanger the social texture of the destination, e.g. by displacing residents due to the "tourism invasion" of historical centers.

Creativity and innovation for industry

Cultural Heritage may contribute to create competitive advantages and innovation in Europe. Ffostering creativity it opens up a space for rejuvenating historical industrial districts and low-tech sectors, through both new applications of science and research activities to old low-tech firms localized in historical systems, and the introduction of innovative business models in traditional sectors. Art, culture, design, and cultural heritage become an important element of our identity both as consumers and citizens.

Design and digital tools or products are cross-sector technological platforms, capable of enabling cross-fertilization, knowledge spillover, and revitalizing old industries. The consumption and production of "culture in place" can generate innovation in a sort of serendipity as inputs for other sectors: creativity, in this sense, is a matter of recombination of new and old knowledge, new and old ideas, new and old sectors, and new and old usages.

In this respect the local civic communities can play an important role. There is a growing awareness that regions may build their competitiveness leveraging their cultural heritage. Cultural clusters, business networks and new forms of entrepreneurship and regional competitiveness are crucial in order to attract tourists, to foster innovation and regional growth.

Bridging culture, society and creative spaces

Cities (or metropolitan areas) are becoming places globally interconnected, where we find altogether a high density of knowledge, density of skilled workers, and density in the use of new information technologies.

They are the most suitable locations for creative and cultural activities of all types. However, there have been major changes in the physical milieu that need further consideration and investigation. A process of homogenization of the urban landscape, connected with economic and cultural globalization and gentrification, is underway. In this contest it is important to recreate authenticity and promote and stimulate social inclusion, and paying attention to society transformations. Here a new division of labour is emerging between the "creative class", workers possessing high levels of formal qualification and human capital ("cognitariat," "symbolic workers," "knowledge workers"), and a low-wage "new servile class" or "precariat" whose economic functions are primarily focused on direct servicing of the upper tier of the labour force.

In this sense it seems important to promote some actions that should be focused on some key aspects like:

- mapping social transformations, expectations and knowledge bases of the "creative class" across Europe; aligning education policies in the cultural heritage field to development strategies and market needs;
- forming an entirely new class of meta-managers/policy makers able to exert the governance that complex cultural ecosystems deserve nowadays.

Conclusions

More in general, at any levels an increase in complexity of the phenomena under observation is detectable, making necessary the development of multi-level governance models capable of involving multiple aspects of the issue, and of pondering its positive and negative aspects.

Such policies seem to find in the societal dimension their focal point. The strategic role of identities, the risks from potential losses of authenticity and the role of culture for social integration and cohesion are certainly the main is-

sues, as much as the reflection on a possible overcoming of cultural-based capitalism as a response to economic crisis. The raised debate thus represents a wide and deep reflection on the relationship between culture, economy and society, and brings society back to the centre, because it acts at the same time as the keeper of accumulated heritage and the maker of future culture.

Culture and cultural heritage, in particular, are tasked with an ancient and renewed role for protecting society and the system of values that it represents.

It is even more crucial that Cultural Heritage may arrive to our successors, with all the material signs and the immaterial features, the values and the meanings (already known or still hidden within their bodies) that history stratified upon (and within) of the several artefacts belonging to our built environments, so that these last can be really conceived as Cultural Landscapes in which our societies can find a consistent reason to survive and consciously develop in the future. In this respect it seems to be absolutely strategic for Europe to sustain and to reinforce its leadership in conservation science.

Culture can then be seen as a way for a "new beginning" of the new millennium, a tool for exiting the crisis and starting over again, by building a new model of economic development rooted in the past and open to the future. A model that considers the "European knowledge" embedded in its tangible and intangible heritage as its main symbolic capital and competitive advantage. The safeguard of heritage will concern, in this sense, knowledge, skills and practices which found the individual's and the European community's identity, together with the young, creative class which will help to carry us into the future.