THE SAFEGUARD OF CULTURAL HERITAGE

A CHALLENGE FROM THE PAST FOR THE EUROPE OF TOMORROW

Edited by Marco Fioravanti and Saverio Mecca

COST STRATEGIC WORKSHOP

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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

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

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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

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A NEW VISION OF CULTURAL HERITAGE
Reflections after the workshop

Marco Fioravanti
Scientific Coordinator of the Workshop

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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.

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[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.

CULTURAL HERITAGE AND THE POLITICS OF CONFLICT, POVERTY, PEACE AND PROSPERITY

Carsten Paludan-Müller
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Cultural heritage is by some regarded as a field for the particularly interested, or even for the specialists.

Nothing could be more wrong. Cultural heritage is here as long as there is a general social consensus that certain objects from the past should remain as part of our cultural environment.

Cultural heritage is an essential part of how societies remember. For Western societies the tangible heritage has for a long time held a strong position in this respect. So strong that it has lead to the misunderstanding that it exists as heritage independently of its intangible component, which is exactly where the ascribed value and the will to protect it is embedded.

Under a modernistic perspective such a one sided view of cultural heritage made good sense. But the decades following the end of the Cold War has learned us a lot about how societies remember, what part cultural heritage plays in this, and how memory affects our perceptions and actions in the present.

Culture and cultural heritage is to day increasingly recognised for its potential - positive and negative in the development of conflict and poverty or peace and prosperity.

Much of what we discuss in to days world concerning the politics of migration, integration and identity has a link to cultural heritage.

Also cultural heritage is an asset in economic development. But it can also become a burden. Equally cultural heritage can be used positively as well as negatively, in the process of healing or creating wounds in the social fabric.

Cultural heritage is to important to leave to the specialists. We need a more conscious involvement on the side of the citizens and their elected representatives.

INDIVIDUALS, SOCIETIES, CULTURES AND HEALTH

Marc Caball
Chair COST DC ISCH

THE SAFEGUARD OF CULTURAL HERITAGE

Women Writers In History Toward a New Understanding of European Literary Culture - **IS 0901**

Start date: 01/10/2009 - End date: 30/09/2013

Chair: Suzan van Dijk, Huygens ING (Royal Dutch Academy of Sciences), Participating countries: 23

Objectives

• To create international networked collaboration between researchers in women's literary history.

• To promote a more accurate perception of women historical participation in the public sphere and the literary field in Europe (West and East, Women' s writings and their reception)

• To create the technical conditions for a more systematic analysis and use of online editions of / data about women writers (inventory of sources and online research infrastructure).

European Architecture Beyond Europe: Sharing Research and Knowledge on Dissemination Processes, Historical Data and Material Legacy (19th-20th centuries) – IS 0904

Start date:10/05/2010 - End date: 09/05/2014

Chair: Mercedes Volait, INVISU - CNRS/INHA, Participating countries: 13

Objectives

• To set a European network for the study of European and westernized architecture in the Mediterranean, Middle East, Africa, Latin America and Asia

• to produce a new and broader understanding of the worldwide spread and local appropriation of European architecture across empires during the 19th and 20th century

• o build a collaborative online bibliography to produce and release relevant digital data and resources

Medieval Europe - Medieval Cultures and Technological Resources - **IS 1005**

Start date:31/03/2011 - End date: 30/03/2015

Chair: Agostino Paravicini Bagliani, SISMEL International Society for the Study of Latin Middle Ages, Participating countries: 18

Objectives

• To promote an understanding of Europe as a union of diverse but complementary heritages

• To improve the accessibility to results of medieval research, through increased technological standards and skills

• To construct a portal which provide information on digitalized manuscripts, authenticity lists of medieval authors, bibliographies on medieval cultures and a library of medieval texts.

Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf - TD0902

Start date:04/11/2009 - End date: 03/11/2013

Chair: Geoffrey BAILEY, University of York, Participating countries: 22

Objectives

• To develop a new and interdisciplinary and international research collaboration and provide guidance to archeologists, environmental and marine scientists, heritage professionals, government agencies, commercial organisations, policy makers and a wider public

• To improve the method of investigating, interpreting and managing underwater evidence relating to human settlements on the continental shelf during periods of lower see levels – between 16000 and 6000 years ago.

SCIENCE FOR THE CONSERVATION OF THE CULTURAL HERITAGE

Piero Baglioni
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Conservation of Cultural Heritage is fundamental to transfer to future generations our Culture, traditions, way of thinking and behaving, and has an impressive impact on our society, from a political, economical, sociological and anthropological points of view. The conservation of Cultural Heritage is a very peculiar field, where scientists intervene on often unique handcrafts, whose degradation is the result of a delicate balance of aging, unpredicted events, environmental conditions and wrong previous restoration treatments. The peculiarity of the research in Cultural Heritage, where basic studies are usually associated to applied research and restoration workshops, resides in its multi-disciplinarity. The co-operation with conservators, private and public institutions for diagnostics, and experimentation of innovative methodologies is fundamental in the definition of the restoration procedures for the conservation of the works of art. All the interventions directed to preservation of the historical meanings of the works of art may be designed as Conservation treatment. In its general meaning, it can include diagnostics finalized to the knowledge of materials and techniques, environment monitoring and control, modeling of aging processes, management of the works of art, and setting up of innovative formulations to restore the original materials.

During the last years, the contribution of scientists to this field has largely grown up. The knowledge of a work of art is not anymore restricted to humanists, and it should be becoming predominant for the prediction of the degradation insight and for the rescue of Cultural Heritage. Conservators often have to remove chemicals from the surfaces as fats, salts, varnishes, pollutants. This is, usually, done by using chemical, physical, and mechanical methods. The treatments to preserve works of art from damage and deterioration is the matter of scientists aiming to rescue the original materials. The development of novel diagnostics tools, more efficient materials and the study of physico-chemical phenomena at the nano- and macro-scale will presumably improve further the performance of restoration formulations and our comprehension on degradation mechanisms. Modern Conservation Science originated from the tragic flood that wasted Florence and Venice in 1966 imposing the search for new conservation methods. An Italian "school" in restoration was established at that time, which reflected the new awareness about conservation science and whose influence has spread worldwide. In this framework, a major role of scientists in the decision-making process together with the "stake-holders" of the cultural heritage sector was recognized. Unfortunately, this original stream, with only few exceptions, has been inhibited, and after few decades scientists role is still definitively underestimated. Trial-and-error practice still is the most frequent design principles of formulations both for cleaning and consolidation of works of art. This has lead in the recent past to wrong treatments, such as the application of acrylic and vinyl resins to wall paintings that might irreversibly threaten the existence of most of our Cultural heritage. Nanotechnology, biotechnology, laser technology and other promising tools are revolutionizing Materials Science in a pervasive way, similar to what had happened in the past century with Polymer Science.

CENTERING THE ROLE OF DOCUMENTATION IN CONSERVING OUR BUILT HERITAGE

Mario Santana-Quintero
University of Leuven, Belgium

The rapid rise in new digital technologies has revolutionized the way that our built heritage, with these new opportunities; there are also conflicts and challenges, especially in guaranteeing the scientific correctness and reliability of information used to record and document historic buildings.

This talk is aimed at tackling the notion of effectively capturing and disseminating knowledge of heritage places, taking into consideration a holistic approach, centered in the relevance of information to understand the significance, integrity and threats to our built heritage.

Furthermore, examples from UNESCO World Heritage Sites will be provided to illustrate the contents of these concepts.

Mario E. Santana-Quintero is both professor at the University College St. Lieven and assistant professor at the R. Lemaire Centre for Conservation (University of Leuven). As well as, lecturer at the University of Pennsylvania and guest professor at the University of Aachen RWTH. Along with his academia work, he is currently the President of the ICOMOS Scientific Committee on Heritage Documentation (CIPA) and executive officer of the Virtual Systems and Multimedia Society. Since 1997, he has participated as Cultural Heritage documentation consultant for UNESCO, World Monuments Fund, Getty Conservation Institute, UNDP, ICCROM, Euromed Heritage, Abu Dhabi Authority for Culture and Heritage, Welfare Association, and the Petra National Trust. The projects have been carried out in Afghanistan, Belgium, China, Cyprus, Egypt, France, Germany, Jordan, India, Iraq, Italy, Kazakhstan, Sudan, the Sultanate of Oman, Syria, United Arab Emirates, USA and Yemen.

FROM DESIGN EXCESS TO WHAT? NAVIGATING NEW BUBBLES WHILE AVOIDING ECO-BUNKER CHIC

Philip Cooke
Centre for Advanced Studies, Cardiff University

This contribution aims to explore more closely than has been done hitherto, the relationship between economic and cultural-creative transitions. It will apply transition theory, which was developed to draw up routemaps towards a green and sustainable landscape away from the prevailing 'black' and unsustainable fossil-fuel exploiting economy. As a preliminary insight, note may be taken of the evolution of a certain 'clean lines' aesthetic in association with urban eco-design shared not only among certain Nordic exemplars (Hammarby Eco-city, Stockholm; Western Harbour, Malmö) but also by the new *Senedd* building in Wales (architect: Richard Rogers) designed with eco-principles foremost. This is not just a 'waterfront' aesthetic, whose spectacular but non-ecological principles of the 'experience economy' (Pine & Gilmore, 1999) are expressed by Frank Gehry in Bilbao or Santiago Calatrava in Valencia or Malmö (a crucial aesthetic regime comparison with Malmö's newly built eco-aesthetics). The aesthetics of spectacle are redolent of the neo-liberal 'bubble' economy that collapsed in 2007-8 but whose residue lingers on due to the timebound nature of the architectural planning process. Thus we need a 'green creative model'.

No policy and little theoretical work has been done to apply this thinking to the creative economy. There is little recognition of the inter-twining rise of aesthetic 'modernism' and mass-production or the equivalent interaction between the rise of post-modernism and 'diversified quality production', 'flexible specialisation' and 'post-fordism' (Cooke, 1990). Indeed in the European Commission's *Europe 2020* strategy for recovery from the global financial crisis, while some mention is made of the potential of 'greening' the economy to rebalance the highly disequilibriated financial 'securitisation' dependence of the past, neo-liberal investment experiment, little or nothing is said about the restorative economic powers of the cultural-creative platform. Thus there is 'technophilia' but 'aesthophobia' in the highest decision making arenas, it is plain to see.

This is part of the path dependence of contemporary policy-making involving: desire for predictability; reverence for science and technology; fear of fragmentary or duplicative activity; desire for controllability through monitoring and penalisation of non-measurable outputs and outcomes. These are all embedded deep in the texts of documents like *Europe 2020* and member state equivalents. Meanwhile in policy theory itself, creative forms of reasoning are being elevated above 'scientific' ones. Thus 'abductive' is increasingly preferred to deductive or inductive reasoning in evolving corporate strategy in the private sector (Martin, 2009). Why is this? It is argued that for half a century private and governmental policy has been guided by the 'wrong model'. A physics model of certainty and predictability has been highlighted rather than a biological model of 'possibilism' and unforeseeable novelty which embraces the core evolutionary biological principle that 'life cannot be predicted', mutations occur, they can be understood *ex post* but not foreseen *ex ante*. This way of thinking is germane to cultural-creative evolution but has never been explored. Now is the opportunity to proceed.

One way complexity thinking makes sense of a complex adaptive system like a regional or urban economy is to conceptualise it as a landscape or topology within which the development of a city or an industry occurs with greater facility in one rather than another direction. *Growth for both will be stunted where there is too little 'variety' in the system to enable novelty or creativity to flourish. Alternatively, the evolution of both may be facilitated where knowledge recombinations arising from system variety prevail.* Thus a city waterfront of abandoned shipyards and port facilities stunted by a crisis of competition may re-stabilise where such facilities come into contact with creative industry and associated design aesthetics (e.g. the 'Bilbao' effect).

Another way to think of this in relation to the possible mutation of ecological priorities and creative design priorities is where an unlikely material like timber evolves a new iconography outside its normal aesthetic of wooden furniture, floors or finished building elements. One example is the innovation by the failing pulp and paper company *Domsjö* from Sweden that *discovered how to produce organic cotton from wood pulp*. This raw textile can be produced in one variety that has the sheen of a cotton-silk mix at an affordable price well-suited to quick fashion (*pronto moda*) textile users like *H&M*. Another variant reinforces traditional cotton and is under test for the outdoor clothing aesthetic by a leading firm like Sweden's *Fjallraven*. At a time when environmental and political shocks amid rising demand from emerging markets mean world prices have risen to produce 'peak cotton' conditions, such 'resilience' is a vivid illustration of complex adaptive system innovation (Cooke & Eriksson, 2011).

As the aim of this contribution is deliberately diffuse, with no attempt at pinpoint focus its key aim and ultimate result cannot easily be predicted either it is deliberately explorative rather than definitive. This is because there is little settled, theoretical guidance on its subject and the issue of 'green creativity' is only recently 'emergent' and unformed. In such circumstances, reflection must be somewhat experimental rather than taking the concrete form of a 'green creativity model', desirable as the latter is. As Great Recession effects begin to bite hard on public expenditures which funded urban spectaculars that clustered specimens of trophy architecture in cities ambitious to make a global mark, the idea of these great 'urban tattoos' begins to fade. This process invokes a need for understanding based on theory, review, and relevant empirics to help us grasp whether the turn towards 'cog-cult' (Scott, 2008) was mainly a neo-liberal form of cargo cult, as signified by American 'declinist' tendencies in the face of Tea Party demands for cuts all round, including the CIA. Mention of which draws attention to recent events in Pakistan. Now that Osama bin Laden - some kind of cultural icon no doubt - has been terminated, that event brackets the years of excess 2001-2011- from boom to slum(p) - perhaps <u>too</u> neatly.

Hence there remains a need to anatomise that frothy, sunbelt-led, SUV-fuelled, trophy architect-saturated urban growth era as it fades aesthetically before our eyes. This conference contribution will provide a critique of the follies of the 'experience economy' as a predicate for this, exposing the urban placemaking, 'branding' and global 'positioning' mantra for the flim-flam it now seems to have been. Contrariwise, the presentation will examine what survives of this long emergency of shrivelled and shriven 'urban triumphalism'? Does it presage a world of hyper-consumption for the 'socialised rich' of two-bonus bankers attending charity plate operas while juvenile isolates pore over their 'social' wiki-networks? Does the apparent resurgence of the international (albeit conservative) art market presage a new cultural 'bubble' in tandem with a new ICT 'apps' bubble? Are America's new, peri-urban 'tent cities' any guide to the aesthetics of an increasingly polarised society? This bifurcation may yet be aesthetically represented in the cultural union of new Damian Hirst iconic diamond skulls of the lately departed in some kind of union with varieties of beefsteak-clad Lady Gaga overlays. Here, the rich appropriate the human skeleton as an aesthetic icon and can afford to wear meat, unavailable to the poor, as clothing. However, might an alternative, possibly more stoic,

even spartan ('clean lines') aesthetic be emergent, though as yet shambling and unformed, in the green shadows of a now debilitated, slightly eerie Gehryesque, urbanity? What might eco-architecture and eco-design look like were it to move beyond its current, windowless 'bunker aesthetic'? The contribution will propose informed but inevitably speculative answers to these and related questions and issues.

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Session 1
The Human dimension in Cultural Heritage

THE HUMAN DIMENSION IN CULTURAL HERITAGE

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Concept of cultural heritage

Beginning with the concept itself a real consensus exists at least on the following points :

The concept of cultural heritage is considerably enlarging, involving more and more levels on investigation

Language, texts, music, images, medieval manuscripts and handwriting, early printed books, buildings and landscapes, but also light, spirituality, mythologies, memory, emotion, constitute our cultural heritage which needs two different levels of analysis, material and immaterial

The concept of cultural heritage needs to be constantly rethinked, also in connection with the concept of culture itself (Unesco).

The concept of heritage does not exist outside diachrony (history).

'Culture' and her social dimension/implications are fundamental factors of (European) heritage.

Scholarly research and cultural heritage are indissociable and need more and more to be supported by technological tools and resources. The main reason is that modern onthologies and other technological tools are able to link the analysis of the infinite diversities of the European cultural heritage, which characterize Eureopean cultural heritage. Diversity is at first linguistic: Pluringuism is the most fundamental feature of European history and has to be considered as such in each re-thinking of European cultural heritage. Translations – from arabic into latin, from hebrew into latin, but also from arabic into hebrew and greek or from greek into latin and even from latin into greek – constituted the first western laboratory of scientific language. All this means that the medieval written culture – transmitted through several hundred thousands of manuscripts preserved in our libraries – was, even if written in one single language (latin, 500-1000) – pluricultural and pluriconfessional.

There is no hierarchy between different elements of the European cultural heritage – landscape, archaeology, written culture, etc.

Landscape

The 'landscape' themes occupy an importante place among the re-thinking of the concept of European cultural heritage, constituing a new strong scientific trend.

1. Connecting landscape and heritage appears as indispensable, simply because landscape has to be considered a cultural product. There cannot be a satisfactory approach to the problems connected to landscape leaving by side the cultural aspects. E. g.: Landscape was a factor (spiritual, political etc.) for monastic comunities, for urban settlements, for imaginary environments etc.

2. Landscape alters heritage practices and has to be analysed also on a immaterial level. Landscape is about the relation between object and subject, between viewer and actor, is also about policy and its use... National or regional parks have – at least in France – more and more the fonction to keep up traditional activities and landscapes. Resistances and contrasts are active: but national parks are no more seen only in the perspective of the conservation of natural environments.

3. Landscape as a cultural product reminds us that «the past is in the present». Memory, identity, cultural modifications (mythology, imaginary etc.) testify that 'landscape' is not only material but immaterial. Urban landscape is surely the result of social migrations but can also be the result of memory of antique agricultural settings. The urban landscape can therefore imply a consciousness of the 'loss' of land (e.g.: the survival of agricultural landscape at the boundaries of a city as Liverpool). 'Landscape' is a factor of lifestyles, identity, memory, and therefore a reconstruction and a reinterptation is eventually possible with the help of light archaeology. Reinterpreting in that way historical buildings and landscapes allow to link archaeological research and social visibility of archeaeological results, making possible a necessary visualization and accessibility to a large public of scientific results.

4. Landscape research needs a historical perspective also in order to find how and why imaginary (mythological) landscapes have influenced the actual use of landscapes (tourism) under economic pressures.

Written culture

Great attention has also been accorded to the European written culture (medieval manuscripts and early printed books).

1. For these both major fields of the European cultural heritage, the creation and the connection of large data base will be one of the most important challenges for the scientific community in the next decades. For medieval manuscripts and early printed books large database are indispensable, because these technological tools allow integration and interoperability of large amounts of informations still fragmented and largely unknown/unedited.

2. Because written medieval culture was so diverse, modern onthologies are a perfect instrument in order to interrogate this millenary European heritage. Common standards, onthologies and other technological tools will allow old and new linguistic, textual and iconographical database to elaborate in realtime new questions, new themes, new conceptualizations.

3. Reconstructing libraries – medieval, early modern – will be able to give to the immense librarian European heritage a more integrated 'landscape' (integration of: institutions, regional features, schools, scholars, writers etc.)

4. Medieval manuscripts and early printed books are changing over time, and are – not in equal extent – the product of art, craft, and manifacture. These are important concepts which have a great influence on the scholarly research in this particular field of European cultural heritage.

5. Human sciences are since longtime familiar with Semantic Web, Linked Open Data, e-Humanities Services, Virtual Centres, and digitized enterprises. But: this does not mean that we have to face a «Data Deluge». The answer is a clear: No! Only 3,5% of relevant objects in national libraries have been digitized! There should be no interruption in such enterprises, so important for a real democratization of the accessibility of European cultural heritage.

5. Thematic Repositories allow integration of various categories of information; and enable the presence of multiple interpretations; they allow scholarly analysis yielding new 'objects' and new interpretations etc. But the technological resources already existing in the web let arise great difficulties on how to find everything relevant, on how find relevant relations between different versions, or between objects and public research. All these difficulties make urgent a new reflection on the necessity to search agreements on possible similarities on the terminological level. 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.

To sum up

1. From the perspective of 'landscape', 'archeology' and written culture, European heritage is profoundly cultural, on both levels, material and immaterial.

2. European cultural heritage is a constantly changing concept and enlarging towards new objects, new themes, new fields. But one element remains constant: the necessity to apply a diachronical perspective (history), even in approaching landscapes.

3. European cultural heritage is the result of an extraordinary diversity: European history being characterized by plurilinguism, pluriculturalism, pluriconfessionalism. These features (should) influence the entire scholarly approach on European cultural heritage.

4. Technological resources (including large database, collections of data) and tools are indispensable in order to assure new questions, new fields of research, new possibilities of integration and de-fragmentation of disciplinary traditions.

5. There is no 'Data Deluge', on the contrary: digitalizations – particularly of medieval manuscripts – are seen as indispensable also in order to allow a democratic visualization and accessibility of European cultural heritage.

6. In all these approaches towards European cultural heritage scholarly analysis and study is indispensable also in order to help policy makers to take decisions (in connection with the landscape) capable to assure an equilibrium between the saufeguard of the heritage and the necessities of social and economic emancipation.

7. Scholarly research will be more and more indispensable not only to make possible the technological integration and operability in the field of the European cultural heritage, but also on the social and cultural impacts that such technological resources and tools will have on European citizens' life.

MEDIOEVO EUROPEO. MEDIEVAL STUDIES AND TECHNOLOGICAL RESOURCES

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I would start with three questions, which are at the same time three theses

1. Can we imagine the future of the medieval studies without the new technologies ?

2. How the new technologies shall contribute to safeguard medieval written culture and the quality of research on it ?

3. Why medieval written culture is one of the most important European cultural legacies ?

If we try to give an answer to these questions, other questions arise immediately :

1. What would we know of the Greco-Roman culture without the medieval manuscripts? Each edition of a Roman author grounds on one or more medieval manucsripts. The Irish monks, the libraries of the monasteries of the High Middle Ages (http://www.libraria.fr;http://www.sismelfirenze.it/index.php/it/ricerca/itemlist/category/34-biblioteche-medievali-ricabim), the manuscripts of the Carolingian Renaissance, the manuscripts of the XIIth century and so on allowed to the European culure to maintain a direct contact with the great authors of the Greco-Roman world, and to comment it. The Italian Humanism and the European Renaissance have enlarged fundamentally our access to the classical Antiquity, but even Humanists used medieval manuscripts in their reading and commentin of the Classical culture. From this perspective, medieval manuscripts constitute a fundamental cultural heritage not only for the Middle Ages.

2. What we know (from 500 to 1000 or so) on Celtic, German, Scandinavian medieval cultures etc. grounds exclusively on the latin medieval written culture and his physical written vehicle (the handwritten book). To be more precise : after the fall of the Roman empire, from the Vth century on, Europe integrates progressively German, Saxon, Scandinavian and East European cultures, creating a new Europe (http://www.staff.hum.ku.dk/mjd/ms-bibliography.html). The consequence is that linguistically, during half a millennium, the entire european literature was written in one language, latin. The consequence is that linguistically, during half a millennium, the entire european literature was written in one language, latin. This means that medieval writers writing from Vth century to XIth century allowed Europe to have an access to her cultural diversity. From the perspective of European cultural heritage we have therefore to be aware that medieval manuscripts have been the vehicle of the diversity of European premodern cultures. Medieval manuscripts constitute therefore a fundamental cultural heritage not only for the Middle Ages.

3. From the XIth century on, from their boundaries (Sicily, South Italy, Spain, East and South-East-Europe), Western Europe has progressivley imported a large number of texts coming from the Arabic world. Thank to an extraordinary plucrilinguistic, pluricultural and pluriconfessional scientific effort (translations, commentaries), Western intellec-

tuals have increased their knowledge in the field of the 'philosophy of nature' (cosmology, nature, body). Translations – from arabic into latin, from hebrew into latin, but also from arabic into hebrew and greek or from greek into latin and even from latin into greek – constituted the first western laboratory of scientific language. As a whole, medieval manuscripts containing scientific texts of the antique philosophers, physicians and scientists, written and copied by Islamic, Judaic and Christian translators and commentators reflect intellectual exchanges which has no real comparison in premodern European history. All this means that the medieval written culture – transmitted through several hundred thousands of manuscripts preserved in our libraries – was, even if written in one single language (latin, 500-1000) – pluricultural and pluriconfessional. The handwritten medieval culture is therefore an unique heritage of the cultural diversities and particularities of premodern European culture.

At the same time, medieval written culture is characterized by a strong cultural unity. The Carolingian Renaissance or the medieval Universities are the best expressions of this general tendency of the medieval written culture to think itself as universal and global. Such an aspiration to universality explain also the history of the medieval handwritings – inherited from the Classical Antiquity or developped in the Middle Ages, as the Carolingian or the Gothic handwritings – whose diffusion was during the Middle Ages very often surprisingly uniform through all the (then known) European regions. Diversity within a concept of universality concerns also the medieval world of images (miniatures, diagramms etc.). Medieval miniatures allow us to reconstruct the dominant culture in the Middle Ages – perhaps even more that many texts do – by revealing very often complexe stratifications of the pre-christian european cultures. These fundamental features of the medieval written culture – diversity combined with universality – cannot be studied without large databases – textual corpora, linguistic corpora, collections of images and of manuscripts (for an international overview on medieval databases: www.menestrel.fr). The reason is that large database – manuscripts, words, textes, images – allow to exam diversities and particularities in aEuropean cultural context grounding in the Middle Ages on a so strong common base. In this sense, medieval corpora, repertories and database contribute to the European selfconscience.

1. The linguistic and textual corpora and even the enterprises of digitalized manuscripts and images are the result of autonomous, individual or national academic traditions. Most of them reflect the fragmentation of medieval studies (linguistic, disciplinary and national). In the next decades the scientific community will surely organize itself in order to elaborate common standards, best practices and possible technological integrations. The new COST Action IS1015 Medioevo Europeo. Medieval Studies and Technological Resources demonstrates that the future 'has already begun'. So far 17 COST member States have accepted the Action's Memorandum of Understanding (MoU). "The main objective of the Action is to increase accessibility to and integration of medieval research results and tools through improved technological instruments and skills. This will not only upgrade quality and efficiency of research in this field, through the use of advanced ICT, but will also ensure increased employment potential for early stage researchers". COST ACTION IS 1015 Medioevo Europeo. Medieval Studies and Technological Resources, initiated by the SISMEL, Florence, Certosa del Galluzzo, pursues the objective to create a Virtual Centre for Medieval Studies: a virtual, team work space in which to collaborate, communicate and share work and research tools. This technological rethinking is in perfect coincidence with the main feature of the cultural medieval heritage: diversity within universality (http://www.cost.esf.org/domains_actions/isch/Actions/IS1005).

2. Because written medieval culture was so diverse and universal, modern onthologies are a perfect instrument in order to interrogate this millenary European heritage. Medieval studies are already influenced by the modern ontholo-

gies; But a new revolution is on the way : common standards, onthologies and other technological instruments will allow old and new linguistic, textual and iconographical database to elaborate in realtime new questions, new themes, new conceptualizations.

To sum up :

1. Medieval written culture has been the medium which transmitted to Europe the diversity of cultures which formed it, within a context of universality.

2. Thank to their interoperability, the new technologies (onthologies, digitalization etc.) are a perfect instrument for the preservation and the study of this fundamental European cultural heritage.

3. From the success of such a technological interoperability – which will be one of the greatest challenges for medieval studies in the future – will depend the quality of both the preservation of written medieval culture and the research on it.

4. There can be no satisfsactory future without an intense cooperation and integration between a research on manuscripts and texts and technological resources.

This means precisely that:

1) the scientific community ('medieval studies') has to be aware of the necessity of a real collaboration-integration with the technological knowledge

2) the safeguard of the European medieval written heritage grounds on a real dialogue of institutions financing technological resources with scholars devoting their scientific life to the study of manuscripts and texts. The reason is that this dialogue is particularly abe to preserve the main feature of medieval written culture, to be a quasi unique witness of the diversities and particularities of pre-modern Europe and her exchanges with other Mediterranean civilisations.

21ST CENTURY LIFESTYLES:
LANDSCAPE, HERITAGE AND URBA IDENTITY

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

The idea of 'Cultural Heritage' (CH) sometimes seems to exclude landscape, particularly the landscapes of towns and cities. Whereas the Faro Convention defines cultural heritage widely, including landscape, customs and performance, CH is often limited to great architecture and art, to separate manageable 'things'. Materiality alone does not constitute heritage, however; the human, social and cultural *values* ascribed to it are just as or more important. In one sense all heritage is intangible.

Landscape is not simply a sub-category of CH but a 'way of seeing' that forces us to reassess Cultural Heritage as a whole. Landscape is part of cultural heritage, and cultural heritage is also a part of landscape – but only one of its parts, because landscape integrates all aspects of how people respond to and live in their world, from (for example) ecological and environmental relationships to social, political and demographic issues. The result of this integration – Landscape - is much more than just the 'environment'. It is quintessentially cultural, a human construct in both material and mental terms. It is plural and ubiquitous, dynamic and fluid; it is continually contested and renegotiated, actually *characterised by* change. Normative criteria such as authenticity and preservation lose relevance when confronted by landscape's dynamism.

Landscape also introduces into CH an idea of living with and even celebrating change, rather than only stopping it. CH viewed as architecture or art is said to be mainly concerned with things from the past that are no longer in 'functional' use, but landscape in contrast is always still in use. The 'lens' of landscape converts CH from something reserved for holidays (the unusual and exotic, reflecting elite and/or expert values) to something that is everyday and everyone's (the inherited frame of everyday life, not the stuff of tourism). In central Florence the two coexist, but elsewhere CH needs to adjust its field of vision to see both.

Landscape perspectives provoke a more inclusive and democratic approach, too. Landscape creates conversations about ownership and access in the context of politics, class, social equity and inequality; it is a universal commons, contested but always shared. It calls for cross- and inter- (perhaps post-) disciplinary collaboration (Bell *et al* 2011), which will allow it to help address the grand challenges facing Europe, from demographic change, local, national and global interactions and new patterns of mobility to energy deficits and climate change responses. The recent COST and ESF Science Policy Briefing on Landscape makes this abundantly clear (http://www.cost.esf.org/library/newsroom/spb).

The 'ecosystem services' idea is currently fashionable in policy circles. It suggest that cultural services are a product of a well-managed ecosystem, but a landscape view suggests the opposite. Landscape (and CH) provides services for society too, that contribute to economic and social well-being and for which we use various words such

Fig 1: Street art in Cordoba, 2010: Politics and landscape? Perceptions of rural v urban? A new version of Sienna's Good & Bad Governance?

as identity, place, genius loci or memory, but it also provides ecological services. We routinely manage the landscape to 'produce' – or to nurture – 'Nature'. We live in the 'Anthropocene', a period in which human influence is so major that natural systems are everywhere distorted and it can be argued that biodiversity and environmental goods are also in reality provided by the cultural system, not by the eco-system (itself now a product of cultural activity). Through the idea of landscape, people, and their lifestyles, activities and aspirations, could be at the centre of environmental as well as spatial planning and development policies.

In Europe today, most people (probably well over 80%, the world average is 50%) are urban dwellers, either directly, in cities, suburbs and peri-urban (so-called urban sprawl) areas, or indirectly because they live urban lifestyles in supposedly 'rural' contexts. They are no longer farmers; their landscapes are urban(ised), their perception, world views and aspirations are urbanised. Land use, heritage and social policies should reflect this, but rarely seem to.

Politicians and policy makers have plenty of evidence (such as the Dobris assessments) for the rural-ness, land cover and ecology of Europe's landscape, but they lack similar evidence for cultural diversity and landscape character (particularly of the most urbanised regions) at European scale. Consciousness of the long term continuing 'loss' of land to urban growth has not only created a rustic nostalgia but in some countries at least a sense that envi-

ronmentally (or even morally) "rural is good, urban is bad". Beyond undeniably important historic urban cores, urban landscapes are overlooked in heritage policy and research even though they are most people's everyday landscape, the landscape of residents not tourists. Yet even modern cities have their 'past in the present', and a key goal of landscape-based cultural heritage research should be to identify and increase the legibility of these heritages.

Three important policy and promotional tools have appeared since 2000: the European Landscape Convention (ELC, Florence Convention, 2000), the Faro Convention on the Value of Cultural Heritage to Society, 2005), and 'Landscape in a Changing World', an ESF/COST Science Policy Briefing on landscape research (2010).

Florence (the ELC) tells us that landscape is everywhere - and everything, containing all periods of history (including the very modern), all qualities (not just beautiful or tidy), all types (farmed or abandoned as much as designed, urban or marine as much as rural). It involves multiple and plural views, and both external and internal perspectives. Read closely, the ELC tells us that landscape is living (constantly both transformed and transformative) and must therefore be managed and modified, not just protected.

The Faro Convention adds a wider view of CH, including the actions of making and constructing heritage (lived-in landscape) as well as its fabric. It insists that heritage is a central part of society, which like landscape can create powerful national and local identities, a strong sense of place and an awareness of 'other' heritage. It calls for democracy in CH - a different sense of ownership and a right to your own heritage, but equally responsibilities to respect other groups' heritage (Council of Europe 2009).

"Landscape in a Changing World', the ESF/COST Science Policy Briefing (SPB41), added a scientific research dimension to these Conventions. Several recent conferences and books have spoken of moving 'from research to action' and of making research socially relevant (eg Berlan-Darque *et al* (eds) 2007, Bloemers *et al* (eds) 2010). The SPB now underlines how landscape research can help to address the socio-environmental grand challenges facing Europe. It is a strongly integrative idea for framing research throughout all the domains of the social sciences, humanities and physical sciences.

These three documents do not provide strict regulations or laws to stop change, because they concern matters for which continued change is an inevitable or even desirable aim. They do however call for landscape and heritage policies to be integrated more strongly into the mainstream of policy in order to combine protecting the inherited landscape with shaping future landscapes.

"Performing heritage" in this new way is more difficult than practising old-fashioned CH. Aiming to create a landscape for tomorrow that contains the memory and remains of the past is a very different goal to trying to keep past landscapes as islands within a 'modern' landscape. Broader agendas are needed (eg Fairclough and van Londen 2010). Future CH research on landscape needs to be about people as well as landscape, in particular, for example, interdisciplinary collaboration is needed between environmental and ecological history and archaeology on the one hand and sociological and political studies on the other. What do people want; where does lifestyle meet landscape?

The SPB suggests broad themes to frame future research. The following might at the forefront:

European-scale overviews of the diversity and commonalty of inherited landscape, to avoid national exceptionalism whilst identifying both distinctiveness and shared character; what precisely is the European landscape?

More understanding of how towns and cities (from historic cores to metropolitan sprawl) actually work as 'landscape',

Insights into the effect of migration and movement on people's landscape perception and identities;

The mechanics and mentalities of how past and present actually co-exist within the (city) landscape.

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POTENTIAL OF CO-OPERATION OF THE PAN-EUROPEAN PLATFORM ON CULTURAL HERITAGE AND LANDSCAPE

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The paper discusses several challenging issues of a forum offering the advantage of bringing European Union member states together with non-members on the topics which should be equally shared – cultural heritage and landscape.

The Pan-European platform - what has happened so far?

The Pan-European platform as a unique place in the international political landscape with the potential to provide space for developing common responsibility and new approaches to cultural heritage and landscape could be identified as the forum of the parties to the European Cultural Convention. Created by the Council of Europe (Paris, 1954) this convention helps to promote and protect cultural diversity throughout Europe. It works to encourage appreciation of the many national identities that comprise Europe's common cultural heritage, with a focus on languages, history and society. Belonging to the main conventions of the Council of Europe, is intended to demonstrate Europe's cultural diversity through qualitative treatment of citizens' environment. Without duplicating UNESCO's World Heritage procedures (dealing with outstanding sites) the aim of Council of Europe (CoE) is to help 47 member countries to formulate and test inter-sectoral and cross-cutting policies on cultural heritage and landscape protection, management and planning through so called *cultural heritage conventions.*

Promotion of cultural heritage and landscape through CoE activities

As the guardian of the fundamental values *human rights - democracy - rule of law* „the primary aim of the Council of Europe is to create a common democratic and legal area throughout the whole of the continent with the objectives such as to protect human rights, pluralist democracy and the rule of law; to promote awareness and encourage the development of Europe's cultural identity and diversity; to find common solutions to the challenges facing European society; to consolidate democratic stability in Europe by backing political, legislative and constitutional reform". With the motto: „*47 counties, one Europe*" CoE has brought into the life four cultural heritage conventions which *"constitute a platform that expresses a European model of development based on the effort to achieve overall progress for society, implying sustainable management of each area's cultural and landscape resources, taking account of the longer term rather than the immediate benefits, and presupposing that the public is encouraged to take full responsibility for, and play its part in, the future of its cultural and natural environment" (CDPATEP (2008) 21).* As the international intergovernmental organisation it seeks to work with the governments on the implementation of:

The Convention on the Protection of the Architectural Heritage of Europe (Granada, 1985)

The European Convention on the Protection of the Archaeological Heritage (La Valletta, 1992) revised

The European Landscape Convention (Florence, 2000)

The Framework Convention on the Value of Cultural Heritage for Society (Faro, 2005)

Served as a basis for consolidating policies to protect and for making policies more effective, those conventions also provide a legal framework for international co-operation. The international co-operation could have many different forms though.

Relation, and co-operation among different stakeholders

The potential of the co-operation should be viewed through different lenses. The intergovernmental cooperation at the European level promoted by CoE means the co-operation with its member's states (supported by the CoE secretariat). Than national, regional and local levels with the appropriate stakeholders involved (possibility for trasfrontier assistance) is left on a coordination of a single member state. Important to mentioned is the huge potential of the cooperation with the international movement around the conventions (target groups as local and regional authorities, universities, NGOs). Concerning different kind of contribution, priorities and involvement of the parties some limitations has been observed during the past four years (active vs. passive approach, experienced vs. less experienced performances, etc.). Debating the issues in four major forums, which meet at regular intervals the decision making with the CoE is taking at *Committee of Ministers (decision making body,* comprises the 47 foreign affairs ministers of the member states or their permanent representatives "ambassadors" in Strasbourg). *Parliamentary Assembly* (deliberative body, representing the parliaments of member states), *Congress of Local and Regional Authorities* (a consultative body, Advises the Committee of Ministers and the Parliamentary Assembly on all aspects of local and regional policy - is a political assembly whose members represent over 200 000 local and regional authorities throughout Europe" and *The Conference on International NGOs* (comprises some 400 international non-governmental organisations provides a vital link between politicians and the general public, Brings the voice of civil society to the Council of Europe) are the bodies to be in a close relation with while promoting the role of cultural heritage and landscape in society. Just to fulfil the whole picture together with *European Court of Human Rights*, *The Commissioner for Human Rights* there is The Secretary General manages the secretariat and co-ordinates the activities of the organisation (elected for a five-year term by the Parliamentary Assembly).

Monitoring of the progress, one of the biggest challenges

With the reference to the Article 10 of the European Landscape Convention – Monitoring of the implementation „*Existing competent Committees of Experts set up under Article 17 of the Statute of the Council of Europe shall be designated by the Committee of Ministers of the Council of Europe to be responsible for monitoring the implementation of the Convention"* the Steering Committee for Cultural Heritage and Landscape (CDPATEP) has been established in the year of 2008. Merging agenda of landscape to the previous work of this committee on cultural heritage, such unity represented a huge step forward as a strong message to members state to work closer on those two agendas. The main objective of the committee - the monitoring of the Council of Europe conventions combining heritage and landscape, the work of the committee had to go through some limitations. As a difficult exercise to compare experience and break down the barriers between sectors as well as moving from "the observers status" towards real monitoring task using the tools of HEREIN and ELCIS which were under the preparation. Commonly heard reference of the success with the implementation of cultural heritage conventions should be taken more carefully here till the real assessment of the achievements are available.

CoE under a reform and what is the future of the Pan-European platform

With a new leadership of the CoE secretariat in autumn 2009, the whole institution is going through a massive change having a significant influence also on the field of cultural heritage and landscape. Under the pillars of democracy new terms of reference for the new monitoring committee to be set up in 2012 as the *Steering Committee on Cultural Diversity and Intercultural Dialogue (CDCDID)* which will replaced CDPATEP. Changes in agendas and composition of the committee are to be expected. With the reference to the report of the Group of Eminent Persons of the Council of Europe *Living together* (as the main focus of CoE) members states should be aware that the target - integrated conservation - can not be achieved with (more likely expected) passive role - taking results of the working programmes into consideration, together with bureaucratic procedure and slow development of observation. In order to achieve *"the European open debate"* a new attitude is desired: impulses coming from the international forum, more proactive support the secretariats involved, introducing the Conference of the parties (COP) with a high level involvement (as a highest monitoring body), regular stock-taking exercises, rich discussions among the stakeholders. Openness for the new ideas would require potentially also an intersection of cultural heritage and landscape agendas with spatial planning agenda (CEMAT), using the synergy effect, and to distinct between items for the monitoring which could be for information only and for discussion required appropriate feedback. There is a possibility to ask for the observer status at CDCDID at the moment. Since terms of reference of this committee is expected to be approved in autumn 2011 (expire by 31 Dec 2013) the right composition of the delegations to the new monitoring CoE committee as the nomination to the Advisory body (group) on cultural heritage and landscape is still open.

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"FACING THE LANDSCAPE": HOW CULTURAL HERITAGE IS TOOK IN ACCOUNT IN FRENCH NATURAL PARKS

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When the national parks were created in France (law of July 1960), two main objectives were given to them: conservation and knowledge of *natural environments*. Even if the conservation of the cultural heritage passed to the second plan, the project of the French national parks was characterized however by maintaining traditional economic activities, in marginal regions where they are difficult and not very profitable. This conservation was specially the case of the Park of the Cevennes (created in 1970), park of low mountains and plateaus, including inhabited villages, where the present situation and diversity of the environment are closely related to a long agro-sylvo-pastoral history. It the mountain parks (Vanoise-1963, the Pyrenees-1967, Ecrins-1973, Mercantour-1979), pastoralism has also a great importance in the historical and actual landscapes dynamics. However, the weak interest of the services of the majority of the parks for the questions of cultural heritage was as of the beginning a reason for aggravation of tensions with the populations and local actors. In the years 1980, the legitimacy of the parks was strongly disputed, several projects failed and there was no more creation on the metropolitan territory until our days.

During the same period, the legal arsenal of protected areas was reinforced, with the appearance of the Regional natural parks (created by the decree of 1967), of the Conservatory of seashore (1975) and the new natural reserves (1976). The regional parks were developed on the basis of a project clearly including the conservation of their *natural and cultural heritage* shared on a coherent territory. The regional parks function on the basis of the consensus and the spontaneous adhesion of the communes to a charter of project and good practices. There is no specific regulation nor imposed constraints, except those which rise from an application of the charter in the local procedures of urban development, rural, or of environmental management. Social, economic and environmental animation near the actors and of the population remains one of the principal functions of the PNR. Conservation of historical heritage and high quality landscapes is of the hand goals of regional parks since the beginning. The regional parks had great success and today one counts 46 of them on the territory, whereas only a new national park was created in Guadeloupe (1989).

At the time of the 5th congress of the protected areas in Durban (2003), the governance was presented like a major stake; the new law on the national parks which was promulgated in France (April 14th, 2006) can be considered as a translation. She theoretically gives to the local actors the possibility of building a project of territory and a partnership policy, which are exposed in a charter. The new project of governance is translated in the reinforcement of the powers of the Board of directors, of the Scientific committee and by the creation of an Economic and Social committee. It also gives to the communes the possibility of a free adhesion to the charter of the park, the "zone of adhesion"

replacing the old "peripheral zone". In a certain way, this possibility of accepting or of refusing to adhere brings closer the national parks to the regional parks. The evolution of the governance facilitated the creation of two new parks in 2007 (Reunion and Guyana), a third being in negotiation in metropolis (Calanques).

This evolution is translated in the charter by a taking into account much larger of the questions of cultural heritage and resources: management of forest, pastoral and cultural heritages, very as much as the conservation of the natural heritages (waters, fauna, flora). Within this framework, the landscape, synthesis of the various patrimonial elements, in particular of the agro-pastoral heritage, is proposed as a factor of local identity.

The case of the park of the Cevennes is particularly representative of this concern. It is a park whose totality of the landscapes are deeply anthropized, with presence of permanent populations, in villages of a high architectural originality. Some emblematic landscapes, as the field terraces, were the subject of projects of conservation an development, in particular within the framework of the zone of guaranteed origin of the sweet onion of the Cevennes (55 ha of terraces, 150 farmers). The landscape of terraces became here an element of the valorization of the agricultural production. In addition, the Causses-Cevennes region, including the totality of the central zone and part of the zone of adhesion of the park, as well as a Causse out-park area, was registered on the list of the UNESCO world heritage as cultural landscape of Mediterranean agropastoralism. An atlas of the landscapes is in work at the level of the park, following the model of the European landscape convention.

In the pyrenean parks (National park of the Pyrenees, regional park of Ariege, regional park of Catalan Pyrenees), the landscape policies are very different according to each park. In spite of this, during the drafting of a partnership convention between the three parks in 2010, the question of the landscape management was one of the principal points of agreement.

The regional park of Catalan Pyrenees does not have a very developed landscape policy. He did not really complete works or atlases on landscape and bases himself on very simple documents and charters. One cannot say, in spite of appearances and the vocation of the PNR, that this park is really interested by landscape management.

In the regional park of Ariege, on the other hand, the landscape is conceived like a resource for the park as of the beginning of project. Since 2006, the park is an active partner in a project of a photographic observatory of the landscapes. It continues to develop actions in this field (development of architectural and landscape charters, participation in various local studies, animations and conferences, etc.).

The national park of the Pyrenees had not really developed many research about cultural heritage or landscape before the years 2000, which was regularly reproached to him by the local actors and representatives. In 2005, the scientific committee decided to start a study of the Park landscapes, and two of its members began the realization of a map of the landscape units at the level of the whole of the park, which was achieved in 2010. At the same time, was launched a project of a landscape observatory, while in 2011, the project of the first scientific workshops of the park was oriented, according to the wishes of the direction, on "landscapes of yesterday, today and tomorrow". The negotiation of the charter of the park is always in hand, and the direction wishes to be based on landscape researches to change the image of the park of exclusive conservative of nature.

LANDSCAPE – MIRROR OF OUR CULTURE. AN INTERDISCIPLINARY CHALLENGE SAFEGUARDING LANDSCAPE VALUES

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THE SAFEGUARD OF CULTURAL HERITAGE

Landscape as cultural heritage

The example of landscape – with the ascent of the Mont Ventoux by Francesco Petrarca in 1336 (Neumann, 1998) as a first milestone – illustrates that cultural heritage is a concept which is to a large extent determined by human thinking and acting. As Petrarca was the first towards the end of the Middle Ages to perceive and enjoy the beauty of the scene that opened up to him from the top of a mountain (Fig. 1), and – more important – he reflected on that (Ritter, 1962), his ascent was symbolic for a new relationship to nature. This relationship is an aesthetical one rather than the everyday utilitarian attitude that is related to farming or hunting (Ritter, 2008).

Landscapes, even before they were acknowledged as such, have developed under the continuous functional dedication of farmers, monks and landlords. They had no notion of the beauty of the landscape, just worked the landscape as a self-evident environment for their everyday life. This has led to an astonishing diversity of cultural landscapes all over Europe (Pedroli *et al.*, 2007). The awareness of the value of this diversity has grown only relatively recently, culminating in the European Landscape Convention (Déjeant-Pons, 2004; Olwig, 2007). Cultural landscape, as is cultural heritage anyway, is a very recent issue. It is not long ago that heathlands in the Netherlands and northern Germany – exponents of intricate cultural landscape systems of long history – were considered wasteland (Webb, 1998).

Common heritage

Since the functions under which the landscapes have grown to their present expression have drastically changed in many places in the past 100 years, landscapes have often lost considerably in character and identity (Arnesen, 1998; Del Árbol *et al.*, 2005). Unlike land, landscape cannot be owned, but since landscape is a common heritage (Ritter, 2008; Bloemers *et al.*, 2010), it can be considered a mirror of how our modern culture is gradually alienating from nature. This is confirmed by changing social perceptions of landscape: the preferred landscapes are no longer the familiar landscapes of childhood and small scale farming, but wild landscapes further away (Buijs *et al.*, 2006).

Intangible heritage

Landscape heritage implies that something is inherited from the past. The problem is that there does not exist *one* past, landscape is a palimpsest by all means (Palang *et al.*, 2011). Therefore, the challenge in landscape heritage management is the responsibility to take care of the landscape of tomorrow rather than just protecting yesterday's landscape. Unlike material objects like wooden artefacts, books or castles, landscape is a clear example of intangible heritage, though with a physical expression. To assess the biography of landscape (Renes, 2011), not just geological, biological and archaeological knowledge is needed, but also sociology, semiotics and aesthetics (Stobbelaar & Pedroli,

Fig. 1. View to the North from the Mont Ventoux (50 km north-east of Avignon, France).

2011). Only when all these disciplines join efforts and cooperate on the basis of consciously developed images of the landscape, they can identify the landscape values at stake, including the values as perceived by the public.

Landscape paradoxes

Landscapes that represent a rich past as well as the potential of a rich living future can evolve when people are committed to them. Thus, the heritage paradox (Bloemers *et al*., 2011) implies that not only protection of cultural landscapes should be focussed on, but that landscape development is instrumental to preserve landscape heritage. It is through development that the embedded values of landscape can be protected in the first place and a healthy landscape biography can be defined (Roymans *et al*., 2009).

Another paradox exists in the mentioned lack of competence of the authorities responsible for many of the (largely unintentional) landscape effects of public policies in the European Union. The research community is challenged here to present their expertise in a direct answer to policy gaps perceived by the competent policy makers. COST and ESF play an instrumental role here (Bloemers *et al*., 2010), but also Joint 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.

Landscape heritage and civil society

A last paradox to be mentioned is the notion that valuable landscape heritage should be protected against disturbance. But who are disturbing? It are always citizens, or communities of citizens, or organisations of citizens (not to speak about the devastating and sometimes intentional effects of war-time activities). The only way to increase the public support of landscape heritage conservation, is awareness raising and involvement of the public in landscape development for the future. Public participation is easily phrased in policy documents, but practice is problematic (Jones & Stenseke, 2011). Especially the concept of landscape poses problems, because of the large variation of interests, and the varying perceptions of landscape. But principally there is no difference with cultural heritage in this re-

spect. What matters is to find ways to take civil responsibility for the care of our common heritage. Landscape in that perspective is certainly a key to enhance a living cultural heritage.

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FLORENCE AND MEDICAL HUMANITIES: INTANGIBLE HERITAGE OF MANKIND

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THE SAFEGUARD OF CULTURAL HERITAGE

The Faculty's Centre for Medical Humanities was recently constituted, following a decision of the Council of the Faculty of Medicine and Surgery of Florence (June 13.th 2007). The foundation of this organization inside the Faculty of Medicine is very reminiscent of another important moment in the history of medical thought, when the first chairmanship in Italy of Philosophical History of Medicine was founded in Florence in 1805.The aim of this lecturing was to hinder the spirit of the medical systems which had become established at that time and recuperate a critical approach to medical work, which should also have been founded on philosophical culture.

Nowadays, the scene is very different and knowledge has become more complex: with the transformation of *little medicine* into *great medicine*, where the figure of the researcher, of the clinician and of the practical doctor do not coincide any more, as they did in the past, the sharing of knowledge has become indispensable, spontaneously creating a network of collaboration, which corresponds to the inter-multi-disciplinary assessment of the research.

Diverse skills and experiences interact more and more, causing a widening of the standpoint, creating the possibility of a rich and varied point of observation and at the same time permitting a deeper study of the different subjects.

In the frame of the disciplines which are traditionally called Medical Humanities, this method can't be eluded, because Medical Humanities represent a transversal reflection both in the initial approach and in clinical experience, where the historical, ethical, pedagogical, technical and artistic perspectives find continual opportunities of assessment and expansion.

The Florentine situation is perhaps privileged and the Florentine and Tuscan frameworks themselves, thanks to their natural vocation, represent strong points in this perspective.

This is due to the territorial resources and the various skills, which the Florence Medical School has been capable of nurturing, both inside and outside its walls, thanks to its strong cooperation with other Faculties.

Our Faculty therefore represents the natural place, the meeting point, where diverse skills can integrate and show off each other. It can also be entrusted with the role of coordinator to all the scientific-cultural and strategic-managerial competences, which belong to these sectors: this will strengthen and openly confirm this network of knowledge, thus ensuring the empowerment of the single competences.

The individuation of an exclusive organization, with the power to direct the management of initiatives and projects, will prevent the dispersion of skills and resources and, at the same time, will allow higher quality achievements by valuing the various potentials.

The transfer of this outline of operations in the Centre for Medical Humanities represents, from this point of view, a very interesting opportunity for the development of integrated projects, in order to create a space of intervention where different competences have the right to be heard in the frame of a transversal and multidisciplinary approach, which is expected to solve the dualism art/science in a profitable way for everyone - individuals and institutions- who is an active and dynamic part of the new clinical relationship.

As far as the cultural heritage of the medical world in Florence is concerned, starting from the consideration that the concept of cultural traditions is gradually moving from tangible objects to intangible heritage, such as performance strategies and cultural nets, the Centre of Medical Humanities of the Faculty of Medicine and Surgery (Florence) intends to regain the humanistic approach to Medicine, in order to improve an innovative/better clinical relationship, using historical, ethic, pedagogic, technical and artistic tools.

The long history Medicine reflects itself on objects, writings, visual arts, but above all on thought: to inspect the past can be a proper way to build up a different knowledge, based on technical skills and deeply aware of the human nature of Medicine.

Florence provides different structures where the history of medical science and health can be reconstructed: therefore, aim of the Centre is not to be competitive with these institutions, but to enrich them with its particular contribution, which is dramatically strengthened by the clinical approach.

In fact, the Faculty of Medicine and Surgery is not only a natural collector of materials linked with the history of Medicine, but it also a meeting point of different competences (scientific-cultural and managing), which contribute to provide a three hundred and sixty degrees evaluation of men/patient.

In this context, the Florentine and Tuscan settings represent great opportunities to realize it, thanks to its glorious and ancient rooted tradition.

Written heritage libraries, archives and other collection of social documents can be used also

To demonstrate the composite nature of Medicine;

To show the importance of errors (not mistakes) in Medicine;

To follow the *progression* (not progress) of Medicine itself;

To improve the human approach to the Sick.

Cultural Heritage in fact includes intangible heritage (oral cultures, local traditions, performance strategies, musical traditions, mnemonic systems, cultural nets and interactions) and the interactions between these aspects.

To inspect the past can be a proper way to build up a different knowledge, based on technical skills and deeply aware of the human nature of Medicine.

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PUBLIC SPACE AS CULTURAL HERITAGE

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In their quality as lived spaces, places embody the complex stratification of meanings that people attach to them.

Places hold a special *sense* that does not lay in their physicality, but in their ability to communicate, generate and re-generate -also through their specific material setting- relationships, interaction, identification/recognition, in short social meanings.

Therefore, every public space, as a vehicle of inter-subjective signification processes, can in a certain sense be considered part of cultural heritage.

As Clifford Geertz wrote, products of different cultural contexts (independently from their nature) can be seen as a kind of "text". Just because they are text, they do not simply communicate something about the cultural context where they have been created: they are subjected to many different interpretations. The products can directly "speak" to us, they are able to transfer an indefinite quantity and quality of messages, according to the historical and cultural framework.

This perspective is at the very base of the research we set up on Florentine public space. We have tried to understand to which extent public space embodies elements of collective cultural heritage, within global processes that are deeply transforming urban life. Our studies focused especially on squares and markets.

The results show that squares and markets in fact guard, and at the same time feed, specific kinds of meanings and social interaction, that could not be reproduced in other formats. This patrimony, that would not make sense to try to fix in abstractly defined traditional forms, represents a very precious cultural heritage, which greatly contributes to regulating and characterizing our city life.

WETTUS-WETLANDS ATLAS OF TUSCANY

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The core of the project are the wetlands of the coastal and inland Tuscany (historical transformations and environmental, historical-cultural and socio-economic components).

Wetlands, once economically marginal and unhealthy, are now considered a resource in terms of biodiversity and as places that attract responsible tourism.

The deliverables of the project are:

1) a geodatabase that provides an integrated management system of different sources of knowledge (cartographic, photographic, statistical, documentary, archeological, etc.) and allows the identification of structural invariants of the landscape and the development of a support system to evaluate sustainability and durability of the environment impacts and socio-economic development projects.

2) a tool, accessible via Internet, for data exploration and production of reports and dynamic maps. The choice of formats and data infrastructure can ensure the highest interoperability and it has been carried out in a perspective of dialogue and integration between regional information systems.

Fig. 1- Wettus

Ricostruzione dell'uso del suolo nella pianura meridionale pisana nella prima metà dell'Ottocento. Base IGM 1:100.000

THE ROLE OF CULTURAL HERITAGE IN SHAPING SYMBOLIC CORPORATE LINGUISTIC IDENTITY

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The concept of organizational identity is a topic of interest among many specialists, including, among others, sociologists, psychologists as well management experts. Apart from the multidimensionality of conducted researches, the linguistic aspect of this phenomenon has not been studied in depth. The aim of this project is to show a different perspective to the issue of organizational identity. The author, being a linguist and an economist, wants to show the effective role of language in creating and sustaining organizational identity. Taking into account the multitude of factors shaping organizational identity, the author will concentrate on cultural heritage as the crucial identity identifier. Regardless of the approach used to analyze the individual or social personality, corporate identity is related to symbols (common values, things, heroes), language (jargon, slogans, humor), practice (common rituals, ceremonies, activities), stories (common myths and legends) and various forms of physical expression (movement, architecture), common to most workers and stakeholders. All the above-mentioned elements are part of cultural heritage, at both the individual and group level, and share some symbolic features at the same time. Thus, the author wants to show how various individual and social elements created by cultural heritage shape the symbolic character of corporate linguistic identity.

THE HISTORY OF EMOTIONS AND THE SAFEGUARD OF CULTURAL HERITAGE

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My present research is devoted to reconstructing the doctrine and vocabulary of "shame" of some Dominican authors contemporary with Thomas Aquinas, in the middle of the 13th century. There are two main reasons for which I choose these authors, William Peyraud, Humbert of Romans, Hugues of Saint Cher, as witnesses for my research. First, this period between the 12th and the 13th century is a key moment for shaping the concept and vocabulary of shame. Second, the authors taken into consideration here produced many works for the sake of educating the friars, whose daily duties consisted in taking confession and preaching to lay people. Analysing the discourse of these cultural mediators, we will be able to grasp not only the technical formation of new concepts, but also their introduction and transformation into the cultural milieu.

My research deals with the history of emotions, a new field which has been raising a lot of attention lately. Although my dissertation is not dedicated to the question of the preservation of cultural heritage, I believe that the study of past sensibilities could bring an interesting contribution to this field. An interdisciplinary approach, putting together the methodology of historical research with the latest outcomes of psychological and neuropsychiatric research, allows to deal in depth with questions which had seemed to be out of the historians' capability even until some years ago. This specific case will allow to examine the relation between emotions and places. Barbara Rosenwein has recently suggested to analyse pilgrims' tales from this perspective. Similarly I think that sermons could be an interesting research material. Understanding past human emotions toward monuments, churches, and other relevant places to people's life (including the landscape) allows not only to make a historical survey of this question possible, but also to grasp such dynamics that could be used today to enhance our cultural heritage and to urge people to get more interested in it.

THE HISTORIC URBAN LANDSCAPE OF FLORENCE. CRITICAL SURVEY AND REDEVELOPMENT OF THE URBAN LANDSCAPE

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In the last forum UNESCO – University and Heritage, held in Hanoi in April 2009 in the Final Declaration, the historic urban landscapes are defined as an "expression of cultural diversity resulting from a permanent and continuous process of cultural layering that has tangible form to which symbolic and intangible values are attached and understood through sensory perception, local knowledge and investigation of the interconnections between these layers."[1]

The project "The historical centre of Florence in transformation. Critical survey for the requalification of the urban landscape" is carried out in conjunction with the Department of Architecture of the University of Florence and the Region of Tuscany and is partially funded by the Ente Cassa di Risparmio di Firenze. It fulfils a role of specific interest in the UNESCO site of Florence management plan (Plan of action for research and awareness), with the goal of establishing a jurisdiction over the landscape. It will be under constant monitoring on behalf of the UNESCO Office of the City of Florence[2]. Within the various aspects that will be considered, attention will be especially given to the number of noted panoramic or belvedere sites.

The project[3]: Today the Historical Centre of Florence, recognized by UNESCO in 1982, World Estate of the People, is a magnet of attraction at both national and international scale. This leads to the urban and rural landscape to change constantly. The theme of sustainable changes, intended to act as a balance between economic goals, overseeing of resources and quality of the environment is today a central theme when planning at all levels. In order to have a deeper understanding, jurisdiction, conservation and development of the site, we suggest a method of evaluation and a critical analysis of the urban landscape largely experimented during the last years in the scientific and professional fields, based on visual perception analysis, as well as qualitative surveying.

Aims:
• To enhance identity and places
• To identify the qualitative aspects of the urban image
• To propose shared operational solutions

Tools:
• Prospective views that identify the places
• Qualitative survey of the historic urban landscape
• Guidelines for the development of the urban image

[1] Twelfth International Seminar of Forum UNESCO – University and Heritage held in Hanoi, Socialist Republic of VietNam (5 – 10 April 2009) entitled 'Historic Urban Landscapes: A New Concept? A New Category of World Heritage Properties?, Hanoi on Historic Urban Landscapes, 2.17, 2009'
[2] http://unesco.comune.fi.it/progetti.html
[3] http://unesco.comune.fi.it/piano_gestione.html, Subjects involved: District of Florence, University of Florence, Region of Tuscany

Our eye must be accustomed to see (understand and recognize) the structural components of the urban landscape and to identify the elements that may constitute a deterioration, as well as those

that constitute an improvement (points of strength and points of weakness). This allows elements that constitute change and the qualities and not the quality of the places to be emphasized; the vulnerability and potential strength of the actors to be established; the guidelines to be recognized. The end goal is to provide support tool at the deciding, planning and implementing stages. The critical survey has been placed on a geo-referential map and is managed by the GIS system. This thematic maps seeks to identify the belvedere sites, axis for visual enjoyment, walks for visual enjoyment, visual edges, observable tree-lined zones, lines which interrupt the continuity of the landscape, visually attractive and unattractive elements.

In 2008, in collaboration with the Cultural Administration of the Municipality of Florence and the Florence University, we worked to organize and plan the exhibition bel_Vedere_firenze, the graphic design of image used for the exhibition's informative material, the editing and design of the exhibition catalogue. A catalogue card has been created for the Belvedere, called "B".

The model used was taken from the normative version.3 for the cataloguing of MiBac, Istituto Centrale per il Catalogo e la Documentazione, which is available online. Specifically, the PG card (parks and gardens) has been modified to fit the needs of the Belvedere catalogue card During 2009 -2010 we have applied the method of 'Urban Critical Survey' nord-south axis, inside the historic center of Florence, which leads from Porta St. Gallo comes to Porta Romana, and in other particular places of the Historical Centre, like Piazza della Signoria, Piazza Santa Croce, Via delle Brache. Along the north-south road axis we have developed the following thematic maps:

· Urban Landscape Units

· Road signs and state of deterioration,

· Street Furniture and state of deterioration,

· Facades and street paving and state of deterioration,

· UPU_A, Visual cones and axes,

· Synthesis: Urban Critical Survey, Perceptual Visual Analysis in UPA_A "Piazza della Libertà-via San Gallo" e UPU_L "Piazza della Calza_Porta_Romana",

· Actions' qualitative evaluation, aimed to identify action priorities,

· Guidelines and best practice.

The development of these thematic maps has the ultimate goal of focusing on subjects which illustrate both the quality of the landscape for the historic centre and identifying guidelines for the project along the network of present relations, thus creating a tool which will aid in the management of the world heritage historic centres present in Italy and Europe.

PERSISTENCE AND METAMORPHOSIS IN THE SETTLEMENTS IN TUSCANY

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In recent years, regional and urban studies have developed a growing attention to identity of places, that is, the processes that produced and constantly transformed them. The design of future is written, somehow, in the depths of that thickness. The description of the territory should improve the ability to capture the dynamic relationships between environment, landscape and settlement, as an essential element to define the transformations to come.

The research documents the period of construction of present buildings throughout Tuscany region, referring to a series of photo-cartographic historical documents.

The project addresses the need to compose a picture of homogeneous knowledge all over Tuscany with respect to the steps and the characteristics of settlement growth.

Valuable territories, but weak in terms of economic resources, often cannot sustain the financial burden of specific studies on the morphological identity of their built environment. Urban growth and metamorphosis is, moreover, one of the most relevant phenomenon that characterize transformations of the landscape and should be an essential source of information for planning and governement agencies.

The research describes the evolution of the Tuscan built environment from early nineteenth century to present days.

Documentary sources used for the task are: cadaster maps of nineteenth century, 1954 orthophoto (so-called GAI Flight, orthorectified in this occasion) 1978, 1988 and 1996 orthophoto.

Comparison with each document allows to assess the absence or the presence (total or partial) of each present building with respect to these time thresholds.

The interest of the work can be may be referred to several issues: first, the identification of growth – in quantitative and qualitative terms - for both large and small Tuscan towns, and, secondly, the transformation of the relationship between cities and countryside.

The progress of research will attempt to explore the metamorphosis of relationships between the built environment and the evolution of the ways of living and producing.

REMARKS ON LANDSCAPE

Luigi Zangheri
ICOMOS-IFLA

THE
SAFEGUARD
OF CULTURAL
HERITAGE

Following 1962 UNESCO's Recommendations on the protection of landscape's and historical sites' beauty and features, 1972 UNESCO's Convention on the preservation of world-wide cultural and natural heritage, several charters by ICOMOS on preservation and restoration of monuments and sites (Venice Charter – 1964), on historical gardens (Florence Charter – 1982), on the protection of historical cities (Washington Charter – 1987), and after the more recent European Convention on landscape in 2000 and the Vienna Protocol of 2005, a new Recommendation on historical urban landscape has been compiled on the occasion of UNESCO's General Conference – 36th session.

Throughout these documents the approach to the concept of landscape changes: according to the World Heritage Centre, landscape is identified with cultural landscape, or, indiscriminately, with natural, rural, urban and suburban areas as in the 2000 European Convention. Furthermore this topic has promoted many studies, conferences, documents in various sections: urban landscape, agricultural, cultural, etc. It's actually true that studies on landscape in a broader sense are fewer. We must recognize, though, IFLA's effort to propose a document which can be complemented with the European Convention on landscape, valid for all Countries.

It's worth mentioning that in all the available documents relating to the different sectors of landscape (urban, agricultural, cultural, etc.) there's a common survey on subjective notions, definitions and views on conservation and valorization of landscape. To give an example, regarding the system of values and meanings about urban heritage: "The recognition of the evolution of values associated with the conservation of urban heritage will open the way for a definition of the present and future values system. The transition from the notion of«monument» to that of «social structure» and «living heritage» needs to be understood in order to promote a new approach".

The globalization of the economy and the nonstop evolution of its processes determine a speed and intensity of changes, the non enduring use of resources, an uncontrolled development, a quick urbanization of the cities and, at the same time, an impoverishment of the countryside that threatens the identity of the community and the *genius loci*. In response to this trend, it's necessary to support landscape policies, and strengthen the institutional defenses against assault, degradation and destruction of the landscape heritage. Moreover, measures and intervention strategies in the direction of disinterested scientific observation must be launched and tested, along with incessant critical considerations on landscape management and creation based on the experience derived from the debate and socialization. Fortunately, it's generally understood that efforts should be directed to the territorialization of the landscape policies, and not to the traditional practices of landscape management and protection. Emphasis must be put on the projects *about* landscape and not on projects *within* the landscape, aiming at its preservation and enhancement.

TOURISM AND RECREATION VERSUS PROTECTING CULTURAL LANDSCAPES AND HERITAGE IN THE SCOTTISH HIGHLANDS

Alasdair Ross

During the last forty years there have been radical changes to the Scottish economy. The rapid decline of heavy industries during the 1970s and 1980s, aided in part by political processes, has resulted in a rapid rise in service industries, increasing interest and investment in power generation by 'green' technology, and a heavy emphasis upon tourism as a means of generating income. It is this latter area that this paper will discuss in relation to protecting and investigating cultural landscapes.

There are a number of cultural icons that visitors to Scotland (and Scots themselves) are most familiar with, including castles, tartan, and the Highlands. The Highlands in particular have become valued both by visitors and by native Scots as 'wilderness' areas, largely untouched by human influence, where people might escape from the pressures of modern-day life through recreational activities like hill walking and mountaineering. During the last decade, two such large areas of mainland Highland Scotland have even been turned into national parks to promote these express purposes. However, few people who visit such areas and who value such 'Highland wildernesses' are aware of the depth of cultural history attached to such sites. This is partly the fault of tourism, mainly because it is primarily interested in promulgating the Scottish Highland 'wilderness myth', and partly the fault of government which does not currently protect much of the rich cultural history of such areas.

To be fair, most people will be unaware that that many current Scottish cultural icons are largely inventions of the 19th century and the idea of a 'Highland wilderness' also dates to that period. From the 1840s the twin platforms of Clearance and Balmorality combined to create the idea of the Sublime, where upland landscapes became primitive, something to be both feared and admired. During this period entire anthropogenic landscapes were abandoned and centuries of careful management were rapidly discarded in favour of creating a new landscape where the elite alone could hunt wild animals. Naturally, this has affected biodiversity across many upland areas.

Queen Victoria was one of the first authors to articulate this new reality in the Highlands:
The Cairngorms are an area without historical incident [...] owing to their almost complete inaccessibility [...] their great height and bulk, their narrow glens and gorges with stupendous precipices [...] a tumultuous waste of mighty mountains, all of stern and rugged grandeur [...] they are the home and birthplace of storms and mists where the growth of vegetation is completely impossible, they are truly sublime and impressive and primitive [...] the glens were once inhabited before the people had to give way to sheep and deer and tourists are now not especially welcome [...]

These ideas have gained a hold in popular consciousness and are still repeated today. The following extract comes from current national park literature:

The Cairngorms are Britain's premier mountain range. Their scale, their altitude, and their value as wilderness country - for recreation and for nature conservation - are without equal in these islands. Here also is one of the last wilderness areas in Western Europe. Scotland has a few other large tracts of wilderness, but none so natural, varied, or so important for recreation or wildlife. Increasing numbers of people find in wilderness a respite from hectic urban existence, a restoration of their sense of serenity and proportion in life, and experiences of solitude, adventure and beauty that linger lifelong in the mind. It is as much a part of our historical heritage as castles and cathedrals, but considerably more ancient, going back for 8000 years. It is the primeval landscape from which most of our country evolved. It must be sustained.

Few are prepared to admit that what these national parks are protecting are in fact artificially fossilised landscapes that have been actively managed for only one specific purpose (hunting) for the last 150 years. In fact, such landscapes have a much richer and deeper history going back some 1200 years when the entire Highland landscape was first divided into units of land assessment for the specific twin purposes of resource exploitation and taxation.

One of the most important remnants of these older landscapes is their anthrosoils. Historically, over 95% of Highland Scotland has been classed as wholly unsuitable for the cultivation of cereal crops yet the inhabitants of such regions circumvented this problem by creating large areas of anthrosoils. This was undertaken by composting down traditional building materials (wood and turf) on a seven-year cycle, which were then likely mixed with human and animal waste (and perhaps other organic matter) to create deepened soils. Such anthrosoils have not yet all been identified but some can extend to 2km^2 in size (up to 1m in depth) and there may be much larger examples still awaiting recognition.

Our other problem is that these upland anthrosoils have never been scientifically investigated to try and determine their exact composition and, more importantly, they are not currently protected under law. Some are now being irrevocably altered and even destroyed as Highland estates and landowners attempt to diversify the economic portfolio of their properties through the creation of activities like quad biking and mountain biking, both of which require the creation of new tracks and paths across upland landscapes.

It is probable that a sustained programme of combined scientific and historical investigation into these Highland cultural soils would greatly enrich our knowledge about the environmental history and heritage of upland agriculturally-marginal areas in Scotland. However, there seems to be little official enthusiasm for such a project, perhaps because it would necessarily result in the destruction of the now universally popular idea of Highland Scotland as a sub-arctic primeval wilderness, untouched by human hand. The irony is that such an inter-disciplinary investigation would likely enrich the totality of the visitor experience.

Alasdair Ross is the Director of the Research Centre for Environmental History and Policy at the University of Stirling, Scotland. He lectures in medieval and environmental history, specialising in units of land assessment, resource utilisation, and long-term resilience of management systems. He is particularly interested in landscapes altered by past human activity, and in raising awareness about such landscapes to better inform current upland management strategies. Alasdair is a member of CARMEN (co-operative for the advancement of research through a medieval European network), which facilitates networks between scholars of medieval history on a European platform.

THE HISTORY OF EMOTIONS: PRESERVING EUROPE'S CULTURAL HERITAGE THROUGH INTERDISCIPLINARY RESEARCH COLLABORATION

Claire McIlroy
ARC Centre of Excellence for the History of Emotions, University of Western Australia

The History of Emotions

Emotions underpin our everyday lives and shape our mental, physical and social wellbeing. Changes in how we construct these feelings have had profound impacts on our social, religious, political, scientific, literary and artistic life. But what is the historical significance of emotions? This question is being investigated by a number of research-based and cultural heritage organisations across the world and in particular, in relation to pre-modern Europe. In Australia, the Australian Research Council has recently awarded AUD$25m to fund an international, interdisciplinary, multi-organisation Centre of Excellence for the History of Emotions (CHE) based at the University of Western Australia. To date, biological and social sciences have dominated research on emotions but as yet no previous study adequately explains how human emotional behaviours (individual and collective) change over time. By addressing the big question of how societies think, feel and function, this Centre aims to rethink interdisciplinary research collaboration in the humanities and creative arts to account for long-term changes and continuities in emotional regimes in Europe 1100-1800. The Centre will investigate mass emotions and their social, political and economic influences, as well as demonstrate how emotions were performed in music, art and drama, and explore how this European heritage underpins modern Australian emotional culture. For Australians it is particularly crucial to understand the history of emotions in those Western European cultures which provided the immediate past context for early European settlement, and have since formed the basis of many of our cultural norms and presuppositions.

The Centre's research takes place within and between four programs, each of which is led by an outstanding researcher of emotion in their own discipline. Each research program includes multiple chief investigators and international partner investigators from a variety of disciplines, working on collaborative sub-projects, and operating across multiple universities:

"Meanings" is led by internationally renowned scholar of Shakespeare and early modern English literature and drama Professor Robert White. This program studies the changing understandings and categorisation of emotions over the period 1100-1800 in Europe.

"Change" is directed by the leading historian of early modern panic literature, Professor David Lemmings. This program investigates the drivers of changes in societal emotional regimes, and the power of collective emotions to produce major cultural, social, political and economic change.

"Performance" is led by top creative practitioner and performance practice researcher Professor Jane Davidson. This program will interrogate how emotions were performed and expressed in pre-modern dramatic, literary, artistic and musical performances.

"Shaping the Modern" is led by internationally renowned cultural scholar Professor Stephanie Trigg. This program will

explore Europe's legacy of emotional understandings and practices in Australia today, and the many ways in which modern Australians engage with and re-interpret Australia's emotional heritage.

The research also aims to invigorate contemporary Australian performance practice in opera, art curation and drama through collaborative research findings, analyse modern audience reactions to these performances, and link with key cultural industry partners in art, drama, music and broadcasting.

Interdisciplinary Research Collaboration and CARMEN

One of the keys to the success of this cultural heritage initiative is the interdisciplinary and international nature of the research programme. To further international research cooperation, the Centre has formed links with wider research networks such as the European-based Cooperative for the Advancement of Research through a Medieval European Network (CARMEN). CARMEN links research institutions, universities, interest groups and individuals with a common scholarly interest in the history of the Middle Ages and aims to bring groups of researchers together to form international collaborative projects. CARMEN also aims to pro-actively shape the research environment for scholars of the Middle Ages by identifying funding opportunities and new research trends. CARMEN particularly supports projects which develop fundamental research and which addresses global challenges facing our societies today.

In April 2011 CARMEN and Centre of Excellence for the History of Emotions collaborated to apply for a European Science Foundation Exploratory Workshop based on pre-modern performance practice entitled: "Re-inventions of Early-European Performing Arts and the Creative City, Civic Regeneration and Cultural Tourism (REPACC)".

The proposed workshop brings together researchers from the humanities, social sciences and performance practitioners and will explore the questions: how have pre-modern performance arts (drama, music) been re-used across Europe to comment on the modern cultures to which they are appropriated? And how have revivals and reinventions been employed for purposes of urban regeneration or cultural tourism, or developing the creative or post-industrial city? The workshop proposes to explore the ephemeral records of significant modern productions, and investigate case studies of modern revivals, reconstructions, and appropriations, to explore how the emotive impulse to revive the performance arts of the medieval and early-modern periods have been deployed in the recuperation and construction of cultural memory. The aims of the exploratory workshop are:

To identify research paradigms and needs in a new sub-field of humanities research.

To track examples of best practice and case-studies across Europe and to begin mapping a pan-European approach to highly local, fragmented fields of practice.

To bring social science experts together with humanities scholars and practitioners to identify ways of measuring, quantifying and maximising the social impact of re-inventions of historical performing arts in contemporary urban settings.

The aims of the proposed exploratory workshop listed above in many ways encapsulate how interdisciplinary research collaboration is the key element to the preservation of an important aspect of Europe's cultural heritage – the long history of emotions in pre-modern Europe.

Claire McIlroy is a Research Associate (International Liaison) for the Australian Research Council Centre of Excellence for the History of Emotions (CHE) based at the University of Western Australia. She is the Vice-President (Australia) of the Australian and New Zealand Association for Medieval and Early Modern Studies (ANZAMEMS) and a member of the Executive Committee of the European-based Co-operative for the Advancement of Research through a Medieval European Network (CARMEN) - a worldwide network that brings together scholars from universities and cultural heritage organisations actively involved in the research of the Middle Ages. She is also a member of the editorial committee of the ANZAMEMS journal *Parergon* and a series editor for the Brepols Publishers series *Early European Research*. Her personal research interests are primarily Middle English devotional literature and the history of religious solitude, and her professional interests are centred on the promotion of international, interdisciplinary collaborative research in the area of medieval and early modern studies.

MEDIEVAL MONASTERIES AND RELIGIOUS ORDERS AS LABORATORIES OF INNOVATION FOR MODERN TIMES

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THE SAFEGUARD OF CULTURAL HERITAGE

To present the monasteries of the middle ages as centres, even laboratories, of innovation, whose impact can still be felt in modern Europe, may be an unexpected statement which sounds unbelievable to some because it is based on the precondition that the monastic way of life represented a fundamental cultural building block, a medieval heritage of lasting significance. Despite a seemingly endless number of studies in which the history of religious orders was analysed, this aspect has not yet been sufficiently emphasized by historians and consequently there is no general awareness of this shared heritage in the collective self-image of Europe. This issue will be addressed in a long term research project of the Academies of sciences of Leipzig and Heidelberg which I am delighted to be directing jointly with my colleagues Bernd Schneidmüller and Stefan Weinfurter. The project was initiated only recently and we intend to achieve our aims within the coming fifteen years.

In particular between 11th and 13th centuries monks and nuns made a significant contribution to the creation of European concepts of the interplay between individual and community by setting the standard through the structures they created. They taught Europe rational planning, the creation of norms, the division of labour, the assignment of assets and the achievement of economic efficiency as well as dealing responsibly with property and destitution. The monasteries were protagonists in the advances made in the fields of medicine, farming development, architecture, education, written communication and technology. Monks and nuns successfully tested the rational organisation of social systems – for example through the creation of normative texts which were systematically updated – and in this way they opened up the path to state creation, which was another feature of this period. Long before the towns the orders introduced parliamentary structures which controlled the executive. In this context the Dominicans invented the principle of the three readings of a proposed law and they began to differentiate between constant and changeable legal principles – as is done in modern constitutions. All monastic congregations and religious orders were able to extend efficient networks of communication over the whole of Europe which allowed a speedy exchange of political analysis and news relating to economic performance, morale, architectural techniques and the like via central points of exchange. Monks and nuns challenged the limits of rational thought, using the method of scholastic dialectics, at the same time crossing them through individual ecstatic mystical experiences. They taught the people to act righteously, showed them the paths to their inner self and explained nature, life and the beyond in their sermons, delivered by orders which had been specifically developed for preaching.

Medieval monks and nuns could only achieve this by determining the respective contents in a new and decisive manner and by recalibrating their most important device – writing. Writing as the basis of for a higher cultural level had to be rediscovered after the collapse of the ancient world. Monasteries were predestined for this task. A written culture had survived here since late antiquity because their basic norms – the rules – were preserved in written form. For centuries the monasteries were the most competent in the systematic use of the written word, surpassing secular as well as other ecclesiastical institutions. Writing became a medium where information could be stored and retrieved, dissociated from the body of the speaking individual and from the context of the conversation. Information be-

came transpersonal, it could be communicated in different timeframes and spaces. – The monasteries used this instrument innovatively in two areas in particular: in law and in paraenesis, instruction in ethics.

Legal texts were the precondition for the introduction of standardised patterns of behaviour which were to be observed by all, in an identical manner, irrespective of location and context. In addition the collective achievements of religious orders demanded a system of norms which was based on consent and which was independent of the individual. At the same time it had to be binding for all, including those whose duty it was to enforce the rules. The universal application of the norms also had to be based on the objective medium 'writing', which did not permit any arbitrary interpretation or alteration, or which at least made such changes visible. At the same time it allowed modifications by consent or even the abolition of norms. Monasteries were able to adapt their normative practices and they ensured the universal application of their legal norms – thus creating one of the foundations of modern legal culture.

Large numbers of paraenetic texts – treatises of ethic-religious instructions – were produced to familiarise monks and nuns with the basic principles of spiritual and moral progress. Their counterbalanced the legal norms which were intended for the community as a whole. Their claim to authority was based on the fact that the principles of personal conduct recommended by them were indispensable for salvation. Their array of sanctions consists exclusively of the retributions passed by divine judgment and their effectiveness hinges on the conscience of the individual. They are taylored for the individual. The purpose of these texts was twofold: firstly to convince the individual to accept the rules of the monastic community and secondly to generate the spiritual preconditions for an invidualised form of life. Thus the monasteries were the first to address the issue of the inner self. Attempts were made to describe individual forms of behaviour in the context of a predefined and at the same time experienced world, analysing the relevant internal conditions and causalities at the same time – pre-empting an approach much later used by modern psychology. Monasteries were the first communities of the middle ages which were able to create forms of organisation for specific purposes, creating the potential for future activities with predetermined results. When forced to make decisions they were able to make a choice between targeted action or a uniform response. Reaching for heaven also required action in the material world. Religious orders were the first to structure and organise time in the alternation of prayer, work, mealtime and rest. They were the first to create economic empires, with overwhelming success, to achieve the rational goal of autonomy but they were also the first who raised the profile and social acceptance of labour and voluntary poverty. This all applied effortlessly to today's challenges in the rational approach to time and space, to law and to economic processes.

Monasteries were also the first to create a form of common life which – as was mentioned above – attributed responsibility to the individual, enabling him or her to pursue perfection in the development of the soul. Monasteries gave dignity to the individual in the community and this dignity gave a responsibility to each religious before God – a status which enabled the creation of Luther's ideal of „The Freedom of a Christian Man" – no coincidence here that Luther was a monk –and which later enabled the philosophers of the Enlightenment to attribute an inherent dignity and rights to each human being. –

But it will only be possible to offer a plausible characterisation of medieval monasteries as centres of innovation, if we manage to analyse the specific core of the monastic form of life, taking into account the potency of medieval assumptions relating to God and man, individuality and community, belief and reason. Notably this way will be emphasised in my oral presentation.

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THE ROLE OF RESTORATION OF HERITAGE IN THE FUTURE EUROPE: RECOVERING THE CULTURAL LANDSCAPE AS AN IDENTITY SIGN

Camilla Mileto, Fernando Vegas

THE SAFEGUARD OF CULTURAL HERITAGE

The European cultural landscape, a value to discover

The European cultural landscape, understood as environment in its various forms, from natural man-made landscape to the historic centers of its villages and towns, represents the biggest richness that Europe treasures. Much has been done in the last decades in order to restore and put it into value, but much more is still to be done, if we take apart the most well-known and touristic villages and cities. The landscapes of production, linked to agriculture, vernacular production, industry... constitute a written heritage on the map that has been overlapping during centuries in the European geography. But the built landscapes of every historic rural or urban setting gather in their walls all the material culture that has generated them, as a book gathers in its pages all the written history.

The territory as common heritage, understood through its international routes

This cultural landscape seen as a territory acquires an extraordinary value as common heritage through the whole of relationships among the several European countries, through historic connecting routes, from religious pilgrimages like the one leading to Santiago de Compostela, to the Viking migrations, the commercial routes related to ceramics or amber, the exchange routes of the Mediterranean, the river ways like Danube, Tajo, etc., the paths of Charlemagne, Frederic II or Napoleon, the entrance ways of the Tatars or the Muslim in Europe, the musical routes of Wagner, Bach, etc, the literature routes of Thomas Mann, Franz Kafka, Gunther Grass, the roman Limes, etc. They are a whole net of interconnecting routes in the European territory that allows building a united Europe by a common international heritage formed by its history and cultural events.

The landscape of preindustrial production as an identity substrate of Europe

The change in the means and systems of production and the slow disappearing of all the material built culture based upon handcraft production that had been taken increasingly place since the 18th century onwards till the demolishing change of the middle 20th century, aims to the necessity of recovering and putting into value the landscapes and architectures linked to the economical systems of preindustrial vernacular, before its complete and definitive cancellation. The landscapes of agriculture, the former stone caves, the primitive hydraulic infrastructures, but also the tike, gypsum, lime kilns, the wind and water mills, the oil and wine presses, etc. constitute the identifying finger traces of a common past of European countries, that might be put into value before its last memory disappears. The same happens with the landscapes of more recent archaeological industry of the 18th, 19th and beginning of 20th century, that represented the motor of the present European economical development.

Recovering the landscape of rural and urban historical centers

Recovering European historical centers, in their condition as residential tissue and environment for their already known and protected monuments, with their values of scale, scenery and built and material culture, has been done in some cases but is still to be implemented in many other urban and rural settlements. The visitors of one place not only visit the monuments, but above all, promenade, live and get the impression of the atmosphere of historical centers that treasure, justify and give life to them. The built environment of the historical cities must be enhanced so that its culture and richness may appear on the surface.

A new way for recovering European cultural landscape

A new way of restoring historical monuments and residential buildings is proposed that may pay attention to the conservation of their traces and materiality, as transmitters of all the messages of the past, as historical built documents that tell their history, the local production systems of the past and the daily life of the European inhabitants. We propose recovering these places in its intrinsic identity, avoiding to become them fake, avoiding as well the standardization of solutions and results, promoting the identifying character of the place that helps it to become something unique and special.

The sustainability as guideline for the future of restoration in Europe

Recovering a building represents an act of reuse and recycling that is already sustainable, but the approach of restoration and the materials and techniques to be employed may contribute greatly to reinforce this sustainable character that has the restoration. The employment of ecological materials that generate less CO_2 trace, the use of traditional techniques together with modern techniques, the reasoned improvement of the living and isolation standards, the use of healthy materials, etc. allow to approach a sensible restoration to the environment. The employment of manpower, materials and local means also allow to reactivate the local economy and to promote both handcrafts and constructive tradition of the place. Restoration thought not for the next 10 years, but for the next 100 years, taking into account all these other factors related to the environment, the society and the economy, would allow the construction of a sustainable future of a Europe that knows how to value all its landscapes of natural and built heritage.

Conclusion

Europe has a very rich whole of cultural landscapes of natural, manmade, built character linked to its history, culture, inhabitants, intertwined and related through the commercial routes and the migration movements of the past. These landscapes represent its more significant identity signs. Therefore, recovering and putting into value this vast culture heritage in an era where standardization and homogenization prevail through all the means is a priority task in order to preserve and reinforce our European identity.

Fernando Vegas (PhD, 2000) and Camilla Mileto (PhD, 2004), Universidad Politécnica of Valencia (Spain), are architects and full professor at the same university. They are co-editor of the magazine Loggia and have extensively worked and published on architectural restoration. They have got the 1st European Union Prize for Cultural Heritage twice (Europa Nostra 2003 and 2011), the National Research Prize Concepción Arenal 2004 of Spain and one more Europa Nostra Awards for their restoration work in 2008. They have made several studies, projects and interventions for the preservation of the Alhambra of Granada, among other monuments of Spain. They have experience in international research collaboration, with the participation in four EU research programs, among other workshops, meetings and team work.

HERITAGE IS A FINANCIAL ASSET

Ray Bondin
Ambassador & Permanent Delegate of Malta to UNESCO

We live in times when generally the financing available for the protection and conservation of heritage is getting lower and lower. The protection of heritage has to compete with the financing of performing arts with which normally the budgets are tied to.

We also live in a situation when the support for environment protection is on the increase as against the support for heritage. It is indeed incredible that environment and heritage get so different levels of support. Environment is a key word for financing but that is not the case for cultural heritage. What is the community responsible for cultural heritage doing wrong? Why do we not attract more funding?

For all of us tourism has become more and more important. There is no country that does not try its best to increase tourism levels. Tourism depends on heritage completely. No one goes to a city to see the skyscrapers. The tourist wants to see heritage. So if tourism is so important why is there no more funding for heritage protection?

And when everyone wants to spread tourism beyond the major centres that are already inundated with tourism, why is it that heritage protection financing is very strongly biased towards the major cities and sites?

There is a lot that needs to be done to rebalance the way things are done. Certainly we need to convince governments that heritage is not a financial burden but a financial asset. We have to convince them that we should start to look at heritage as a positive element that deserves to be funded. Most governments look at heritage as a financial burden and struggle to find the necessary funding in their budgets. Furthermore many governments are nowadays pushing the responsibility of protecting heritage more an more towards the private sector or towards local and regional institutions.

Whilst there is certainly nothing wrong in spreading the responsibility for heritage protection and in involving all stake-holders, governments can not negate their responsibility.

UNESCO have taken up very much this theme through the 'Culture and Development' programme which is still very much evolving. Can we link culture to development? How can the right balance be found? How does the 'Historic Urban Landscape' approach fit into all this?

Then we have to face another growing concern: most governments think that heritage protection and everything that is related to heritage, including museums, should be self sufficient. Can this be possible? Is it ethically correct? These are the many challenges and questions that we are facing.

Ray Bondin has been active in heritage conservation for over twenty five years. For twenty years he was responsible for seven historic cities in Malta. He was a Member of the ICCROM Council, a member of the ICOMOS International executive, and held other important international and national positions. He is currently the Ambassador and Permanent Delegate of Malta to UNESCO and also teaches in various universities about the management of historic cities and culture and development.

HISTORY AT MUSEUM, MUSEUM FACED WITH HISTORY: A DEBATE UPON EMOTIONS

Paul Mironneau
Conservateur général du Patrimoine, Chief curator of the castle of Pau

THE SAFEGUARD OF CULTURAL HERITAGE

This intervention intends to put forward some remarks about the presence of history and about search of history into cultural and patrimonial heritages, and especially into the museum collections.

A topical debate, an historian debate, a French debate? In search of patrimonial and European expression

The present French debate (2010-2011) about the creation of a new institution devoted to a special display of French history in several forms, which could be open to everyone from visual and pedagogical standpoints, has persuaded many historians to express themselves. Jacques Le Goff, Pierre Nora, Jean-Pierre Rioux, Benjamin Stora, Jean-Pierre Babelon, many historian-archivists and through them university, Institut de France, the National Archives and the flower of French historiography – but very few museum curators – have let know how they perceive this State project and, by this way, how they deal with their own experience as historians, researchers, teachers, and even visitors of museums and patrimonial sites. Controversies (because there is controversy) don't concern this intervention, but these controversies gave rise to an important questioning over which it seems useful to go back.

About patrimonial object as irreducible

Among such questions, those more noticeable, at least as far as press communication was concerned, were connected with archives, archives management and contextualisation. Linked to a pre-established presentation and to the search of an interpretative coherence, would archives preserve their full status of historical source? Some interrogations arose, altogether, upon the possible erosion of their patrimonial status, for lack of material taking into account of archives as objects, particularly as fragile or precious objects, beyond their semantic and illustrative value. Interesting references have been done to previous experiments, for an acute defence as for the Musée de l'Histoire de France in National Archives, created in 1867 and where most remarkable archives were treated as real museum works of art; with criticism, as for the historical museum galleries set up by Louis-Philippe in the castle of Versailles in order to celebrate "all the Glories of France" and inaugurated on 1837, in the presence of Victor Hugo, Eugène Delacroix or Alexandre Dumas. The projects taken under consideration in the future are bringing into play museums, because, on one hand, they intend to organize the participation of some of them in the new institution, and on another hand, museums are intended to supply models, examples and methods. But the creation of an establishment without the name of *museum* makes wonder about the status of museum objects and about the essential links between cultural heritages and museum collections. In spite of an argumentation focused on French context, the questions of European relationship and artistic autonomy of collections remain in the matter of patrimonial heritages. In a quite different connection, Gallo-Roman archeology and even prehistory are supposed to be involved in that approach to French history, giving rise to epistemological interrogations.

In search of the great men

Perspectives can be expanded beyond this current cultural scene, in a more particular field, in order to explore the life and part of the great men into arts and history, referring to a national defined context. An aesthetic approach of the knowledge of these founder personalities confronts us with the problem of emotional subjectivity. The key of the problem lies in intellectual and emotional appropriation of works of art by publics who have good reasons to claim their international features, but jointly feel very desirous and anxious to improve *in situ* their chance of feeling a strong relation with history and inedited experiences, between critical vision and constructive subjectivity. So, famous historical houses coming within the development of individual success – like House of Clemenceau in Paris or at Mouilleron-en-Pareds (Vendée), reconstructed House of Cristoforo Colombo in Genova, or House of Jean-Baptiste Bernadotte (king Charles XIV John of Sweden) in Pau, France – or devoted to a main *figure* who attracts universal curiosity and inquiry, and, through them, a real worship tied to national, family or identity backgrounds (Bonaparte House in Ajaccio). So royal and imperial palaces (those of Sweden monarchy or, in France, those of ancient monarchy marked by imperial transformations). In all these cases, collections gather semantic and patrimonial elements of very unequal value, but endowed with coherence and worth to receive critical appreciation tools and contextualized cultural data.

Two main examples of mixed patrimonial and non material cultural heritages

Two important structural groups of collection will be observed from that point of view. At first, the exceptional family patrimonial riches of the Medici dynasty in Florence were strictly bound to the State machine of the grand duchy of Tuscany during XVIth and XVIIth century. They reflect a creation, production and interpretation system putting in play all diplomatic aspects of Medici politics on Italian and European courts, whose larger ambition was reached *under* Ferdinando I, with Henri of France and Maria de' Medici wedding (1600). This original system lasted up to the end of the dynasty and was symbolically safeguarded by the 'Family Pact' signed on 1737; it is still *legible* nowadays in the organizational structures of Florence patrimony.

The second example concerns national castle-museums and houses of the sovereigns in France, that is, mostly, ancient residences of the monarchs. Castle of Fontainebleau, "the true home of kings, the house of ages" (as wrote Napoléon 1er 1816) was one of the mean palace of the successive dynasties, while Bonaparte house (Ajaccio), donated to the State by Prince Victor Napoléon in 1823, became a national museum in 1967. Castle of Malmaison, sold by Prince Eugène in 1828, was donated to the State in 1904 and inaugurated as museum in 1906. As regards the castle of Pau, it comes from king of Navarre patrimony, included in French crown possessions in 1607 and 1620. All these facts emphasize the essential European links of museum collections.

The debate on both European and emotional approach of the museums highlights uniqueness and coherence of each important historic collection, making history and deep impression by his own means, that is by his specific and somehow direct sense and signification for human *sensitivity*.

Paul Mironneau.Conservateur général du Patrimoine, Chief curator of the Castle of Pau, Chairman of Commission des acquisitions des musées-châteaux nationaux (ministère de la Culture), Member of Commission des acquisitions du musée du château de Versailles. Co-direction of commemoration project of the death of Henri IVth (Polo museale Fiorentino, Réunion des musées nationaux, Cappelle Medicee, Musée national du château de Pau) in 2010: exhibition (« *Paris vaut bien une messe !* » *1610 : hommage des Médicis à Henri IV roi de France et de Navarre* / « *Parigi val bene una messa ! 1610 L'omaggio dei Medici a Enrico IV re di Francia e di Navarra*), Pau, musée national du château, Florence, Capelle Medicee Museum, co-direction of the relative publication (Livorno, Sillabe / Paris, Réunion des musées nationaux, 2010, 280 p., italian version and french version), 29.IX. 2010, Florence (Polo museale fiorentino, Casa Martelli) : co-direction of seminar *I grandi apparati Medicei / Les grands* apparati *médicéens /*

LIGHT AND PUBLIC!

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LAM – Laboratorio di Archeologia Medievale (DSSG)

THE SAFEGUARD OF CULTURAL HERITAGE

What can Medieval archaeologists do for today societies? Florence University team of Medieval Archaeology developed a strategy for funding base research projects at international level with the aim of showing how academic achievements could provide actual benefits to a wide public, including governing institutions, non state actors and heritage tourists. The posters present a selection of three international projects from 2006 to 2011 to illustrate how this was done.

Medieval archaeology is quite a recent academic field in Italy (from 1970s) and is characterized by high interdisciplinarity within Human and Natural sciences. Medieval landscapes and urbanization are the blueprint of today's Euro-Mediterranean countryside and cities. Medieval architectures are a key feature of modern historic centers and in a very great number of cases medieval buildings are still in use as public or private structures across Europe and the Mediterranean. These facts provided the ground for designing projects that could serve the purposes of academic research as well as to help addressing issues of heritage governance and of promotion of social cultural growth and awareness for local and tourist populations.

A crucial point for the viability of such projects was the actual engagement of non academic potential beneficiaries into a joint cooperation with University of Florence on an equal basis. Community activation, based on the methodology of EU Leader Plus programme for rural development (then embedded within Public Archaeology), helped bridging the obstacles of potential distrust between academic and non academic actors through the development of a common language and through clearly defined roles within project consortia. The aim of maximizing benefits for all partners was interpreted in the sense that projects should respond to clearly identified needs of each partner/stakeholder, that has to actively take part to project planning and activities, thus helping an actual engagement of all project actors. All activities are subject to monitoring and impact evaluation. Projects developed by the Chair of Medieval Archaeology within this frame provided additional funding for base research (also in the form of research grants); sustained and implemented a scientific network of international public research institutions and their activities (including joint scientific missions and publications); created territorial, national and international networks of academic and non-academic actors able to join forces in project consortia and, recently, developed spin-off actions in the field of heritage services/enterprises.

In the case of the "Atlas of Medieval Buildings" (2006-2008), the outcome of archaeological research on medieval still standing structures of Mount Amiata in southern Tuscany, based on procedures of Light Archaeology (using

non-invasive methods, limited excavation and focused on reconstructing territorial histories) produced in turn usable tools of heritage governance for 10 local municipalities (EU Leader Plus "Colleganze") as well as a local museum (funded by Municipality of Arcidosso, University of Florence and Regione Toscana) for disseminating the results of academic research towards heritage tourists and resident population. The scientific study was carried out by the Chair of Medieval Archaeology and was aimed at recording and interpreting lordly settlement strategies of earls Aldobrandeschi (and Conti Guidi in the central and northern Tuscany) between 10th and 14th centuries as part of a wider research programme on medieval rural aristocracies in Tuscany that includes areas in the provinces of Florence and Arezzo, once lordship of earls Guidi. A management plan for the Arcidosso Museum, aiming at sustaining base research in the long term, is under development at present.

The international exhibition "From Petra to Shawbak. Archaeology of a frontier" (Florence, Pitti Palace, 2009) is a second case study. The exhibition was organized in cooperation with Jordanian and Italian institutions and was funded by public and private sponsors. The event had the aim of communicating to a large and segmented tourist audience the outcome of the results of University of Florence's international archaeological mission *'Medieval' Petra – Shawbak Project*, which has been running since 1980s in Jordan, for studying medieval settlement in Crusader-Ayyubid-early Mamluk south Transjordan (cc. 12-14). University of Florence works radically revised the role of Crusader presence in Jordan, highlighting its regional political centrality and a permanence of its basic settlement features well into later periods (with echo until today). Moreover the area of Petra and Shawbak was deeply reinterpreted on a Euro-Mediterranean scale, emerging in the Middle Ages as a crucial frontier territory, with a specific cultural identity distinct from Egypt and Syria. The 2009 Florence exhibition was the first in Italy to be developed through the methods of Public Archaeology. Monitoring tools showed a high degree of visitors' satisfaction (around 200.000 people) as well as a measured impact on Florence local economy of 300% of the original investment, in 3 months. Moreover 2010 tourism figures for the site of Shawbak (the main focus of Florence exhibition), in Jordan, showed an increase of 24% tourist presences as well as the starting of private investment in the tourist sector (2 small hotels were opened).

Data as such are crucial for demonstrating the social relevance of archaeology and are a key point for developing research in this field.

The latest case study is "Liaisons for Growth" (EU ENPI CIUDAD 2010-2012), the only Public Archaeology project funded by the European Commission under the Neighborhood and Partnership Initiative. It fosters the creation of rural heritage tourist districts in Italy (Regione Toscana - Maremma), Jordan (Shawbak Municipality) and Armenia (Armavir Region). The Chair of Medieval Archaeology is general project scientific coordinator (Regione Toscana is the applicant). Liaisons for growth aims at establishing sustainability for base research in the long term, funded by shares of local tourist economy. Heritage governance will be implemented through the design of tourist master plans managed by local development agencies in which project partners and stakeholders will be represented. Funding from private sources and the market will progressively substitute public start-up funding provided by the European Commission.

One of the objective of the above presentation is to highlight that research in Humanities (in Medieval Archaeology in this case) could be fully able to create benefits for its own base research and for associated project partners (including actors from natural sciences and Ict), in the medium/long term, on an international scale. Product and process innovation, in the above cases, was never centered on 'new technologies', although the Chair of Medieval Archaeology provided funding for new-tech development through its projects. We propose that in FP8 case studies as this may be taken into consideration in order to let Human Sciences perform their positive impact on ERA and Euro Mediterranean societies. Impact assessments and evaluations clearly show that the usual ancillary role of humanities in past FPs is not fully understandable. Culture and Heritage economies, in the EU, provide a substantial contribution to national GDPs and recent studies (*Sponsorvalue* 2010) show that Heritage market could be fairly expanded with specific investments. FP8 should support sustainability in base research in Humanities, since human sciences hold key expertise to activate the potential of Heritage and Culture for the benefit of both EU researchers and EU citizens.

PRESERVATION AND VALORISATION STRATEGIES THROUGH DIGITAL HUMANITIES: THE CASE OF THE CVCE'S ENHANCEMENT OF RESEARCH AND EDUCATION IN EUROPEAN INTEGRATION STUDIES

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The Centre Virtuel de la Connaissance sur l'Europe (CVCE) is an interdisciplinary centre of research and documentation on the European integration process, with a mission to create, disseminate and share knowledge in an innovative digital environment. The main objective of the centre is to valorise the outcomes of its key areas of activity, namely:

Interdisciplinary research on the European integration process in the 20th and 21st centuries;

Research, development and integration of tools and methods using state-of-the-art information and communication technologies to support advancement in European Integration Studies.

More particularly, its main area of activity is European Integration Studies (EIS), namely, research into the European integration process from the pioneering projects of the 20th century to the most recent developments, from a historical, political, legal and socio-economic viewpoint.

The CVCE's core research projects focus on European organizations; States and the European integration process; key figures and ideas, values and identities are the subjects. The Centre's work in connection with these research projects is primarily based on searching for primary and secondary sources – published and unpublished material – which are then selected and analysed to compile multimedia and multilingual digital research corpora for research purposes and as a base for scholarly publications and thematic dossiers with a more didactic orientation, compiling key project documents and pedagogical materials encouraging classroom debates. Original material produced by the CVCE, including relevant interviews, scientific articles, tables, bibliographies, audiovisual documents and maps, is used to complement the presented digital research corpora. A significant part of this work (more than 16.000 documents) is published and freely accessible online in the 'Collections' section of the CVCE's website (www.cvce.eu). The CVCE's website is a showcase for the centre's research and innovation work, providing access to research files; oral memory archives; previously unpublished documents; contemporary film footage; analytical material and scholarly articles on the European integration process with its challenges, vagaries and successes, etc. The publication of these resources in a digital knowledge environment helps make the results of the centre's research available to a remarkably wide audience: In 2010, 2.8 million users visited the website and over a million documents were consulted each month.

In this sense, one of the CVCE key strategies for the preservation of sources in European Integration Studies (EIS) and the promotion of multi and cross-disciplianry research in this field lies in the implementation of digital methods based on ICT tools in order to support advancement in the aforementioned research clusters and thematic axes, by means of the promising premises and developments of the interrelated field of Digital Humanities (DH).

The Digital Humanities (DH) field is transdisciplinary by nature and is situated at the crossroads of EIS and ICT within

the centre's areas of expertise. The main activities illustrating the conceptual development of the centre's digital environment relate to the following aspects:

Demonstrating a deep understanding of Information and Communication Technologies (ICT) and experiencing their usage in the context of research in European Inttegration Studies (EIS).

Leveraging on this expertise to define relevant methodologies and best practices.

Playing a proactive role in designing new software components and tools.

As this is an emerging field, a special emphasis is put on monitoring and participating in international research and innovation projects within this domain, as well as in its very essential transfer and valorisation undertakings. Such actions include:

Organising and taking part in scholarly events in this field, participating in collaborative international projects in connection with the centre's areas of expertise, namely, EIS and ICT.

Participating in academic workshops and seminars.

The development, monitoring and follow-up of cooperation networks: This facet will be reinforced by means of the building and dynamisation of the CVCE's new online research and teaching collaborative platforms also completing their coverage by leaving a thoughtful margin for unexpected audiences. In this sense, one of the forefront topics will focus on how to contribute to the consensually defined principles which will serve to progressively identify the discipline by reflecting upon successfully proven good practices. Hence, there is a full theoretical and empirical niche to be explored, which will also demand to keep an open mind regarding the centre's positioning in this field of Digital Humanities (DH), given its constant technological and thematic updates and the creativity deployed via growingly crowdsourced and multipolar contributions.

One of the main challenges to be faced, from this perspective, focuses on providing the guarantee of an intuitive user-oriented articulation of the modes of presentation of such research and didactic collaborative networks on European Integration Studies (EIS) with a view to consolidate an interdisciplinary dynamisation as well as in the ways of assuring the effective involvement of targeted audiences, properly gauging their interest and propelling their initiatives towards the enrichment of European Integration Studies (EIS) activities and projects – either from a specialised or non specialized standpoint. In addition, another significant challenge is the one constituted by the balanced and responsible moderation of competing narratives in online debates regarding the European Integration Studies (EIS) field and, more particularly, a fair representation of interpretations, opinions and research lines concerning contextual features, specific objects/documents epitomizing such context and conclusions inferred from a research, didactic or general public approach to the CVCE's main products (digital research corpora, thematic dossiers, etc.).

It should be equally noted that the implementation of online research and teaching collaborative platforms by the CVCE touches upon two fundamental concepts examined by Robert Putnam in view of the development of social capital through online media: bonding and bridging (Putnam, 2000). According to Putnam, the notion of "bonding" is in-group-oriented and presupposes the deepening of relations, exchanges and proposals between acknowledged members of interconnected communities united by the same interests or thematic specializations. On the other hand, the concept of "bridging" implies a multiplying factor constituted by transdiciplinary cross-connections where specialists and non-specialists coming from different domains of expertise, approaches and methodologies come together to meet each other and look for fruitful points of convergence. In this sense, it is important to take into consideration the high potential derived from bridging capital: the more you build, the more you are likely to expand and diversify the quality of multipolar contributions, since it allows the possibility of tapping into lots of different networks for eventual crowdsourced solutions. As a matter of fact, the e CVCE's online research and teaching colla-

borative platforms will apply these two principles, thus helping both to intensify and continuously expand dynamic sources of collective contributions for the benefit of its main products.

Last but not least, it should be taken into account that one capital characteristic of the social sciences and the humanities in general is its explorative character while embracing controversy and learning about different viewpoints consensually integrating them in an ensemble of cumulative knowledge offered to society for its successive questioning and analysis. In similar vein, a Digital Humanities (DH) approach also encompasses these aspects while multiplying potential receptors and diffusion options for cumulative knowledge. In fact, one important objective of the CVCE from this point of view would be to offer both thematically structured and scientifically based visualisation tools as well as interpretative mechanisms for a fusion of integrities constituted by an interactive aggregate of sometimes opposing views and conclusions by the participants in our online collaborative platforms (research and teaching platforms).

In sum, the Centre Virtuel de la Connaissance sur l'Europe (CVCE) aims at linking preservation and valorisation parameters hopefully leaning towards the enhancement of a decidedly European cultural heritage – namely, the sources and the critical anaylisis on the history of the process of European integration –through the practical strategies of research and education promotion by means of a closer examination of the new research field of Digital Humanities.

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Cristina Blanco Sío-López is a Researcher in European Integration Studies and Project Manager at the Centre Virtuel de la Connaissance sur l'Europe in Luxembourg, where she currently directs the research project 'Spain and the European integration process'. She obtained her PhD and MRes. in History and Civilization – specialising in History of European Integration – at the European University Institute and holds an MA in European History and Politics from the University of Edinburgh and a BA in History from the University of Salamanca. She has also conducted studies at the University of Heidelberg, the FUB, the GWU, the BKVGE and the San Andrés University of La Paz, and has completed the Space Exploration Studies and Astronaut Training programme at NASA's US Space and Rocket Center. She was awarded with the European Research and Mobility Prize 2007 of the European Academy of Yuste Foundation. Cristina has worked at the DG Enlargement of the European Commission and at the US Congress and taught European Studies for Georgetown University. She has also worked at the Robert Schuman Centre for Advanced Studies and for the EP project '50 Years of the European Parliament'.

PRESERVING THE PAST, IMAGING THE FUTURE: HOW DEMOCRATISING ACCESS AND GENERATING MEASURABLE CHANGES TO PEOPLE'S LIVES IS AFFECTING PRESERVATION STRATEGIES FOR CULTURAL HERITAGE

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Imagine walking into one of Europe's great cathedrals. As you take in the architectural, cultural and religious ambience, your mobile device automatically engages with content on your behalf.

So, just when you ask for it, the local tour is available in your own language. But there is much more: images and information on the stained glass too high to view, videos of famous ceremonies, 3D walk-throughs showing how the cathedral may have looked in previous centuries, full text of historic and literary references, a list of people buried, baptized or married, choral works performed, oral histories of local residents, news reports through the centuries: this list of opportunities could and will grow even longer.

This is the inherent promise of digitised resources and yet we have not achieved this goal with many of our digital collections. Technology exists to drive forward a vision of intelligent environments that supply the right information to the right person at the right time. Paradoxically, what is missing is the depth of digitised content to make such technical developments more significant than mere mobile playthings. The treasure house of content has to be digitised much more comprehensively.

Much has been achieved, but there are opportunities for much more impact, benefit and a greater return if we continue to invest in the knowledge economy by digitising our wealth of information resources.

Learning

Educational benefits are gained from a wide variety of activities introducing people to culture in digitised information and experiences. This might mean using digital content to teach history at university or biology in a school classroom; an introduction to new activities such as creative writing or renovating a steam train; or visiting museum collections. Education benefits should strive to include all members of society, not just university students or schoolchildren: there is a hunger for learning and for resource discovery at all levels.

Research

Research benefits accrue when we invest in deepening our understanding of the world and build upon the intellectual legacy of previous generations. Cultural content and digital resources continue to transform the research process. The researcher can now ask questions that were previously not feasible; they can engage in a new process of discovery and focus their intellect on analysis rather than data collation.

Consumption

The most obvious benefit of digitised cultural resources is the value people get from using them. The term consum-

ption is intended to include both the "entertainment" value of engaging with digitised content and the personal value added from participating in a community of use. Increased consumption will also benefit economic sustainability. Strengthening communities and regeneration

Digitised resources make it possible for communities to grow more cohesive as common interests and a common vision can be shared. Some community regeneration projects also include important skills development in the digital domain. Other programmes aim to use cultural resources to integrate people at risk of exclusion from society such as the elderly, sick, disabled or economically/socially disadvantaged.

Building collaboration

Working together in collaboration maximises impact – whether for research, education or societal benefits. In particular, the Digital Humanities fosters collaboration and best practice between universities nationally and internationally. They enable mutually beneficial links between universities, memory institutions, publishing and media to develop digital content and provide a context for use by a wider community.

Collaboration also has a shown a strong impact upon building recognition internationally, leading to new economic and innovation opportunities. Giving access to a high volume of digitised content will confer a high profile to the quality of the institution's work.

Research directions

Impact

We remain in a situation where the creative, cultural and academic sectors are not able to adequately demonstrate from a strong enough evidence base that they are changing lives or having a positive impact with regard to digitised content in the way that other sectors have found it possible to do for their services or products.

In short, we need better evidence of impact. How has the cultural digital resource delivered a positive change in a defined group of people's lives? The kinds of changes to be measured are diverse, and are likely to be in the following areas: economic, social, educational, cultural, health, political, and environmental, amongst others. I see this as an important subject for further research especially if such research included a longitudinal element to extend studies beyond the confines of project funding. My research is attempting to address some of these issues: http://www.kdcs.kcl.ac.uk/innovation/impact.html

Preservation

The research challenges can be broadly defined across 5 general groupings:

archival repositories - technical architectures, models, format repositories;

archival collections attributes – metadata, interoperability, context-aware digital entities, function and behaviour documentation, automated metadata creation;

archiving tools and technologies – salvage and rescue, media, formats, storage, accelerated aging, anomaly detection, multilingual entities, and automation;

strategy, policy, economic, and risk management issues – intellectual capital, authenticity and information quality, scalability, repurposing,

metrics, evaluation, performance, and effectiveness – modelling preservation processes, collection completeness, acceptable loss, quantifiable risk, cost benefit analysis tools,

More research attention should also be focused on metrics and quantifiable factors that deliver cost models against

benefits, risks and values of digital objects. Surveys continue to provide a somewhat bleak picture of cultural institutional readiness and responsiveness regarding digital preservation strategies.

Metadata is clearly of vital importance to the Semantic Web and must be more widely deployed and very much more scalable than it is now. At the very least, a clear definition of its value must be promulgated across the community and creator, mediator and user need to understand their roles and respect the benefits concomitant in metadata creation.

Metadata will certainly be captured closer to the point of resource creation. Further research to discover means and modes to bring the 'designated community' and the service providers closer together are essential.

At the discovery level, metadata must be developed that allows descriptions of content and context that will be understood and processable by machine to machine interactions. Deep semantics and domain ontologies plus taxonomies need to be fully populated and linked. This will enable tools for greater levels of automated metadata creation, capture and update to be widely utilised. The goal of enabling more metadata to be inferred automatically from the resource characteristics will ensure that where human intervention is required it will deliver greater value.

Simon Tanner is a senior academic, consultant and innovator at the Department of Digital Humanities, King's College London. As Director of Digital Consultancy he has an excellent international record of delivering digitisation programmes and strategic change management to major cultural institutions. He has collaborated with colleagues across Europe, Africa, Oceania and the America's to understand and deliver innovation in preserving digital culture. His strength of academic vision, matched with his professional experience, has assisted many memory organizations to transform their digital collections and online presence. Simon is also co-director of the Masters in Digital Asset Management and he founded the Digital Futures Academy. Simon's main areas of research revolve around the economics of the digital domain and how we sustain cultural content. He has pursued significant research towards understanding the impact, value and benefits of digital culture. Simon wrote the book, Digital Futures: strategies for the information age and edited the book, Digital Preservation with his colleague Professor Marilyn Deegan.

THEMATIC REPOSITORIES OF CULTURAL HERITAGE CASE STUDIES TO INFORM FUTURE RESEARCH AND DEVELOPMENT

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THE SAFEGUARD OF CULTURAL HERITAGE

The arts and the humanities, as academic disciplines, often have divergent methods and goals. As categories of cultural heritage, the associated primary artifacts also diverge often in the requirements they pose to the mission of preservation and transmission[1] to future generations. Here I will illustrate these divergences and their implications for the cultural heritage mission, and specifically that of needed interdisciplinary research, through two projects developed at the Institute for Advanced Technology in the Humanities (IATH) at the University of Virginia, namely, *Leonardo da Vinci and His Treatise on Painting*[2] and *The Chaco Research Archive*[3].

Project 1: *Leonardo da Vinci and His Treatise on Painting*

Francesco Melzi, one of Leonardo's pupils, compiled materials from Leonardo's manuscripts and an abridged version of that compilation appeared as the *Treatise on Painting*. That original manuscript and then numerous variants of it became primary sources in disseminating Leonardo's art theory in Renaissance and Baroque Europe. The set of the manuscript and printed versions[4] constitute a significant collection for art historians to study Leonardo's impact on Renaissance and Baroque art in Europe. Thus, it is a significant humanities collection. The extant artifacts, however, are not housed in a single repository presenting the following requirements:

Unified catalog/index

Digital surrogates for research access

Analytic apparatus to enable and assimilate detailed research

Dissemination methods that allow integration of the various categories of information: artifact metadata, artifact appearance, results of analysis and secondary sources is support of the scholarly conclusions.

These requirements are familiar, yet the *Treatise on Painting* collection makes explicit several subtleties. The "catalog" is, for each individual volume, redundant to the holding-repository's catalog and must not be considered to be the authoritative bibliographic record for the item, yet is a specialization of that authoritative record for the purposes of the item in this particular collection.

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[1] By "transmission" I mean to include processes beyond the base preservation of an artifact that provide access to metadata about the artifact, documentation about its physical location, digital surrogates for the artifact and the cultural context for the artifact.

[2] This project is lead by Professor Francesca Fiorani of the University of Virginia. It is supported by both the University of Virginia and the Samuel H. Kress Foundation. See http://www.treatiseonpainting.org/

[3] This project is lead by Professor Stephen Plog of the University of Virginia. It is supported by the University of Virginia, The Andrew W. Mellon Foundation and the National Park Service. See http://www.chacoarchive.org/cra/

[4] The project is directly studying over 50 volumes that run from the initial manuscript to printed volumes: Italian and French versions printed in 1651 and a 1721 English version.

The "surrogates" may have access limits such that the quality of reproduction necessary for scholarly analysis is beyond that permissible for presentation (even in parts) to the public. In addition, the "surrogates" may be redundant to those provided to the public by the holding repository.

The analytic apparatus is specific to the constellation of scholarly questions being investigated in this particular project[5]. What aspects of the detailed results of the analysis are of interest to a broader community and should be "exposed" for use in other humanities projects?[6]

The items in the *Treatise on Painting* collection are, in several cases, art objects independent of our interest in the set. In what ways can aspects of the art history scholarship be "exposed" to presentations of a volume as an art object, in order to enhance the understanding of the cultural context of the artifact as art.

Of course, the primary scholarship on the *Treatise on Painting* collection is concerned with the relationships between the volumes. However, the justification for many of the conclusions will come from secondary sources. Here access to the authoritative bibliographic records and in many cases portions of the content of those secondary sources is needed in the dissemination process. What are the forms of that access and how does our project assure access into the future?

Project 2: *The Chaco Research Archive*

Chaco Canyon is an area in the American southwest and was the object of study for several very early (1880's and early 1900's) archaeological expeditions (and several since). The materials: artifacts, field notes and reports, from those early expeditions came to reside in numerous repositories with varying levels of cataloging. This project is undertaking to make those materials accessible in order to enable synthetic research not previously practical. In this regard, a substantial amount of the data presently made available has been extracted from the original documents. In addition, most of the original repositories organized their cataloging by the individual leading the expedition. This is an issue only when the person lead several expeditions to several places and the resulting materials become mixed together.

This collection of information is clearly significant for archaeological scholarship. It seems that if could be significant for anthropologists and historians of archaeology. In addition, many of the physical artifacts are art object in and of themselves. Thus, the data collection has several of the aspects discussed above and make explicit the following requirements.

Geo-referencing the data

Data normalization

Provisioning non-commensurate data

Enabling the presentation of multiple interpretations

Clearly geography is important to archaeology, so geo-referencing the data is desirable. However, the process of associating a UTM coordinate pair is rarely sufficient. Often, the geo-reference is really a local measurement, that is, an offset within a "context" that itself is not globally located[7].

As in most disciplines, what are considered to be "modern archaeology" techniques evolve over time, often requi-

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[5] For example, the Treatise on Painting is, as we would expect in modern books, broken into "chapters", however, the information to be recorded for each chapter is specific to the art history concerns of this project, e.g., does this chapter relate to a chapter in other volumes?

[6] Are the chapter-level "indexes" being created in the project of interest to the holding repository or to philological projects?

[7] The context is often one of a grid of meter-by-meter squares within which the excavation occurs. The lack of a global location reference might be because of lost documentation or because of faulty measurement of the location.

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ring normalization of the resulting data[8]. In the extreme, the data may be partially non-commensurate[9] or completely contradictory[10]. Structuring databases and information architectures to allow for recording, analyzing and presenting such data is still a research topic.

Conclusion

I have discussed features of two particular projects but I believe they exemplify important issue related to the mission of cultural heritage in the arts and humanities. They share the following general structure:

Multiple base repositories

Multiple repositories for secondary sources

Specialized research collections

Scholarly analysis yielding new "objects" (many derived objects, some completely new) and new interpretations

Many layers of interconnections between each of the above levels

The creation, maintenance and dissemination of the cultural heritage record of the arts and humanities from such information architectures is our challenge.

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[8] This normalization varies from simple, e.g., all linear measurements to meters, to complex, e.g., merging naming schemes architectural units/subunits for revisited sites.

[9] For example, ceramic classification schemes often agree on most of their class, however, occasionally introduce completely new classes or reinterpret the attributes of a given class.

[10] While two classification schemes might be contradictory, in cases such as the expeditions studied by the *Chaco Research Archive*, an individual scholar might record contradictory measurements on the same situation. For example, the count of "full pots" found in a specific room might be listed as one value in the field notes and another in a expedition report. While one might tend to think the value in the report was an erroneous transcription of the field notes, it may actually have been a correction to the field note value.

ORGANIZING DIGITAL RESOURCES FOR CULTURAL HERITAGE RESEARCH

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There are numerous Web sites and services relevant to cultural heritage research in Europe, especially those which present information about objects and texts together with digital versions of them. Some are produced by curatorial institutions – museums, libraries, archives, galleries – while others are produced by academic research groups and researchers. There are also various commercial products which present relevant sources. These digital resources continue to proliferate at an ever-increasing rate. This has resulted in several major problems for researchers:

• There is a general lack of integration and connection between the many different resources. It is difficult to know what services are available and relevant to a research area or project.

• The use of terminology and standards is inconsistent and unsatisfactory, especially across different languages and cultures. Vocabularies are rarely harmonized or mapped – and when they are, the result tends to be a reduction to a lowest common denominator.

• There is little connection between the resources produced by curatorial institutions and the resources produced by research groups. It is usually impossible, for example, to match descriptions of museum objects or manuscripts with reports of research which relates to them or draws on them.

• Many of the resources are specific to a particular discipline or to a particular type of material. It is extremely difficult to transcend these limitations and take a broader, interdisciplinary view, e.g. of everything relevant to a particular cultural milieu in a particular period.

There have been various attempts to address and mitigate this "data deluge". They include harvesting metadata to a central store on an international scale and creating large-scale collections of digital resources. Recent important European initiatives of this kind include *Europeana*, CLARIN, and TextGrid. Establishing personal discipline-based "virtual research environments" is another approach. Some existing digital libraries and curatorial databases have also been extended to accommodate scholarly annotations and other data-oriented features.

These approaches have undoubted value, but none of them is equivalent to the large-scale, integrated but decentralized "e-research" frameworks which exist in interdisciplinary scientific research fields like climate science, marine science, and earth science.

For cultural heritage, a major requirement is to harness the many existing digital resources into a more coherent framework which can support international and interdisciplinary research, as well as making them more easily accessible to policy-makers and the general community. In specific terms, this will require the following questions to be addressed:

• How to improve interoperability and interconnection between heterogeneous Web sites and services;

• How to identify and apply consistent vocabularies and data standards relating to cultural heritage in a multilingual and multicultural environment;

• How to design and test Web-based frameworks for linking more closely the materials produced by cultural institutions and the continually developing apparatus of scholarship and research derived from those materials;

• How to enable specific analytical software tools to be applied in a more generic context;

• How to incorporate existing digital resources into a broader interdisciplinary environment without superseding or abandoning them or losing their specific research value.

It is not feasible to merge content from multiple disciplines into a single enormous database or digital library, given the extensive variations in standards and approaches. If a serious effort is to be made to overcome the complexities of the current digital landscape, the only feasible solution is to deploy a Linked Open Data environment on an international scale. Linked Open Data focuses on the identification, management and distribution of information about entities (people, objects, concepts, places, events, creative works and the like). It is hospitable to multiple interconnected vocabularies and other naming systems, without enforcing artificial and inappropriate uniformity. It makes use of unique machine-processable codes (Uniform Resource Identifiers or URIs) to identify each entity, and employs the Resource Description Framework (RDF) as the syntax for expressing relationships between entities.

A Linked Open Data system is designed for expressing, tracking and analysing relationships between entities. The most common technical architecture for managing and exposing the complex network or graph of entities and their relationships is an RDF "triplestore". Interfaces for working with and reusing the data can then be built on top of the linked data, as can tools for capturing annotations and for constructing links between entities and different types of data sources. Several European research projects have previously applied these concepts in the cultural heritage domain, including CultureSampo in Finland and MultimediaN in the Netherlands. But these projects were aimed at testing the technologies involved, rather than building workable services to provide researchers with more effective access to a complex digital landscape.

While the Linked Open Data framework is a relatively recent development, there are various initiatives underway in Europe and North America which demonstrate its viability and value for organizing knowledge. The European Commission recently awarded a €6.45m grant to the Linking Open Data project (LOD2) under Framework Programme 7. Building on work originally done for DBpedia, this new project involves academic, commercial and community partners, and will focus on the development and deployment of tools, standards and methodologies for "Creating Knowledge out of Interlinked Data" on a large scale. Linked Open Data does not prescribe standards for content (whether for descriptions or for digital objects), but it does prescribe a minimum format in which data should be identified and exposed for sharing and linking. Existing content can be augmented for delivery in a format suitable for the Linked Open Data environment, while also retaining the native format of the content. Existing tools (for annotation, visualization, mapping, federated searching, crowd-sourcing and so on) can be augmented to refer to this Linked Open Data environment, while retaining their relationship with specific discipline-based services.

A Linked Open Data layer will sit between the various content delivery services and the different tools which work with them. It will act as a kind of switching mechanism, joining a range of tools with a range of different content services. It will also work to connect up these services by making it possible to search and browse across them. It will be a distributed international service, with the various components housed at different institutions.

As a result, cultural heritage researchers will be able to browse and search across the widest possible range of digital resources, in a variety of different types of media and from a variety of different sources and disciplinary perspectives. They will be able to annotate, analyse, map and visualize the results of their investigations. And they will be able to choose to share some or all of these materials with other researchers, both nationally and internationally. The potential for expanding the scale and scope of cultural heritage research is very significant indeed.

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MEDIEVAL MANUSCRIPT HERITAGE: DIGITAL RESEARCH CHALLENGES AND OPPORTUNITIES

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Medieval manuscript books are our principal source of evidence for human history and culture in Europe for just over a millennium, from the fifth century to the later fifteenth century. They are also the key means by which the textual culture of classical antiquity survives. One of the fastest-growing industries in heritage preservation and enrichment is the creation of electronic facsimiles of medieval manuscripts and related metadata. This paper argues that by applying new research strategies to manuscript digitisation we can transform the valorisation and safeguarding of this crucial category of Europe's cultural heritage.

The number of surviving medieval manuscript books is unknown; one estimate gives 600,000-800,000 books in Latin script alone[1]. This means that manuscripts comprise a huge proportion of pre-1600 European heritage. Their value extends beyond the written culture they transmit. Every manuscript book is a unique product of art, craft, and manufacture. They are sometimes the only material objects that survive from societies, communities, and individuals of the past. Many are the products of large investments of time and resource and are objects of great beauty. Today they are of value to narratives of group, regional, and community identities, to the economy, and as a resource for creativity[2].

In view of their value, medieval manuscripts should be central to strategies for safeguarding Europe's cultural heritage. However, they pose distinct and urgent challenges. Access is at the heart of the problem. Conservation concerns and access policies mean that interactions with manuscripts are restricted to a few scholars and curators with specialist knowledge and skills. Access is also limited by practical considerations: historical patterns of production, circulation, and collection mean that manuscripts are dispersed among many different repositories. Most are housed in European libraries, but there are important collections outside Europe, for example the Beinecke Rare Book and Manuscript Library at Yale University, which has 1,100 manuscripts, and the Pierpont Morgan Library, New York, with 1,300. This means that our knowledge of the hundreds of thousands of manuscripts and our understanding of manuscripts as a category of cultural production are very limited.

Digital technologies have the potential to make possible a new relationship between manuscript heritage and society. The *Catalogue of Digitized Medieval Manuscripts* includes records of 3116 manuscripts suggesting (though the catalogue is by no means exhaustive) that a mere 0.5% or fewer of all surviving volumes have been digitised to date, but many extensive digitisation programmes are now in progress. By means of this technology we shall be able to over-

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[1] Eef Overgaauw (Freie Universität and Staatsbibliothek, Berlin), personal communication. The figure includes over 200,000 in Italian libraries and 60,000 in German libraries.

[2] Examples of economic impact include the sale of reproduction rights in manuscript images through rights-managers such as Getty Images and the use of the 'Celtic' Book of Kells to brand tourism in the Republic of Ireland.

come the problems of geographical distribution of codices[3], to create virtual libraries of volumes for comparative investigations[4], and to open new channels of access (for example, interactive touch-tables and apps for e-book readers) to enable unlimited numbers of people, whether their interest is specialist, professional, educational, commercial, or simple curiosity, to interact with even the most precious volumes.

Full realisation of these opportunities requires urgent research. Investigation is required of manuscript digitisation policies across Europe to address problems of wide variation in coverage and standards. Another problem is discovery of resources. Although much digitisation is publicly funded, it can be difficult to discover digital manuscript resources and the work related to them. A related problem is that electronic manuscript datasets are often not interoperable. These problems and the research required to address them were discussed at a recent ESF Exploratory Workshop (Scase, 2009), and moves towards integration of catalogues are being made, such as the *Manuscriptorium* project at the National Library of the Czech Republic. Research methodologies need review and development for working across digital corpora. Palaeographers, specialists in scripts and hands, are working towards a new community of practice building on the ESF Exploratory Workshop on Digital Palaeography[5]. Solving these problems is a pre-requisite for virtual reuniting of dispersed manuscript heritage, and for re-linking manuscripts with historic material culture, built environment, and landscape.
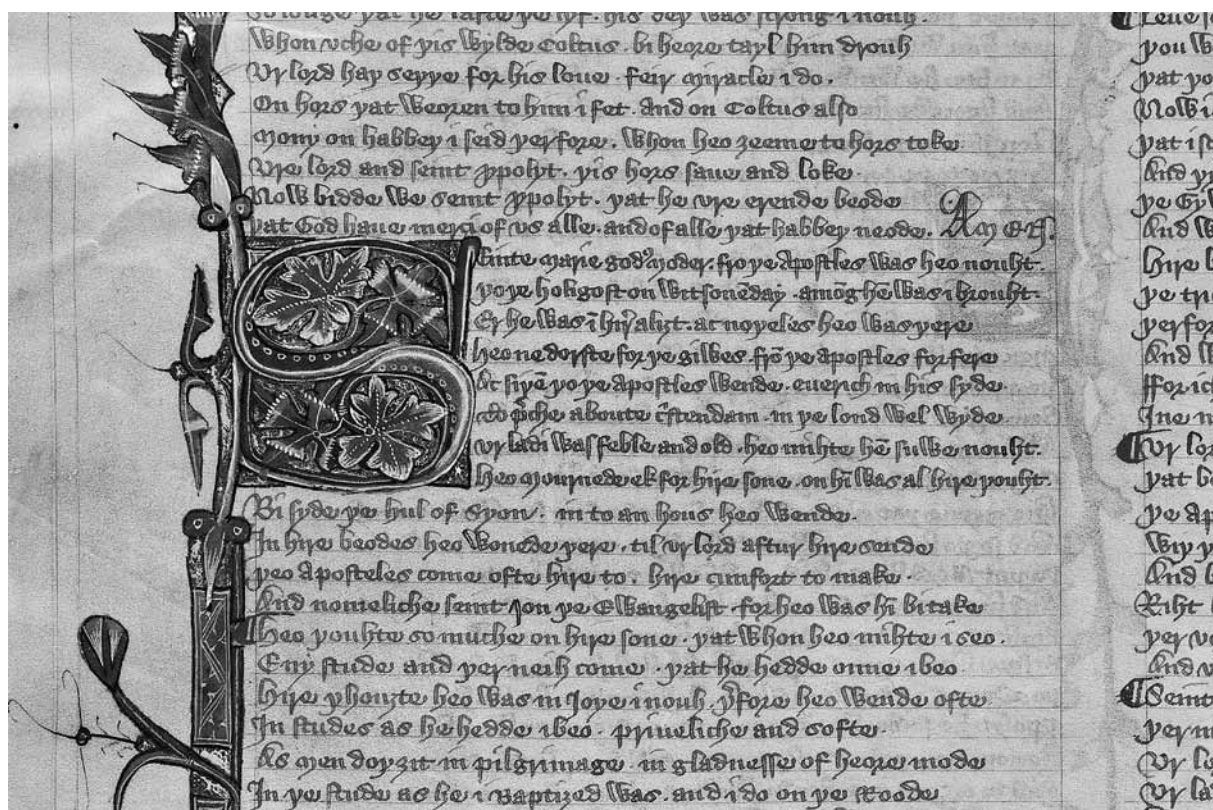
Fig. 1: Oxford, Bodleian Library, MS Eng. poet.a.1, fol. 50ᵛ. By permission of Bodleian Libraries, University of Oxford.

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[3] An example is the virtual reassembly of the world's oldest Bible (*Codex Sinaiticus*, 2009).

[4] For example, the catalogue of manuscripts of the English west midlands (Scase, 2006).

[5] Held in Würzburg, 20-22 July 2011.

Digitised manuscript images are of limited value unless they are richly annotated with metadata such as transcription and description. An example of research into what can be achieved is the Vernon Manuscript Project[6]. Containing an estimated 1,250,000 words in the medieval dialect spoken in the west midlands region of England, and lavishly decorated and illustrated, the Vernon manuscript (Fig. 1) is the largest surviving Middle English manuscript. Over its 600-year history, few have had the opportunity to interact with it. A new facsimile edition (Scase, forthcoming, 2011) developed by the project will provide specialists with ready access, and other planned applications of the files will make the manuscript available to the people of its source region and beyond. One aim is to push beyond the web facsimile as a means of 'virtual repatriation' (Boserup, 2005) to make the manuscript more usefully accessible to its 'source community'[7].

In summary, immediate priorities are recognition of manuscripts as a distinct category of cultural heritage and the development of policies, strategies, and technologies that give manuscripts the central place they deserve in the safeguarding of cultural heritage. This will require co-operation among heritage policy-makers, research funders, librarians and curators, digital imaging professionals, web technologists, publishers, academic researchers, and end users. Beyond Europe, frameworks are emerging to maximise the considerable opportunities of digitisation of manuscript heritage by enabling exchange and collaboration among these groups[8]. Although possessing some of the largest and most valuable collections of manuscripts in the world and home to some of the most ground-breaking digitisation initiatives, Europe lacks a means of co-ordinated participation in emerging global networks. A European Digital Manuscripts Network or similar could review the current state of affairs, identify ways of maximising the transformative potential of digitisation technologies, and develop a programme of research and community-building initiatives to progress them.

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[6] See the project website at www.birmingham.ac.uk/vernonmanuscript.
[7] The term 'source community' comes from museum studies (Peers and Brown, 2003).
[8] For example the Stanford project *Defining a Modular and Interoperating Environment for Collections of Digitized Medieval Manuscripts, Tools, and Users* funded by the Andrew W. Mellon Foundation, and the Australian *Europa Inventa* project.

THE INTEGRATION OF PROVENANCE DATA FOR THE RECONSTRUCTION OF THE DISPERSED EUROPEAN BOOK HERITAGE

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Every European or indeed American Special Collections Library is made of *disiecta membra*: parts of collections dispersed at some point in the past, often many times over, because of inheritance, sale, donation, exchange, theft, war booty, sequestration, modernisation, neglect, or State policies towards cultural heritage (most notably the suppression of religious institutions and their libraries, which at different times affected most European countries from the 16th to the 19th century).

Evidence of the many lives and extensive travelling a book goes through, from the time of its production to the time it enters the repository where it is presently kept, is often still preserved in the books themselves, in the form of ownership inscriptions, coat of arms, manuscript annotations, binding and decoration details, former shelf marks, elements collectively known as provenance (or copy-specific) information.

The recording of provenance information for manuscripts and rare books (incunabula in particular) in printed and electronic catalogues, as a fairly acquired custom, is an achievement of the 20th century. However, these provenance records still are, like the books they describe, *disiecta membra*, scattered in hundreds of paper publications and in hundreds, soon thousands, of electronic library catalogues.

The realisation of national bibliographies, that is electronic catalogue records[1] of all editions in all libraries of each country, is a great achievement of the last decades. And the integration of Europe's bibliographic heritage is again an achievement of the last twenty years. It was the founding objective of Consortium of European Research Libraries (CERL), and the *Heritage of the Printed Book* (HPB) Database, which includes records of books printed up to 1850, has just passed the 3 million records and is still growing.

But as is well-known, one bibliographic record is physically represented by various number of copies preserved in various number of local institutions: each of these copies has a different history, which is summarised in the copy-specific record (which once created, is attached to the bibliographic record).

The rationale of the organisations in charge of integrating nationally the bibliographic records coming from various local institutions has been to export the bibliographic record into a unified central catalogue, but not the copy-specific record, which was kept locally, where it can be accessed only by users of the local OPAC. So, just to give an example, a scholar using the Rome, National Central Library OPAC may encounter a book formerly part of the collection of the Augustinian Hermits of S. Maria del Popolo in Rome, but there is no way, at present, to allow him/her to find other books with the same provenance now in other library collections; only by going through the endless number of catalogues and by sheer good luck he/she may stumble on a book from that same Augustinian collection today in the Bodleian Library of Oxford; and who knows where else the other *disiecta membra* may be?

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[1] Electronic records with only author, title, imprint information, and location (city, library, shelfmark).

As a result of the present fragmentation of provenance information, it is incredibly hard for a library to reconstruct its past, or for a scholar to study the reception of texts throughout the centuries and in different geographic areas as a means to assess the impact of books on social and intellectual history, or to understand the changing use that was made of books as vehicle of texts, and later the collecting of the same books as representative of ideas and ideals (exemplary in this approach is Jensen, K. 2011, *Revolution and the Antiquarian Book, Reshaping the Past, 1780-1815*, CUP, Cambridge).

The world of scholarship has been aware of this methodology of research for some time, and although publications on the subject are still comparatively few, due to the difficulty in pursuing provenance research in the present fragmented environment, copy-specific records are much praised and much used.

Just to give another example, The Provenance Index of the Bodleian Catalogue of Incunabula (Bod-inc) lists around 5,000 entries of institutional and private ownership; today you can find in the Bodleian Library 15th-century printed books which once were in over 500 different monastic German libraries, 112 different Italian religious institutions, 56 French monasteries, and so on, not to count private ownership from all over Europe. This situation is mirrored in every institutional European and American library.

There is the need to focus on the use that libraries and scholars can make of these provenance records, created at great expense of time, money, and expertise.

It is clear that if we want to work seriously towards the reconstruction, for better understanding, of our book heritage we have to integrate provenance records to facilitate systematic investigation across institutional and national boundaries.

Some tools have already been put in place toward this long-term goal: the CERL *Thesaurus* is a database set up 10 years ago and freely available on the CERL Website, which contains forms of imprint places, imprint names, personal and institutional names (over 700,000 records of authors, translators, editors, artists, etc.) that have been involved in the intellectual production of books before the middle of the 19th century – including variant spellings, forms in Latin and other languages, and fictitious names, an essential research tool for scholarship related to the multi-lingual European book heritage. Most importantly, it contains an increasing quantity of provenance information in the form of links to local catalogues anywhere in Europe, where books are recorded that once belonged to them. It also provides links to images of owner marks, signatures etc. http://thesaurus.cerl.org

The *Material Evidence in Incunabula* (MEI) is a database specifically designed to record and search the provenance information of 15th-century printed books not yet described in any catalogue (still the majority), and to transfer information from paper printed catalogues, to allow for its integrated search. http://incunabula.cerl.org

CERL is fostering a long-term plan for integrating provenance records from indexes or authority files created by individual institutions into the CERL Thesaurus, and to centralise copy-specific descriptions of incunabula into Material Evidence in Incunabula. These are two existing databases perfectly placed to integrate provenance data from scattered sources, and to be used by scholarship and education, to research, study, and understand our extraordinary rich and complex book heritage.

Two fundamental issues need addressing, one of principles, one of practice: first, like for the integration of bibliographic records at national then European level in the past, the integration of provenance records today has to be perceived by Libraries and Librarians as the present, indispensable, goal. What is requested from them is first of all to understand, value, and facilitate the move towards provenance records integration. Second, such integration needs to be supported technically and financially: tools such as the HPB, CT, and MEI need to grow in sophistication to accommodate substantially larger quantities of data, extensive logistical planning is needed to identify, harmonize,

and integrate provenance records from databases, catalogues, and authority files which may vary in details if not in substance, finally, qualified personnel has to be in place at the receiving end to handle and manipulate the data.

The goal? An access point to our collective book heritage, for the use of scholarship, libraries, education, as well as the general interested public. Also, setting standards and foster the integration of provenance indexes and authority files into a recognised central repository to reduce and prevent fragmentation of information which acquires its full and fundamental meaning for the European Heritage when seen as a whole.

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[8,876 characters with spaces]

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LANGUAGES: OUR PRESENT AND OUR FUTURE

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Accademia della Crusca

THE SAFEGUARD OF CULTURAL HERITAGE

I appreciate the opportunity to present my thoughts here today. Last year the Accademia della Crusca was invited to take part in the *Biennale della cultura*, an important new event organized in our city by *Florens*, an association that is also one of the organizers of today's workshop. First of all, I wish to thank those who arranged this meeting, and especially to express my appreciation to Anna Benvenuti, who had the idea of including the Italian linguistic discipline as a subject for consideration.

I will speak as professor of the University of Florence and past director of the CLIEO (Centre of research in theoretical and historical linguistics*)*, which is a centre of linguistic excellence at the University, as well as the president of the Accademia della Crusca, an academy that has placed language at the centre of its activities for more than four centuries. The Accademia was the first institution to publish a great historical national dictionary, thus becoming a role model for other similar academies throughout Europe.

At this workshop, devoted to the preservation of European and non-European cultural heritage, I would like to highlight *language* as the keyword of my speech. Subsequently – as a preliminary observation – the emphasis on *language* forces me to express my uneasiness concerning the lack at this conference of a simultaneous translation system, which would have allowed the contributors to communicate their thoughts in the best way possible – in their own languages.

Safeguarding linguistic heritage means giving everyone the chance of expressing his or her thoughts in his or her mother tongue where the delicate union between words and concepts is formed. If the intention of Europe is to preserve European multilingualism – and if this project is real and not merely a declaration of purpose – then it would be appropriate, also for our workshop, not only to provide a simultaneous translation service, but also to publish our speeches in two versions: the original speech, in each presenter's mother tongue, together with its translation in the language that we recognize, today, as the international super-language: English.

Many people may think that putting huge efforts in the field of linguistics is irrelevant. Perhaps they consider languages – the natural way we communicate – as tools that can change or, in some cases, may even become useless and thus, eventually, can be put aside. But languages are neither *codices* nor simple tools for communication: the great national languages are important and historical cultural assets. The relationship between language and culture is crucial because, as Francesco Sabatini – Honorary President of the Accademia della Crusca – recently wrote: "*a language is a tool for identification and interpretation of a culture as a whole, thus it functions as a generator of attraction and involvement toward it*". We must also add that most national languages are essential components of cultural and linguistic mosaics of extreme complexity.

Three years ago I was called to preside over the Accademia della Crusca. As I mentioned earlier, the Accademia, founded in 1583, is the most ancient linguistic academy of the world and has concentrated its activities on language for more than four hundred years. The Accademia is most famous for its huge *Vocabolario* (published in five editions, from 1612 to 1923), which served as a model for the other European national dictionaries and became a fundamental tool in the process of diffusion of Italian as the national language of Italy.

Today, the Accademia is involved with words more than ever: spoken words, written words, transmitted and typed words. Words of yesterday and of today. The Accademia is also strongly committed to the field of digitization, as I will discuss later. Dealing with words is certainly a very topical task, since languages and verbal communication are pivotal in today's world. Verbal communication, strengthened in union with images with their impressive power, their conciseness and immediateness, represents well the speed of the processes that characterizes our times.

Four points characterize the strategic importance of languages in the field of the preservation of cultural heritage, its transmission and its evolution.

1) Language as an intangible cultural heritage

Languages are a cultural asset by themselves. Languages should be protected in their contemporaneity, as well as in their history. The culture of a civilization – its cultural heritage – is heavily dependent upon the language in which it has been conceived. This is because the most basic mechanism of thought is characterized linguistically: it is the process that creates the associations between names and objects or concepts. The decision of dividing semantic fields in one way, rather than another, affects the way we feel and think. This concept becomes more important if we consider that Europe has based its identity on multilingualism and multiculturalism. This is crucial to the common heritage of Europeans.

Two years ago, an International Congress on European Languages organized in Florence by the Accademia della Crusca, was honored by the participation of the European Commissioner for Multilingualism, Leonard Orban, and the Lebanese writer Amin Maalouf, President of the commission nominated by Orban to create the guidelines for the forthcoming European linguistic policy. At the Congress both men reaffirmed that all our languages constitute a great common heritage, which must be preserved in its whole.

Significantly, the Maalouf Report is entitled *A rewarding challenge. How the multiplicity of languages could strengthen Europe*. The report states a clear non-hierarchical vision of all European languages, a vision meant to open new perspectives toward their real – and therefore not only ideal – equality. It is an extremely relevant document of even greater timeliness if we think that in our continent nowadays, for various reasons, some languages happen to extend their power over others, in clear contrast with the principle of unity in diversity, which inspires the construction of the European common house. The risk is that some languages could progressively lose their superior functions, related to such fields as to scientific research, literary expression, and academic teaching. In this project, meant to improve multilingualism and multiculturalism, that are both part of its history, Europe presents itself as a model and a unique example worldwide.

2) Language as a material cultural heritage

Language in general and, in this case, Italian, is not just an intangible cultural asset. Due to its long history as a predominately written language, it is also a material cultural heritage: we can easily and tangibly find it by physically taking into our hands and turning the pages of the books written in the Italian language, especially those fundamental ones such as Dante's *Commedia*, Petrarch's *Canzoniere* and Boccaccio's *Decameron*.

Or we can read other books, like those gathered and preserved in the *Fondo dei Citati* at the Library of the Accademia, which entered the *Vocabolario* "in pieces", as quotations or examples of use that were used to complete the definitions of the words. We can, in a manner of speaking, materially *touch* the Italian language consulting the *Vocabolario degli Accademici della Crusca* and today, thanks to its digitization realized by the Accademia, even through interrogating it online. We can walk through its pages as if we were in a "language gallery", similar to the Uffizi, with words instead of paintings. This striking parallel was written by my teacher, Giovanni Nencioni. For centuries, the *Vocabolario* has been a thesaurus and *the* prescriptive source *par excellence*; it was criticized by many, but was still kept on the desk for consultation by all those in Italy who could read and write.

3) Language as a privileged route of access

Language becomes a privileged route to access cultural heritage, due to its nature as a matrix of thought. Preserving cultural heritage, in fact, means reconstructing a system of thought, in which one then places material objects. It is necessary to follow this process from its gestation to create a continuous transfer of assets. Therefore, it is essential to consider languages in their relation with their cultural contexts, as well as keeping in mind their historical and contemporary global evolution. It is not possible to rebuild an environment, or a reference system, without having direct access to the sources of such an environment or its system: and this can happen only through the knowledge of the languages involved in the process.

4) Language as a computational tool

Nowadays, often the preservation of cultural heritage takes place through the creation of computational tools, databases, repositories. It is an incontrovertible fact that the majority of computational query procedures (retrieval of data, of text, of images, of objects) are possible only with the help of language, or, even better, several languages. Safeguarding the linguistic heritage of Europe is closely related to the capacity of "building" more and more effective systems to access digitized materials online.

Nicoletta Maraschio graduated in History of the Italian Language at the University of Florence and today works as a full tenured professor within the Faculty of Arts of the same institution. She has been highly involved in projects at the Centre of Italian Grammar of the Accademia della Crusca since 1974. In 1997 she became vice-president of the Council of Academicians. She is currently President of the Accademia della Crusca. Elected in 2008, she has become the first woman to fill this position since the foundation of the Crusca in 1583. Among her many publications, particularly relevant are those on specialistic languages, on spoken Italian of the 15th, 16th and 20th century, on the language of the *Decameron* and several essays on matters of punctuation and spelling. She is an experienced scientific project coordinator, with several completed researches on her account, many of them involving numerous universities and other research institutions.

ArCES Project - DIGITAL ARCHIVE OF ITALIAN SCIENTIFIC EXPEDITIONS AND COLONIAL CARTOGRAPHY

Margherita Azzari, Irene Calloud, Paola Zamperlin
LabGeo – Laboratorio di Geografia applicata, Dipartimento di studi storici e geografici
Università degli Studi di Firenze

ArcCES is a study for developing a digital archive about Italian scientific expeditions in Northern and Eastern Africa and the former Italian colonies (19th-20th century). The aim of the project is to assess, protect and enhance an important corpus of documents (historical cartographies, photographs, scientific papers and archive documents) distributed in public archives and private collections.

The database structure is based on Dublin Core metadata standard. The information system is designed to integrate and make interoperable digital resources, to ensure standardized and complex indexing, to support advanced retrieval, according to the standards in use. The geolocation of the resources in a GIS environment can display query results in Google Earth environment.

Fig. 2- Arces
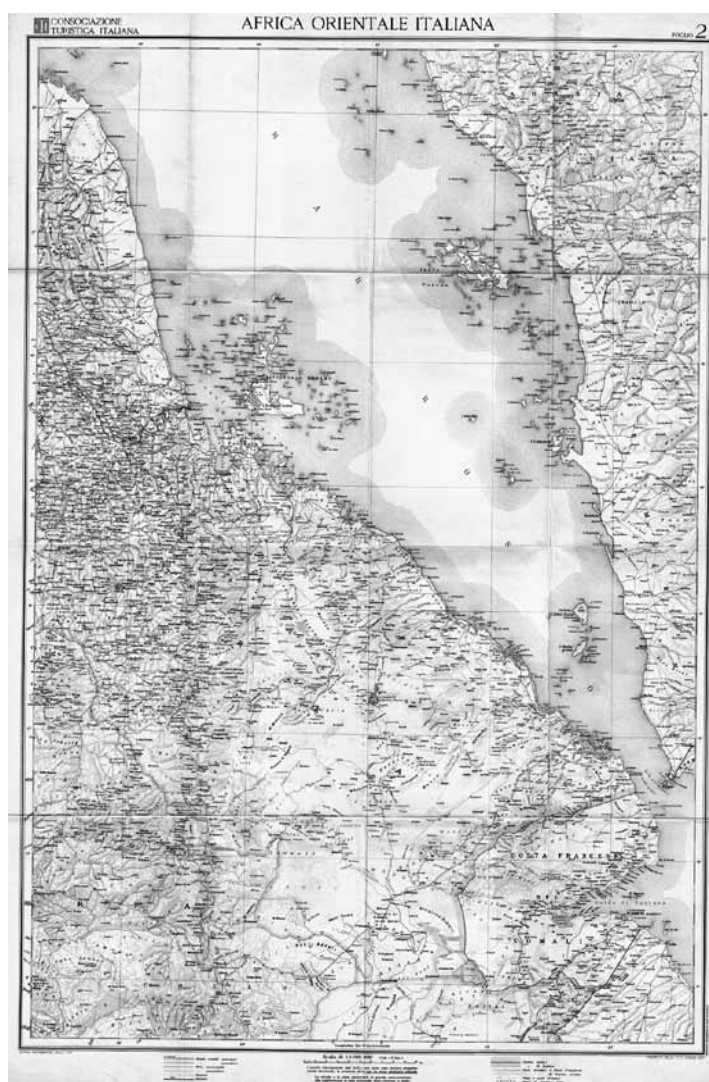
Margherita Azzari is an assistant professor in the Department of Historical and Geographical Studies of the University of Florence and a member of the principal Italian geographical societies. Author of studies in human geography: historical assessment of a country, cultural and environmental heritage, history of cartography, didactic studies of geography and Geographical Information Systems (GIS). Scientific coordinator for some projects promoted by Tuscan Regional Council: Ca.Sto.Re (Historical Regional Cadastres), Geo-Environmental Atlas of Tuscany and Atlas of foreign entrepreneurship in Tuscany. Teacher of Applied Geography, Geographical Information Systems and Geography of Environment and Landscape at Florence University.

CLIEO CENTRO DI LINGUISTICA STORICA E TEORICA: ITALIANO, LINGUE EUROPEE, LINGUE ORIENTALI

THE SAFEGUARD OF CULTURAL HERITAGE

CLIEO - Center for theoretical and historical Linguistics: Italian, European and Oriental languages

Founded in 2004, CLIEO actively promotes theoretical historical and descriptive linguistic research concerning Italian, Italian dialects, other European languages and Oriental languages.

The Center is based on the confluence into a single entity of different institutions previously active in Florence in the field of Linguistics: University structures (Department of Italian Studies; Department of Middle Age and Renaissance Studies; Department of Linguistics; Inter-Universitary Center for the Geolinguistic Study of Proverbs), the Accademia della Crusca, the Opera del Vocabolario Italiano - Italian Dictionary (OVI, a CNR Institute), and the Institute of Legal Information Theory and Techniques (ITTIG, a CNR Institute).

The project of the Center has been endorsed by Italian and International Institutions and researchers.

The Center focuses its activity on the study of single languages – or groups of related languages – but also of transversal issues, especially in the perspective of multilingualism in Europe, with a special attention to the design and development of ITC and linguistic tools.

Also accounted for are all the aspects relevant to the applications of research which impact on several productive fields, from publishing to information and language industry, as well as in the educational field.

Among CLIEO's activity are worth pointing out those regarding the exploitation of the Italian language as a world cultural treasure; the main project being *Vivit: vivi italiano,* financed by FIRB funds for the period 2009-2011, an integrated digital archive of educational material, texts and iconographic documents for exporting the Italian historical, linguistic and cultural heritage, with a special regard and focus on second and third-generation Italians living abroad.

Also of great importance are the researches aiming to exploit the cultural heritage through a solid knowledge of the original language, such as the one about Leonardo's technical lexicon, under the agreement with the Comune di Vinci, as part of the 7th Framework Program.

THE CENTER FOR THEORETICAL AND HISTORICAL LINGUISTICS: ITALIAN, EUROPEAN AND ORIENTAL LANGUAGES (CLIEO)

Marco Biffi
CLIEO. Centro di Linguistica Storica e Teorica: Italiano, Lingue Europee, Lingue Orientali
Università degli Studi di Firenze

Founded in 2004, CLIEO is a Center of the University of Florence. It actively promotes theoretical historical and descriptive linguistic research concerning Italian, Italian dialects, other European languages and Oriental languages. The Center is based on the confluence into a single entity of different institutions previously active in Florence in the field of Linguistics: University structures (Department of Italian Studies; Department of Middle Age and Renaissance Studies; Department of Linguistics; Inter-Universitary Center for the Geolinguistic Study of Proverbs), the Accademia della Crusca, the Opera del Vocabolario Italiano - Italian Dictionary (OVI, a CNR Institute), and the Institute of Legal Information Theory and Techniques (ITTIG, a CNR Institute). The project of the Center has been endorsed by Italian and International Institutions and researchers.

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Among other activities, CLIEO organizes higher education courses ("Lessicografia: Teoria, Storia e Applicazioni, Italiano ieri e oggi: La componente lessicale"), seminars and workshops ("Elezioni Politiche 2006: La lingua elettorale", "Incontri sulla radio", "L'italiano in pubblico, oggi").

VIVIT: Vivi italiano.

Vivit is a repository of educational texts and images for the knowledge of the Italian linguistic and historic-cultural patrimony abroad (FIRB 2009-2011), realized in collaboration with the Accademia della Crusca, the MICC (Media Integration and Communication Center), the University of Modena e Reggio Emilia, the University of Padova. In the VIVIT project, CLIEO's task is to constitute the integrated database of the lexicons of radiophonic Italian (LIR), of television Italian (LIT) and of written post-unitarian Italian (LIS).

SLITIP

Since 2009 the CLIEO has an ongoing collaboration with the Accademia della Crusca and the ITTIG (Institute of Legal Information Theory and Techniques) for the project named *SLITIP (Strumenti linguistici e informatici per testi istituzionali e professionali chiari ed efficaci),* which is part of the process of simplification of the administrative and more generally communicative procedures. The final goal of the project, among that of the formation of young researchers, has been the compilation of the *Guida per la redazione degli atti amministrativi: regole e suggerimenti*, which is a tool for the simplification of administrative writing. The CLIEO also organizes training courses for the employees of public and private organizations.

Leonardo's technical lexicon

As part of a wider collaboration between the Biblioteca Leonardiana of Vinci and the Department of Mechanics of the University of Florence, in the frame of the 7th Framework Progam, a group of researchers of the CLIEO has realized a glossary of mechanical terms used by Leonardo in the Madrid and Atlantic Codexes. The glossary has been redacted on the basis of electronic concordances prepared by the Biblioteca Leonardiana starting from the printed editions (edited by Reti for the Madrid codexes and by Marinoni for the Atlantic codexes), but with a continuous verification on the manuscripts with electronic instruments that have helped in the reading of the inverted writing of Leonardo on the digital copies. The Glossary is part of the e-Leo database, which contains the electronic edition of the majority of leonardian codexes, both as a transcription that can be interrogated in various ways and as images (http://www.leonardodigitale.com); this has also been published in print with the title *Glossario leonardiano. Nomenclatura delle macchine nei codici di Madrid e Atlantico*, edited by P. Manni and M. Biffi, Florence, Olschki, 2011.

In this first phase the lexical repertoire taken in consideration is limited to the field of theorical and applied mechanics, but already in preparation are similar glossaries for anatomy, optic and geometry, architecture, with the collaboration of the University of Naples "L'Orientale" and of the University of Foreigners of Siena.

Marco Biffi, PhD at the Scuola Normale in Pisa; researcher at the Faculty of Letters of the University of Florence and aggregated professor in "Italian Linguistics". Research activity is centred mainly on the diachronic study of the technical language, of broadcasted Italian (via radio and TV as well as computer-mediated written language), and of Linguistic Informatics applied to the history of Language. To the study of these subjects he has added the analysis of the language of specific authors: Boccaccio, Leon Battista Alberti, Francesco di Giorgio Martini, Leonardo da Vinci. He has taken part in many projects of national relevance supervising the creation of multimedia electronic corpora of broadcasted radio- and TV language, and of databases of written Italian of the XIX Century. Together with Massimo Fanfani he directed the database of the five editions of the *Vocabolario degli Accademici della Crusca*, online since 2005 (www.lessicografia.it); and together with Paola Manni he directed the *Leonardian Glossary*. Since 1996 Marco Biffi collaborates with the Accademia della Crusca in linguistic and computational linguistic activities. Since 2010 is a member of the Scientific Council of CLIEO.

THE ACCADEMIA DELLA CRUSCA

Angela Frati, Stefania Iannizzotto, Vera Gheno
Accademia della Crusca

THE SAFEGUARD OF CULTURAL HERITAGE

For over 400 years, the Accademia della Crusca has been the leading institution for the study of Italian language, yet keeping always an important international, mainly European vocation: numerous have been the non-Italian academicians and its *Vocabolario* (1612), the first dictionary built following modern criteria, has been a model for lexicographers all over the world. Nowadays, its activity is centered on the following issues:

• supporting scientific activity and the training of new researchers in Italian linguistics and philology;

• acquiring and spreading, in the Italian society as a whole and especially in schools, the historical knowledge of the Italian language and the awareness of its present evolution, in the context of the cross-linguistic exchanges that are so common in today's world;

• collaborating with the leading foreign linguistic research institutions, as well as with the Italian and European Governments, to support the cause of multilingualism on our continent.

The Accademia has always manifested a huge interest for the use of information technology applied to the study of the languages, especially in the field of historical lexicography.

In the last ten years the Accademia – either in full autonomy, through its IT Center, or in collaboration with national and international university centers – has completed a rich series of projects aimed on building databases, digital libraries, digital archives and corpora. Here are listed some of the most relevant ones.

Lessicografia della Crusca in Rete

With this project the Accademia publishes online the content of the five editions of the *Vocabolario*, allowing a quick and methodical inquiry with advanced search features that permit the selection of specific sections of each edition, as well as the constant comparison between the various versions of the dictionary. The project also includes a database of images for the five editions. - www.lessicografia.it

Biblioteca Digitale dell'Accademia della Crusca

The database contains the digital reproduction of a selection of works that allow the scientist to reconstruct the cultural environment and the situation of lexical, grammatical and philological studies in exceptionally meaningful moments of the history of Italian language - www.bdcrusca.it

Fondo dei Citati

This database contains the 1.684 books that entered the five editions of the *Vocabolario* as quotations. The collection brings together those texts that, through the centuries, the Academicians of the Crusca selected as the linguistic foundation of the lexical thesaurus that they identified and certified as "Italian language". - www.citatinellacrusca.it

Vocabolario del Fiorentino Contemporaneo (VFC)

The project of the Vocabulary of the contemporary Florentine language was started in 1994 by Giovanni Nencioni, at the time President of the Accademia della Crusca. The basic idea, which the compilation has always remained faithful to, was that of documenting all the areas of the linguistic repertoire in which, nowadays, occurs a missing, or partial, overlap between "florentine lexicon" and "italian lexicon". - www.vocabolariofiorentino.it

Archivio digitale dell'Accademia della Crusca

The Digital Archive of the Accademia grants access to a vast array of queries on the documents housed in the Archive of the Crusca. The data available are the result of the archivistic description of manuscripts, letters, typescripts, loose cards, for a total amount of 1.450 archivistic units (including volumes, file folders, envelopes, workbooks and card indexes). - www.accademiadellacrusca.it/archivio.shtml

Vivit: vivi italiano

Vivit is a repository of educational texts and images for the knowledge of the Italian linguistic and historic-cultural patrimony abroad (FIRB 2009-2011), collected in collaboration with the CLIEO, the MICC (Media Integration and Communication Center), the University of Modena and Reggio Emilia and the University of Padova.- http://trinity.micc.unifi.it/firb-vivit/

Consulenza linguistica dell'Accademia della Crusca

The Accademia's aim is to provide its users with a service that works on several levels simultaneously: an editorial board, composed of linguists, selects some of questions sent to the Accademia via e-mail or other means, which are given answer directly through the website; some others receive a personal answer, while a selection of the most interesting issues is published in the Crusca's biannual journal, *La Crusca per voi*. - www.accademiadellacrusca.it/clic.shtml

LIR – Lessico dell'italiano radiofonico 1995-2003/ LIT – Lessico dell'italiano televisivo 2006

LIR and LIT are the databases of the Italian language of the radio (with two distinct samplings dated 1995 and 2003, on DVD) and of the Italian language of the television (sampling of the three RAI channels, dated 2006) - http://deckard.micc.unifi.it:8080/litsearch/

Per una comunicazione scritta efficace degli atti amministrativi: The *Guide for the compilation of administrative bills: rules and suggestions*, edited by the Ittig and the Accademia, is a tool aimed toward the simplification of administrative writing. - www.pacto.it

This document has been compiled by Angela Frati, Vera Gheno and Stefania Iannizzotto as representatives of the institutions of the Accademia della Crusca.

Angela Frati, PhD in Italian Linguistics at the University of Florence with a final dissertation on the language of radio plays of the RAI, collaborates with the Accademia della Crusca studying mainly transmitted Italian, with a particular interest for the Italian spoken on the radio. She also works on the simplification of administrative and professional writing.

Vera Gheno, PhD in Italian Linguistics at the University of Florence, is in the fifth year of her research grant, co-funded by the Accademia, in Public Online Asynchronous Communication. Her sociolinguistic studies deal mainly with the analysis of several online written communication channels (chatlines, discussion forums, blogs etc.) and short messages sent via mobile phones (SMS).

Stefania Iannizzotto, PhD in Modern Philology at the University of Catania, holds currently a two-year research grant in History of Italian Language at the Accademia della Crusca. Among her main interests are some aspects of the Italian spoken on television. She also works, together with A. Frati, on the simplification of administrative and professional writing.

COMMON STRATEGIC FRAMEWORK FOR FUTURE EU RESEARCH AND INNOVATION FUNDING CONSULTATION

Patricia Engel
European Research Centre for Book and Paper Conservation-Restoration, Horn, Austria

From 9th-11th May 2011 a meeting in Horn/Austria brought together experts on the Conservation of our Written Cultural Heritage.

The initiative for a joint undertaking put forward by the European Research Centre for Book and Paper Conservation-Restoration was enthusiastically supported by many conservators, librarians, archivists, curators of prints and drawings, art historians, historians, chemists, physicists, paleographers, book scientists, scholars of various languages, representatives of the industry and politicians as well as university teachers and other experts from related disciplines responsible for the survival of the cultural heritage of and on paper, parchment, leather, papyrus and similar material stored in libraries, archives, museums and collections.

The opportunity to respond to the EU Green Paper on the Common Strategic Research Framework for Research and Innovation was welcomed by the participants of the meeting.

The excellence, impact and innovative value of conservation research have a crucial role for the future of European culture, prosperity, wellbeing and intellectual life.

Among other things, the suggestions focus on eliminating costly duplication and fragmentation of research activities and to set-up protocols for the research and the conservative intervention in the cultural heritage field. The topics brought forward reflected the strong need for research concerning surveys both of material and content of cultural heritage, storage, preservation, conservation, standardization, microorganism control, development of specific databases and research on the artistic and aesthetic value of the heritage, as well as subjects and areas which are not covered by CEN at the present.

At least part of these requests could have been covered by the "ENV-NMP.2011.3.2.1-1 Development of advanced compatible materials and techniques and their application for the protection, conservation and restoration of cultural heritage assets." This subarea of the programme should be renewed in the FP 8.

Furthermore, the participants of the meeting repeatedly emphasized the pressing need for a strong Network that would support the work of the whole community of people responsible for safeguarding and conservation of our common European written/printed/drawn heritage.

Previous interdisciplinary networking demonstrated the benefit of such structures.[1] The recent gaps in networking bring a risk to the already achieved results.

A stronger involvement of third countries would offer opportunities to capture the benefits of knowledge produced outside the EU.

[1] MIP, COST D42

According to the voices on the conference a greater focus should be placed on the issue of applicability of the research results. The applicability should be already proven within the project frame. This requires an adaption of the structure of the projects. The last 6 months for example could be dedicated to a visibility study.

More intense focus on SMEs and Research Groups and structures for delivering the research results to the endusers could cover the full innovation cycle from research to market uptake. Further education, conferences and visibility studies can help to bring the knowledge from the researcher to the everyday practical work.

A clear legal basis for the exclusive use of results by firms, even if several partners were involved in the development, support in legal questions especially in international trading, support in patent announcing and support in bringing project results into products, which can be sold on the market would be helpful too.

The role of the European Research Council should be strengthened in supporting world class excellence by giving possibility to continue successful FP 7 projects.

The EU should support/assist Member States in building up excellence through clustering, by giving support for setting up Research Centres, Networking, cooperation with researchers and through transfer programmes for scientist and researcher (i.e. conservators, librarians, archivists, natural scientists, historians and all other disciplines needed to protect the written heritage) to work at another institution.

Furthermore support of more actively projects aimed at setting up platforms for meetings was asked for and a way to make industry interested not only in the future opportunities, but also in the current potential offered by ongoing EU projects.

The role of Marie Curie Actions should be strengthened by European PhD grants in general and Conservation-Restoration PhD grants in particular (joint degrees).

By their nature, cultural heritage issues do not always fit big EU programmes, smaller-scale projects and programmes relevant to smaller areas are more appropriate sometimes. However also the big programmes are valuable, as they ensure the markets/endusers for machines and material developed for conservation measures.

Furthermore there should be more room for bottom-up activities. This could possibly be achieved by surveying people more directly to learn about their actual needs and concerns in this respect.

There should be a way to actively feedback to the EU bodies, so as to make the entire system a living organism. This feedback then could include questionnaires distributed to end users, where they describe in what way they benefit from the research results, outline the improvement in the protection of our cultural heritage, among other things, from the economic point of view (less energy consumption for example), or questionnaires which reflect the high relevance of the research results. Also the European citizens should be involved in this procedure.

We should generally make society more aware of the value this (written) cultural heritage has for the European society. Mapping of EU wide regional research could help clustering and the infrastructure and programmes which support this grouping from regional and national to EU wide projects could help avoid double research.

The funding should not be restricted to the present-day political Europe, but to the European area in the cultural sense. Therefore, regions around the Mediterranean, the Middle Eastern and Caucasus region, as well as all the areas towards the East, including Russia, clearly being parts of the European cultural area, should be supported.

In general both scientific and humanitarian research should be supported equally
Safeguarding our heritage as a source for better understanding of our society fits well into the Common Strategic Framework for Cohesion policy of the European Union.
All the above stated is strongly supported by:

Patricia	Engel	European Research Centre for Book and Paper Conservation - Restoration, Horn	Austria
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Spiros	Zervos	Technical Educational Institution of Athens	Greece
Halina	Rosa	Nikolaus Kopernikus University, Torun	Poland
Erich	Renhart	University Library Graz	Austria
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Jörg	Krüger	BAM, Berlin	Germany

Yuri	Aristov	Boreskov Institute of Catalysis, Novosibirsk,	Russia
Theresa	Zammit Lupi	Freelance conservator	Malta
Eduard	Zaloshnja	Archives, Tirana	Albania
Elzbieta-Maria	Jablonska	Nikolaus Kopernikus University, Torun	Poland
Andre	Borodichin	National Library, Novosibirsk	Russia
Reni	Marcheva	National Library "St.St.Kiril I Metodij", Sofia	Bulgaria
Weronika	Liszewska	Akademy of Fine Arts Warsaw	Poland
Igor	Kozjak	Department at the Croatian State Archives	Croatia
Roumiana	Decheva	Ivan Dujcev Centre for Slavo-Byzantine Studies	Bulgaria
Sigrid	Eyb-Green	Akademie der Bildenden Künste	Austria
Juliane	Hofer	conservator	Austria
Mila	Moschik	Akademie der Bildenden Künste, Wien	Austria
Annele	Holm-Louhelainen	Helsinki University	Finnland
Sophie	Rabitsch	Akademie der Bildenden Künste Wien	Austria
Magdalena	Chudzinska	conservator	Poland
Colyn	Wohlmut	UAL Camberwell College	United Kingdom
Klaus	Rubitzko	Akademie der Bildenden Künste	Austria
Miroslaw	Maciaszczyk	Museum Auschwitz-Birkenau in Oswiecim	Poland
Nel	Jastrzebiowska	Museum Auschwitz-Birkenau in Oswiecim	Poland
Michaela	Brand	Deutsches Historisches Museum	Germany
Magdalena	Grenda	The Warsaw Rising Museum	Poland
Asger	Svane-Knudsen	Danish National Archives	Denmark
Helmgard	Holle	Akademie der bildenden Künste	Austria
Ken	McKenzie	Harwell Document Restoration Service	UK
Eugene	Brady	University of Lincoln U.K.	England
Louiselle	Bonnici	Heritage Malta	Malta
Catherine	Charles	University Library of Namur	Belgium
Eduard	van Uum	Papercare	Netherlands
Gerald	Megens	Papercare	Netherlands
Eve	Keedus	National Archives of Estonia	Estonia
Julia	Archakova	The State Museum of the History of St. Petersburg	Russia
Stephan	Ortbauer	bookbinder	Austria
Krystyna	Olczyk	The Kórnik Library of the Polish Academy of Science	Poland
Andrzej	Nowakowski	University Library	Poland
Francesca	Spoerl	Northumbria University	Britain
Anu	Lepp	University of Tartu	Estonia
Paulien	Rings	Koninklijke Bibliotheek / National Library of the Netherlands	Netherlands
Johanna	Fries Markiewicz	National Library of Sweden	Sweden
Katarzyna	Kubis	University Library	Poland
Nicholas and Barbara	Burnett	Museum Conservation Services Ltd/The British Museum	UK
Konstantina	Konstanttinidou	conservator	UK
Louisa	Di Capite	Conservation Studio	England
Anja	Scocozza	National Gallery of Denmark	Denmark

Inga	Steingolde	National Archives of Latvia	Latvia
Judith	Wiesner	Conservation Studio	United Kingdom
Cheryl	Porter	conservator	Egypt
Maria Luisa	Russo	Soprintendenza Beni Librari	Italy
Ilse Birgit	Muehlbacher Speta	Österreichische Nationalbibliothek	Austria
Ewa	Chlebus	Elblag Library	Poland
Joanna	Sroka	Elblag Library	Poland
Dorota	Jutrzenka-Supryn	Nicolaus Copernicus University	Poland
Urszula	Wencka	Ossolinski National Institute	Poland
Benjamin	Bartl	National Archives in Prague	Czech Republic
Anne	Doebele	university of amsterdam	Netherlands
Marie	Benesova	National Library of the Czech Republic	Czech Republic
Dorottya	Szlabey	National Archives of Hungary	Hungary
Janien	Kemp	Stadsarchief Amsterdam	The Netherlands
Rudolf	Eichinger	Cellulose physisist	Austria
Caroline	Checkley-Scott	The John Rylands University Library	UK
Stefania	Signorello	The Wellcome Library	England
Anna	Aaltonen	Finnish National Gallery	Finland
Liisa	Valkeapaa	Finnish National Gallery	Finland
Matthew	Cains	National Library of Ireland	Ireland
Luiza	Macedo	Academia das Ciências de Lisboa	Portugal
Svetlana	Dobrusina	National Library of Russia, St. Petersburg	Russia
Kathleen	Mühlen Axelsson	Konservatorskolen, Kopenhagen	Denmark
Erna	Pilch Karrer	State Archive, Vienna	Austria
Robert	Sablatnig	TU Wien	Austria
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SAFEGUARD OF CULTURAL HERITAGE: A CHALLENGE FROM THE PAST FOR THE EUROPE OF TOMORROW

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The arts and the humanities, as academic disciplines, often have divergent methods and goals. As categories of cultural heritage, the associated primary artifacts also diverge often in the requirements they pose to the mission of preservation and transmission[1] to future generations. Here I will illustrate these divergences and their implications for the cultural heritage mission, and specifically that of needed interdisciplinary research, through two projects developed at the Institute for Advanced Technology in the Humanities (IATH) at the University of Virginia, namely, *Leonardo da Vinci and His Treatise on Painting*[2] and *The Chaco Research Archive*[3].

Project 1: **Leonardo da Vinci and His Treatise on Painting**

Francesco Melzi, one of Leonardo's pupils, compiled materials from Leonardo's manuscripts and an abridged version of that compilation appeared as the *Treatise on Painting*. That original manuscript and then numerous variants of it became primary sources in disseminating Leonardo's art theory in Renaissance and Baroque Europe. The set of the manuscript and printed versions[4] constitute a significant collection for art historians to study Leonardo's impact on Renaissance and Baroque art in Europe. Thus, it is a significant humanities collection. The extant artifacts, however, are not housed in a single repository presenting the following requirements:

– Unified catalog / index
– Digital surrogates for research access
– Analytic apparatus to enable and assimilate detailed research
– Dissemination methods that allow integration of the various categories of information: artifact metadata, artifact appearance, results of analysis and secondary sources is support of the scholarly conclusions.

These requirements are familiar, yet the *Treatise on Painting* collection makes explicit several subtleties. The "catalog" is, for each individual volume, redundant to the holding-repository's catalog and must not be considered to be the authoritative bibliographic record for the item, yet is a specialization of that authoritative record for the purposes of the item in this particular collection.

The "surrogates" may have access limits such that the quality of reproduction necessary for scholarly analysis is beyond that permissible for presentation (even in parts) to the public. In addition, the "surrogates" may be redundant to those provided to the public by the holding repository.

The analytic apparatus is specific to the constellation of scholarly questions being investigated in this particular

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[1] By "transmission" I mean to include processes beyond the base preservation of an artifact that provide access to metadata about the artifact, documentation about its physical location, digital surrogates for the artifact and the cultural context for the artifact.

[2] This project is lead by Professor Francesca Fiorani of the University of Virginia. It is supported by both the University of Virginia and the Samuel H. Kress Foundation. See http://www.treatiseonpainting.org/

[3] This project is lead by Professor Stephen Plog of the University of Virginia. It is supported by the University of Virginia, The Andrew W. Mellon Foundation and the National Park Service. See http://www.chacoarchive.org/cra/

[4] The project is directly studying over 50 volumes that run from the initial manuscript to printed volumes: Italian and French versions printed in 1651 and a 1721 English version.

project[5]. What aspects of the detailed results of the analysis are of interest to a broader community and should be "exposed" for use in other humanities projects?[6]

The items in the *Treatise on Painting* collection are, in several cases, art objects independent of our interest in the set. In what ways can aspects of the art history scholarship be "exposed" to presentations of a volume as an art object, in order to enhance the understanding of the cultural context of the artifact as art.

Of course, the primary scholarship on the *Treatise on Painting* collection is concerned with the relationships between the volumes. However, the justification for many of the conclusions will come from secondary sources. Here access to the authoritative bibliographic records and in many cases portions of the content of those secondary sources is needed in the dissemination process. What are the forms of that access and how does our project assure access into the future?

Project 2: **The Chaco Research Archive**

Chaco Canyon is an area in the American southwest and was the object of study for several very early (1880's and early 1900's) archaeological expeditions (and several since). The materials: artifacts, field notes and reports, from those early expeditions came to reside in numerous repositories with varying levels of cataloging. This project is undertaking to make those materials accessible in order to enable synthetic research not previously practical. In this regard, a substantial amount of the data presently made available has been extracted from the original documents. In addition, most of the original repositories organized their cataloging by the individual leading the expedition. This is an issue only when the person lead several expeditions to several places and the resulting materials become mixed together.

This collection of information is clearly significant for archaeological scholarship. It seems that if could be significant for anthropologists and historians of archaeology. In addition, many of the physical artifacts are art object in and of themselves. Thus, the data collection has several of the aspects discussed above and make explicit the following requirements.

– Geo-referencing the data

– Data normalization

– Provisioning non-commensurate data

Enabling the presentation of multiple interpretations

Clearly geography is important to archaeology, so geo-referencing the data is desirable. However, the process of associating a UTM coordinate pair is rarely sufficient. Often, the geo-reference is really a local measurement, that is, an offset within a "context" that itself is not globally located[7].

As in most disciplines, what are considered to be "modern archaeology" techniques evolve over time, often requiring normalization of the resulting data[8]. In the extreme, the data may be partially non-commensurate[9] or completely contradictory[10]. Structuring databases and information architectures to allow for recording, analyzing and presenting such data is still a research topic.

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[5] For example, the Treatise on Painting is, as we would expect in modern books, broken into "chapters", however, the information to be recorded for each chapter is specific to the art history concerns of this project, e.g., does this chapter relate to a chapter in other volumes?

[6] Are the chapter-level "indexes" being created in the project of interest to the holding repository or to philological projects?

[7] The context is often one of a grid of meter-by-meter squares within which the excavation occurs. The lack of a global location reference might be because of lost documentation or because of faulty measurement of the location.

[8] This normalization varies from simple, e.g., all linear measurements to meters, to complex, e.g., merging naming schemes architectural units/subunits for revisited sites.

[9] For example, ceramic classification schemes often agree on most of their class, however, occasionally introduce completely new classes or reinterpret the attributes of a given class.

[10] While two classification schemes might be contradictory, in cases such as the expeditions studied by the *Chaco Research Archive*, an individual scholar might record contradictory measurements on the same situation. For example, the count of "full pots" found in a specific room might be listed as one value in the field notes and another in a expedition report. While one might tend to think the value in the report was an erroneous transcription of the field notes, it may actually have been a correction to the field note value.

Conclusion

I have discussed features of two particular projects but I believe they exemplify important issue related to the mission of cultural heritage in the arts and humanities. They share the following general structure.

– Multiple base repositories
– Multiple repositories for secondary sources
– Specialized research collections
– Scholarly analysis yielding new "objects" (many derived objects, some completely new) and new interpretations
– Many layers of interconnections between each of the above levels

The creation, maintenance and dissemination of the cultural heritage record of the arts and humanities from such information architectures is our challenge.

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SPOKEN LANGUAGE ARCHIVES AT THE LABLITA-LAB OF THE UNIVERSITY OF FLORENCE. PROJECTS AND RESOURCES

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The LABLITA-LAB

Language archives are a relevant domain in the frame of Cultural Heritage preservation and exploitation. Language diversity in particular is a crucial dimension of Cultural Heritage and constitutes a major issue in Europe. For this reason the setting up of language repositories have been largely funded in the last decades within the Framework programs of the EU.

LABLITA is devoted to the collection and annotation of multilingual language resources and to their exploitation for theoretical linguistics, lexicography, human language technologies applications, second language acquisition. It has a long experience with methodologies for dealing with both written and spoken language corpora in digital format and gathered language resources of European interest.

LABLITA runs corpus driven research for modeling language in all modalities with a special focus on spontaneous speech. It owns the largest corpus of spontaneous spoken Italian presently available and co-ordinates European and national projects. This brief presentation will focus on multilingual repositories accomplished at LABLITA through international collaborations.

C-ORAL-ROM. Integrated Reference Corpora for Spoken Romance Languages

C-ORAL-ROM provides a comparable set of corpora of spontaneous spoken language of the main romance languages, namely French, Italian, Portuguese and Spanish (772 spoken texts and 123:27:35 hours of speech). Four comparable recording collections of spontaneous speech sessions (roughly 300,000 words for each Language). The resource is the result of a project, which has been undertaken by an European consortium, co-ordinated by the LABLITA and funded within the Fifth Framework Program of the EU in ITC-Co-operation program.

The C-ORAL-ROM collection is now distributed in DVD by an international publisher for large exploitation in the academia (Cresti & Moneglia 2005) and by the European Language Resource Distribution Agency (ELDA).for the development of speech technology application in the industry.

C-ORAL-ROM have been recently integrated with a comparable corpus of Brazilian Portuguese in the framework of the agreement between the University of Florence and the Universidad Federal de Minas Gerais (Mittmann, Raso & Mello 2009).

Within the C-ORAL-ROM project a standard multimedia format for spoken language archives have been designed (Fig. 1). The format allows simultaneous access to both the acoustic and textual information. This makes easy the exploitation of corpus data for all purpose and in special for theoretical and applied research on prosody, discourse analysis, speech act theory.

RIDIRE. Risorsa Dinamica di Rete Italiana

The internet is the largest existing repository of linguistic information, but is also one of the main environments for the use of language, the space in which both functional and creative uses of a language are practiced with growing frequency. RIDIRE is a web-based infrastructure aimed at consolidating the teaching of Italian worldwide through the access to the web. This project builds up through crawling techniques a repository of the Italian Language which exploits the Italian contents on the web. The database collects massive amounts of freely downloadable documents, covering a selection of domains of language use which are relevant for the Italian identity: *law*, *religion*, *politics*, *literature*, *trade*, *administration*, *information*, *design*, *food*, *fashion*. The resource accomplished by a consortium of Italian Universities and funded by the FIRB Program of the Italian Ministry of Education is designed for use by all parties involved in the teaching of Italian abroad, who will be able to profit from the access to this huge database of representative texts to better characterize the Italian culture and way of life.

The resulting infrastructure will offer web access to language technologies that will allow the user easy access to Italian language use in all relevant domains, enhancing his capability to write Italian in accordance to actual use of language. RIDIRE.it, will be accessible and searchable online, and therefore easily usable for language learning purposes worldwide.

The IMAGACT-SEMACT Project

The IMAGACT project, now funded in the PAR/FAS program of the Tuscan Region, exploits available large scale English and Italian spontaneous speech repositories for building up a natural language ontology based on actual data.

IMAGACT bootstraps information on the semantic variation of verbs referring to actions in ordinary communication, which is one of the major challenge for automatic translation and cross-linguistic communication.

The project will provide trough corpus annotation a cross-linguistic ontology of the most frequent actions referred in the language usage. The resulting infrastructure will reverse the structure of bilingual dictionaries. IMAGACT will identifies through 3D films high frequency action concepts in everyday life providing their language encoding in Italian, English, Spanish and Chinese (Mandarin).

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RECOVERY AND CONSERVATION OF MUSICAL HERITAGE: THE MUSIC OF GRAND PRINCE FERDINANDO DE' MEDICI

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Musical heritage is an extremely complex area within cultural heritage, due to the interrelationship among its material and immaterial aspects and the necessity to combine conservation requirements with performance of the music of the past, a process that involves several media, with different conservation and management requirements: music is mainly a cultural product based on technical skills and habits, recorded on paper support with an evolving stenographic notation that requires interpretation and integration, and performed through musical instruments that often survive in heavily modified conditions and cannot stand musical use. For this reason the study and conservation of musical heritage requires a combination of historical, archival and material knowledge, on top of the purely musical one, that can only derive from collaborative efforts.

The project presented here is an example of this combination and reflects the result of a multifaceted project to study and recreate the musical context of the court of Grand Prince Ferdinando de' Medici (1663-1713). Ferdinando, son of Cosimo III, is remembered for his striking musical interest and contacts with Antonio Vivaldi, Georg Friedrich Händel and Domenico and Alessandro Scarlatti, making his court one of the most musically relevant of Europe in his years. He also created a unique musical instrument collection – part of which survives in the Cherubini collection in Florence – and surrounded himself of worthy musicians. Unfortunately his musical library was entirely dispersed and less than one tenth of his instruments survive, along with musical iconography, textual descriptions, inventories and other documents related to his musical interests.

Archival research, paleographic interpretation, the study of iconography led to the re-individuation of a relevant corpus of the music of that context, while technical and material studies provided the knowledge necessary to create accurate copies of some of Ferdinando's instruments, in order to revive – to the best of present understanding - a musical context that had been lost for centuries, in an effort to combine scholarly and artistic pursuit.

The project will be presented in a poster and a musical performance based on its results.

PUBLIC SPACE AS CULTURAL HERITAGE

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In their quality as lived spaces, places embody the complex stratification of meanings that people attach to them. Places hold a special sense that does not lay in their physicality, but in their ability to communicate, generate and regenerate – also through their specific material setting - relationships, interaction, identification/recognition, in short social meanings.

The capability of lived space to hold sense and social meanings is especially true for public spaces: every public space, as a vehicle of inter-subjective signification, can in a certain sense be considered part of cultural heritage. Their sense does not simply proceed from the original architectural project, but from the changing meaning deposited through their social use (or not use).

In fact we can apply to public spaces what Clifford Geertz wrote about "cultural" products. They can be seen as a kind of "text", and just because they are text, they do not simply communicate something about the cultural context where they have been created, they go beyond it and are subject to different interpretations. Cultural products directly "speak" to us, they are able to transfer an infinity of messages according to different historical and cultural frameworks.

Public spaces, independently from the period in which they have been created and from the intention of the architect who projected them, embody a changing social meaning deriving from the way people use them, a meaning that is worth to investigate from a socio-cultural (and not merely architectural) point of view.

A socio-cultural perspective has been in fact adopted in the recent debate on public space, for example by R. Sennett and S. Zukin, just to limit us to the most famous names. But the empirical reference point of the debate have been, with few exceptions, north–american cities. Even studies in Italian language lack empirical research on European and especially on Italian cities, often adopting a more evocative than systematic and analytic character.

The Italian public space – especially squares ("piazza") – has been a very important matter of study, but mostly from the perspective of disciplines like Architecture or History of Arts. Little is known about the way Italian public space has been actually perceived and used, about its role in forming public speech, in trading, renewing and negotiating cultural heritage.

This very perspective is at the base of the research we have set up on Florentine public space. We have tried to understand to which extent public space embodies elements of collective cultural heritage, within global processes that are deeply transforming urban life.

Our studies focused especially on squares, outdoor cafés and markets.

The results show that squares and markets, in fact, preserve, and at the same time nourish, specific kinds of meanings and social interaction, that could not be reproduced in other formats. This patrimony, impossible to abstractly

Squares and malls are perceived as

clean	2,69 ... 3,79	dirty
tidy	2,62 ... 3,57	messy
friendly	2,72 ... 2,88	hostile
beautiful	2,75 ... 3,12	ugly
open	3,48 ... 3,66	closed
cosmopolitan	3,48 ... 3,62	provincial
exciting	4,48 ... 4,67	boring
quiet	4,26 ... 5,25	noisy
safe	4,84 ... 6,09	dangerous

very   medium   very

■■■ squares (n=1.168)   ■■■ malls (n=145)
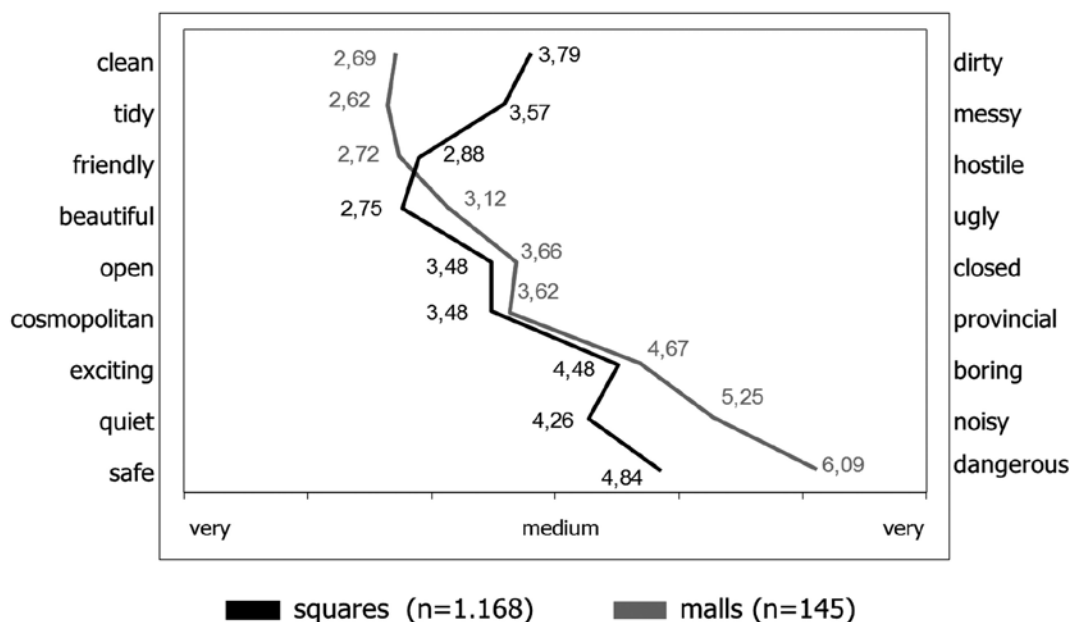
fix in predefined traditional forms, represents a precious cultural heritage, which greatly contributes to regulate and characterize city life.

Our studies on Florentine squares show that they are perceived as materially and socially stable contexts, which communicate a positive feeling of reassuring security. Face-to-face verbal interaction still plays an important role, even if it tends to reinforce identity dynamics more than setting in motion integrative mechanisms. Surprisingly public squares are perceived as being safer than the - obviously more controlled – malls. Therefore some tendency to open-mindedness in front of diversity seems to be the positive effect of the "throwntogetherness" (D. Massey) experienced in the squares.

Our studies on outdoor cafés provide precise and "objective" criteria to quantify the intensively discussed erosion of public space in contemporary cities. They demonstrate the increasing commercialization of public space that accompanies the tourist growth and the new tendency to consume the city as a place for entertainment (foodatainment, drinkatainment). At the same time, however, they allow a better understanding of the changing line that separates private from public sphere, as well as of the new forms of conviviality that outdoor cafés introduce in our daily life.

Our studies on city markets, at last, illustrate that they are not merely places of supply; they are occasion for continuously building and negotiating identities. Especially Florence Central Market plays a crucial role for the social and cultural life of the neighborhood, even impacting on the way tourists experience that area and, consequently, on the image of the city.

Morella Loda is Professor of Geography at the University of Florence and responsible for the Laboratory of Social Geography (LaGeS, www.lages.eu). Her research focuses on the ongoing social and economic structure of contemporary city with special regard to changes in historic city centers and to use and management of urban public space She cooperates with the Italian Ministry for Foreign Affairs and is in charge of numerous development projects in Afghanistan. She is author of four books and has written over 50 articles mainly in Italian and German.
Silvia Aru got her PhD at the University of Trieste and has been visiting scholar at the University of British Columbia (Vancouver). She is currently research fellow at University of Cagliari. Her fields of interest concern Social and Cultural Geography, the Geography of languages with particular attention to the social constructions of identity (national, local, gender etc.).
Diego Cariani received his master degree in "Human geography and regional planning", at Florence University. He collaborates with LaGeS and is a research fellow at the Florence University. He is skilled in qualitative and quantitative empirical research mainly applied to studies on public space and territorialization processes.
Cristina Lo Presti graduated at the University of Florence in "Human geography and regional planning", and is now attending the Master Degree in Geographical and Anthropological Studies. She has researched on informal buildings and slums in Delhi urban area. She attended Film Direction Classes and is specialized in videos and documentary films.

AD900: WRITERS' PAPERS ONLINE

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

Mission

The 'Aldo Palazzeschi' Study Centre deals with the preservation, development and printing of manuscripts and icon-ographical materials left by the writer Aldo Palazzeschi to the University of Florence; the Centre also promotes research on the European cultural heritage of historical avant-gardes; it is a specialised centre which incorporates the use of computer tools in the preservation and study of manuscript deposits of relevant literary and cultural interest.

Main areas of activity and research

From 2000 to date, the study centre has been engaged in the creation of the databank ad900 (Digital Archive of Twentieth-Century Italian Literature), which encompasses digital reproductions and transcriptions of paper and audiovisual documents as well as archive records, bringing them together in a single integrated system.

Manuscripts, letters, photos and video clips in digital format can be viewed and consulted online, allowing for a wide range of research activities on facts and texts.

In keeping with copyright laws, consultation and reproduction of materials is subject to multi-level authorization.

ad900

ad900 (www.ad900.it) contains nine archive deposits (from the University of Genoa, Florence, Rome 'La Sapienza', and Turin), for a total of about 40.000 archive records, 60.000 images and 3.000 authority files (Fig. 1).

Archive documents (correspondence, books, manuscripts, cataloguing records, iconographical material and audiovisuals) have been converted to digital format and filed according to the international archiving standards isad (General International Standard Archival Description) and isaar (International Standard Archival Authority Record) for authority records and integrated in a common software platform set up exclusively with internet/intranet technology. ad900 offers controlled access by authorisation, with the option of allowing differentiated access according to authorisations given by each separate archive manager. Registered users can carry out a wide range of searches for keywords within the whole database or a single archive, and come up with cataloguing records, which offer complete descriptions of their documents and have been created according to international standards (with the addition of several personalised fields designed to meet the specific requirements of literary research). Each cataloguing record offers a link to a digital reproduction of the original paper document (definition varies according to authorisation) or audiovisual document.

This tool has enormous potential, especially considering the problems connected with preserving writers' papers, since direct access to the original documents can thus be strictly limited to utterly exceptional cases. Above all, ad900 is an endless source of unpublished information and updates that can be consulted with a systematic and

comparative approach. Research potential is even greater when the document facsimile is linked to a digital transcription (see for more information Magherini, 2009).

Writers' papers online

This research project consists in adjusting ad900 to the typical requirements of an institutional open archive by creating an innovative access portal. This will allow users to consult digital archives of modern European literature on the Web.

One of the innovative aspects of writers' papers online is the systematic use of descriptive formats in xml language (eXtensible Markup Language). Use of these formats optimises dialogue between ingoing and outgoing information, thus providing the opportunity to integrate new literary archives into the ad900 software platform without having to make substantial changes to portal structure (scalability). These descriptive formats also allow data migration to different platforms (portability), and guarantee ad900's ability to cooperate with other systems reliably while optimising resources (interoperability), ensuring the durability of data in the long term. The use of oai-pmh protocol (Open Archives Initiative - Protocol for Metadata Harvesting) permits the circulation and recovery of data from digital archives on the Internet, while preserving the privacy and property of data owners. Even in processing literary texts, a markup plan will be laid out according to xml-tei standard, so as to allow marked-up texts to be linked to ad900's internal search engine, improving its capacity to filter results as well as its philological applications (generating concordances and study of variants, together with the opportunity to see images of first editions).

This research project thus aims to make a decisive contribution in the setup of the Semantic Web, a space where published documents are associated with metadata which specify their semantic context in a form which may be queried and interpreted.

Simone Magherini is Assistant Professor of Italian Literature at the Faculty of Humanities of the University of Florence. He devotes himself to archives research, to the study of literary letters and poetry of Nineteenth and Twenty Centuries, and to the informatics applications in the Humanities field.He edits the first volume of the *Letters* Moretti-Palazzeschi (1999); a biography of Palazzeschi by images *Scherzi di gioventù e d'altre età* (2001); the catalogue of the *Biblioteca di Aldo Palazzeschi* (2004); the catalogue of the exhibition *Dal Vate al Saltimbanco* (2008); the proceedings of the symposium *Tradizione e modernità* (2009); the *Letters* Palazzeschi-Soffici (2011). On the Informatics side he projected ad900 (Digital Archive of Italian Literary Twenty Century), a modern and useful digital built-in archive for on-line access to the cataloguing cards and to the facsimile reproduction of the papers of Italian poets and writers, on which linguistic research is possible.

Session 2
Science for conservation of Cultural Heritage

SCIENCE FOR CONSERVATION OF CULTURAL HERITAGE

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

Summary of contributions

Subsession 2.1: Conservation methods and materials science

Lars Ivar Elding (*Univ. of Lund, Sweden, and the Vasa Museum*) stressed the rapid scientific development of methods for characterization of properties of heritage materials during the last decade, exemplified by the research on the Vasa warship. *Light- and electron microscopy, X-ray diffraction, -scattering and -fluorescence, synchrotron-based methods such as EXAFS, XANES and X-ray microscopy, solution and solid state NMR spectroscopy, mass spectroscopy (GC and MALDI-TOF)*, as well as chemical analysis by *size exclusion chromatography, lignin analysis, carbon-14 radioactive analysis* and analysis by use of *microbiological and molecular biological methods* have given significant new information. Novel methods for determination of *mechanical properties* of archaeological wood have been developed, as well as computer simulations involving finite element methods, enabling extrapolation of physical data for single construction elements to complex macroscopic structures. This rapid technical development will continue and accelerate. New technologies such as *time-resolved laser spectroscopy, ultrasound studies, neutron diffraction and micro-calorimetry* might be useful. Quantitative determination of the chemical and physical conditions of materials must be carried out before conservation. To predict the expected life-time of wooden artefacts, the key parameters controlling the nature, absolute rates and relative contributions of the various possible degradation reactions must be known. In addition to oxygen consumption measurements and accelerated ageing experiments (inherently difficult to interpret), *novel methods for determination of degradation reaction rates of heritage artefacts as a function of external conditions* have to be developed. Another important field for future research is the development of *novel conservation and stabilization agents*. Novel methods are usually developed at university laboratories or other research institutions. A successful knowledge transfer to those responsible for the cultural heritage will most certainly necessitate future increased recruitment of scientifically trained museum staff.

Matja Strlic (*UCL, London, UK*) emphasized the use of non-destructive methods for material characterisation, in particular *near infrared (NIR) spectroscopy with multivariate data analysis (MVA)*, applied to the study of materials such as paper, ink, parchment, textiles, canvas, and photographs. Applications range from determination of age and provenience to modelling of material properties and estimation of future stability of heritage objects. Modelling of material stability with non-destructive methods is most interesting in the assessment environmental risks to heritage collections and will give hints about the processes governing the degradation reactions.

Luca Uzielli (*Univ. of Florence, Italy*), chair of COST Action IE0601, "Wood Science for Conservation of Cultural Heritage", discussed applications of Materials Science to conservation issues. This COST action aims to improve the conservation (including study, preventive conservation and restoration) of European wooden cultural heritage objects, by fostering targeted research and multidisciplinary interaction between researchers in various fields of wood scien-

ce, conservators of wooden artworks and scientists from related fields. The action's final conference will take place in Paris in November 2011. Cultural Heritage results from this action was presented. A better understanding of *ageing processes and their effects* on wood is needed, as well as *techniques for their detection and evaluation*. Although processes might be very slow, they could still be very serious after a few decades. Further *improvement of non- or minimum-invasive techniques*, mainly dealing with instrument portability, efficiency, resolution, cost and ease of use are needed. The *connection between climate and degradation* is important, in particular in a world where the climate is changing. *Better preservation techniques and consolidants for degraded wood* are needed, as well as better *methods for assessment of the load-carrying capacity of timber structural elements*. Better general *guidelines for assessment and documentation of cultural heritage artefacts* are also needed.

Philippe Colomban *(CNRS, Université Pierre-et-Marie Curie, Thais, France)* stressed the importance of *portable instruments and non-invasive analysis* for scientific study of cultural heritage materials. Development of such devices is linked to progress made in other fields, such as instrumentation for military and aerospace applications. Together with the rapid development of computers, this has led to a revolution in the scientific instruments: their size and weight have decreased by one order of magnitude, as illustrated by the development of *portable Raman devices*. Raman spectroscopy offers a "bottom-up" approach to nano materials and amorphous compounds such as glass. The information obtained by Raman spectra may help in tracing the origin of an artefact. Thus, the development of preparative chemistry since the 14th century has led to new inorganic and organic pigments, giving reliable chronological markers. Using mobile instruments, the study of artefacts such as pastels, bronze, pottery, glass and enamels is possible in the museum rooms or even outside; building parts (e.g. stained glasses), rock art paintings, etc, can be studied. At present, laser wavelengths available for portable instruments are limited to green for inorganic samples and red for organic compounds; the near infrared or ultraviolet/visible spectral range may be obtained by portable sources; convenient miniaturized spectrometers will be available in the near future.

Posters dealt with the effects of thermohygrometric variations on wood panel paintings, development of biopolymers of microbial origin for cleaning of stone artwork and of polymeric systems for cleaning of painted surfaces, use of composite hydroxide/silicate nanomaterials for conservation of architectonic surfaces, techniques based on solid-phase immunoassay and amino acid assay for analysis of protein binders in paintings, and analysis of the effects of fungi colonization and blackening on artistic marbles and limestone.

Subsession 2.2: Archaeometry

This is a broad interdisciplinary field covering the application of many scientific branches (chemistry, physics, geology, mineralogy, biology, material science, etc.) to Archaeology and History of Art.

Vincent Serneels *(Univ. Fribourg, Switzerland)* discussed the archaeology of iron production. Iron is the most efficient metal for the production of tools and weapons and of high strategic and economic importance for pre-industrial societies. At a regional scale, the global approach offers the opportunity to reconstruct the socio-economic patterns and to describe the organization of the production. Ancient production technology of iron can be reconstructed using different approaches such as analysis of excavations, and (the generally scarce) leftover materials such as slag heaps, charcoal remains etc, combined with experimental reconstructions. It was empha-sized that in Northern European countries, mining and metallurgical remains from production of iron and other metals are now being recognized as a significant part of the cultural heritage (15 sites on the UNESCO list involve mining or metallurgical remains), whereas in Southern Europe, attention has been paid almost only to the most ancient periods. This gap should be filled by cooperative work in the next future.

David Bourgarit *(Centre de Reserche et Restauration Musées de France, Paris, France)* demonstrated the usefulness

of *experimental laboratory simulations of ancient metallurgical processes* for their clarification and quantification. Multiple-scale simulation is developed, ranging from the modelling of the theoretical mechanisms underlying the processes, to the field reconstruction of the real operation. Experiments based on model systems where complexity is gradually increased, is a way to optimize the scanning of working conditions. In this way, ancient brass cementation processes have been elucidated. A plus value of this experimental approach is education (of students and of a larger audience, and self-education) taking advantage of the fact that people with a variety of backgrounds are working together, including archaeologists, historians, archaeo-metallurgists, founders, curators, restorers, metallurgists from the modern industry, and furnace designers.

Aurelio Climent-Font (*Universidad Autonoma de Madrid, Madrid, Spain*) presented the use of *Ion Beam Analyses (IBA)* to the study of works of art, with particular reference to lustre ceramics. Lustre is a process for decorating glazed ceramics by inserting metallic nano particles into the existing glaze covering the ceramic object, a method first developed in the Middle East (9th AD). A variety of analytical techniques have been dedicated to characterize the lustre. The complementary use of IBA techniques like *Rutherford backscattering spectrometry (RBS)* and *Particle Induced X-ray Emission (PIXE)* has been successful for the characterization of lustre ceramics.

Vivi Tornari (*IESL, Heraklion, Greece*) provided an overview of the development of *laser technology* as an analytical and structural tool and as a surface cleaning method together with a presentation of state-of-the-art instrumentation. The specific case of structural diagnosis has been developed in the last decade through two specific projects of FP5 and FP6, resulting in new applications ranging from direct surface monitoring to assessment of impact and tracing of fraud art market.

Posters described methods for analysis and preventive conservation of contemporary artworks by pyrolysis and GC/MS, the use of various spectroscopic microanalyses (Raman, ATR, LIBS) for pigments used in Ethiopian rock art paintings, characterization of ancient mortars and manufacture of modern ones to be compatible when used for restoration or consolidation of ancient buildings, Surface-Enhanced Raman Scattering (SERS) for analysis of micro-invasive samples of textile dyes, novel consolidants for wood conservation with structures similar to wood, and experimental monitoring of the poplar wood panel of the Mona Lisa painting.

Subsession 2.3: Climatology and influence on monuments and artefacts

Carlota Grossi Sampedro (*Univ. East Anglia, Norwich, UK*) stressed that the chemistry of the atmosphere is changing in response to climate changes and new environmental policies. The environment is rapidly changing and new models are needed to predict the fate of our cultural heritage. Even a cleaner atmosphere is a factor of increasing importance. Research on the impact of climate change on cultural heritage, such as the pioneering NOAH's ARK and the "Climate for Culture" projects is important in this context. The concept of *"Heritage Climatology"* is the study of how climate parameters affect monuments, materials and sites. A future challenge is the need of extensive research in the area of climate change and stone heritage. Such research should include:

Improving the knowledge of stone vulnerability to climate (proxies for damage, climate parameterisation and damage functions);

Monitoring long-term changes;

Development and down-scaling of high spatial and temporal climate resolution models to modelling work for urban areas;

Estimation of reliability and uncertainty;

Management and development of long-term strategies to prevent damage.

Koen Janssens (*Department of Chemistry, University of Antwerp, Belgium*) presented the potentialities of *macroscopic scanning X-ray fluorescence (MA-XRF)* as a non-destructive analytical technique suitable for monitoring of arte-

facts, in particular paintings by Old Masters, where it may provide a wealth of novel information. Underlying paint layers may be investigated, demonstrating for instance underdrawing, underpainting and alterations. Abandoned compositions on paintings can be discovered, illustrating the artists' practice to re-use a canvas or panel. Such information is also often highly relevant in conservation, when stability problems such as paint discolouration or delamination are studied. Work of this kind is a common research theme shared by curators, conservators and conservation scientists. The method has a great potential, both for art-historical studies as well as for conservation studies of painted works of art and associated value judgements.

A poster discussed the importance of climate monitoring and -control and its importance for the best conservation conditions for objects exposed inside museums.

Subsession 2.4; Novel non-destructive techniques for diagnostics

Rinaldo Cubeddu (*Physics Department, Politecnico of Milano, Italy*) described the development of non-invasive methodologies and portable instrumentation for in situ studies of works of art. *Optical and laser spectroscopy* techniques offer possibilities to identify both the inorganic and organic components of artistic objects with high sensitivity and reproducibility. The possibility to operate with instruments capable to collect spectral information from adjacent points in order to reconstruct spectral maps of artefacts was described. The advantages of imaging techniques, rather than single point measurements, were emphasized. No single technique can face the complex problems encountered in cultural heritage analysis, while the synergic combination of in situ measurements and laboratory techniques allows one to gather the information required for a well designed conservation intervention.

Motoyuki Sato (*Tohoku University, Japan*) presented the *ground-penetrating radar (GPR)* technology, capable of recording information about the subsurface. GPR is mainly employed in prospecting campaigns allowing discovery, mapping and imaging of buried archaeological remains not accessible using traditional field methods. It can be used to guide excavations or to define sensitive areas containing remains to be avoided. The success depends on soil and sediment mineralogy, clay content, ground moisture, depth of burial, surface topography and vegetation. These aspects were discussed also in relation to the consequences of the earthquake and tsunami that attacked Japan on the 11th March, 2011.

Posters presented a multitude of novel instrumental methods for monitoring of cultural heritage objects, such as non-destructive technologies for in situ analysis by use of portable spectrometers, novel early-warning systems for protection of indoor cultural heritage (detecting volatile organic compounds), Hyper-Spectral Imaging for non-invasive diagnostics of paintings and surfaces, remote sensing laser technology for detection of instability of cultural heritage due to geohazards, tetrahertz imaging technology for investigation of artworks, microwave interferometers as a tool for detection of vibrations in buildings, technology for measure of moisture content in historical masonry, radar interferometry for detection of structural deformation and terrain motions, and –finally- infrared thermography (IRT) for detection of heat diffusion processes in samples, providing information on material, structure and processes.

2. Summary and Conclusions

Some general conclusions can be drawn from the material presented in this session.

New instruments and technologies

There is a current rapid technical development of instrumentation and methods for investigation of cultural heritage artefacts stimulated by the rapid and accelerating progress in computer technology, physics and chemistry, and by easier access to large scale instrumental facilities. It is easy to foresee that this development will continue and accelerate even more. Two main lines can be identified:

Development of novel portable, easy-to-use instruments enabling non-invasive investigation of artefacts, often directly on site in the museum, usually without need of transport or destructive sampling, and often based on spectroscopic techniques. The workshop has given a multitude of examples of such methods. Another line of development in this field is the construction of instruments for remote sensing like the ground-penetrating radar and the remote sensing laser technology.

Easier access to large-scale international facilities, such as synchrotrons (e.g. ESRF Grenoble, SSRL Stanford, MAX Lund, Daresbury, UK) and neutron sources (like the European Spallation Source, ESS, now under construction). Use of these facilities enables detailed chemical analysis of speciation and distribution of chemical species in artefacts, not accessible by the small-scale instruments. However, they usually require destructive sampling. Development towards more powerful radiation sources will enable smaller samples.

In general, new technologies such as *time-resolved laser spectroscopy, ultrasound techniques and micro-calorimetry* might offer further possibilities for elucidation of the state of art of archaeological materials. Synchrotron radiation-based *X-ray Absorption Spectroscopy (XAS)*, an already well established investigation method, and synchrotron-based *infrared micro-spectroscopy* will develop further for studies of artefacts, as well as *neutron tomography and computer tomography*.

Development of techniques based on *microbiology or molecular biology* will be important for the diagnosis of artefacts in terms of their historical and current microbial status. They are also important for the understanding of microbial degradation processes.

Development of *advanced computer simulations* involving finite element methods will be important for extrapolation of physical data determined for structural elements to complex macroscopic structures such as bridges, buildings and ships, as a basis for strategic decisions on future preservation measures.

New preservation methods

Novel materials and procedures for stabilization and preservation of heritage materials are being developed. For instance, novel consolidants for archaeological wood could be based on spontaneous assembly to supramolecular structures, and be given properties allowing capture of free radicals and detrimental metal ions. This will be an important field for future research in organic synthesis and supramolecular chemistry. Methods for extraction or neutralization of detrimental chemicals from artefacts are other important fields of future research.

A number of contributions have described the development of novel materials for consolidation or cleaning of surfaces of heritage objects like stone and buildings, paintings and mural artwork. In this field research in nanoscience, material science and chemistry will offer future advances. Laser technology has proven to be an alternative very efficient cleaning method.

Methods for removing undesirable substances and conservation agents followed by re-conservation with state-of-the-art techniques are also a field of current great importance.

Lacks of knowledge

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.

A future challenge is the need of extensive research in the area of climate change and cultural heritage artefacts. Understanding the connection between climate and deterio-ration is extremely important, in particular in a world where the total climate is changing. For example, a deeper understanding of degradation mechanisms of paint layers (in particular on wooden panels) as a function of local climate fluctuations is urgently needed. In general, high-tech climate installations and monitoring systems are necessary for long-term safe preservation of valuable artefacts.

Forefront topics

Can be shortlisted as, for instance:

Development of novel portable, easy-to-use instruments

Increased utilization of large-scale international research facilities

New techniques for evaluation of nature and absolute rates of degradation processes

Methods to stop/decelerate degradation processes

New technologies for non-destructive analysis and monitoring

Elucidation of connections between climate and deterioration

Better techniques and materials for consolidation and cleaning of artefacts

Methods for assessment of load-carrying capacity of structural elements

Development of standards and guidelines for care of European cultural heritage

Interdisciplinary research

Conservation and preservation of heritage materials is by nature interdisciplinary. For instance, current research on the Vasa warship involves close co-operation between scholars from e.g. wood chemistry and technology, molecular biology, physical, inorganic and organic chemistry, materials science, nanotechnology, mechanical engineering, computer science and conservation science. Similarly, preservation research on artwork such as paintings, ceramics, glassware, sculptures and buildings will need close co-operation between specialists in various branches of natural sciences together with those in history, history of art, architecture, etc. The investigations exemplified by the studies of early metallurgical processes and mining offer possibilities for co-operative research involving technology, chemistry, history, economy and social sciences. The exposure of heritage artefacts to a changing climate and to environmental pollution of various kinds necessitates close co-operation between specialists in climatology, atmospheric chemistry and preservation science. The ground-penetrating radar is an example of cross-fertilization between archaeology and geophysics. Thus, interdisciplinary research is and will be of paramount importance for future successful preservation research in the Cultural Heritage area in total.

At the same time, a close co-operation between scientists, who are usually based in universities or other research institutions, and those responsible for the practical preservation work will be necessary and should be stimulated through educational efforts.

Educational aspects

Novel investigation and preservation methods and new instrumentation are usually developed at university laboratories or other research institutions. A successful knowledge transfer 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.

Research in the area of cultural heritage stimulates cross-fertilization between different fields of competence. Noteworthy, scientific research on cultural heritage problems is usually very interesting for the general public, mass media and school children, and could enforce the interest for and understanding of research in natural sciences and technology in Europe, which will be an important side track.

PRESERVATION OF THE VASA WARSHIP

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Introduction

VASA sank in 1628 in Stockholm harbor during her maiden voyage. The shipwreck was relocated during the 1950s and was raised to the surface in 1961. The absence of shipworm in the brackish waters of the Baltic Sea and the anaerobic conditions and low temperature in the bottom sediments 30 m below the surface contributed to the preservation. Several tons of iron compounds from rusting cannon balls and iron bolts and sulfur compounds from the water and polluted effluents from the town impregnated the wood. Attacks by erosion and sulfur-metabolizing microorganisms softened the wood surfaces. During conservation 1962 to 1979, the hull was treated with aqueous polyethylene glycol (PEG) solutions and then dried for another ten years. Large amounts of PEG and boron compounds were added to the timbers in this process. Since 1989, the ship and its collections are kept under controlled climate conditions in the present museum. During the 50 years since 1961, the ship has been exposed to atmospheric oxygen and various degrees of humidity, which has created favorable conditions for chemical and biological degradation processes and transport of chemicals in the wood. This has been the subject of intense multidisciplinary research by an international group of scientists during recent ca 10 years.

VASA is a complete 17th century warship, the largest artifact of its kind in the world with a current mass of ca 900 tons (ca 90% is oak wood) and with more than 20 000 loose wooden objects. So far she has attracted more than 30 million visitors (at present 1.2 million/year); thus being one of the major cultural heritage attractions in Scandinavia and Europe.

Current state of knowledge

Microbial activity under the present dry conditions is negligible, but has been important during the time on the seabed and probably also during the wet phases of the conservation; previously active microbial species have been identified by DNA and RNA analysis. Current wood degradation is caused by chemical processes, involving sulfur and iron compounds in combination with the humidity of the wood and atmospheric oxygen. The chemistry consumes oxygen, and methods for measurement of oxygen consumption in wood have been developed. Acidic salt deposits on wood surfaces, indicating transport of chemicals from the interior to the surface were observed in the 90ties. By use of X-ray diffraction and synchrotron-based X-ray absorption near edge spectroscopy (XANES) the chemical composition of these deposits have been identified, and the mechanism of their formation is currently being studied in climate chamber experiments. Speciation and spatial distribution of sulfur and iron compounds in the timbers has been elucidated in detail by use of synchrotron-based methods, i.e. XANES and scanning X-ray microscopy (SXM), together with X-ray fluorescence, ESCA, scanning electron microscopy and X-ray powder diffraction. High concentrations of sulfur and iron in the bacterially degraded surface regions of the timbers, in some cases up to 10% by weight,

favor sulfuric acid dependent hydrolysis of cellulose in this region. Deep below the surface, sulfuric acid concentrations are negligible, and cellulose degradation as observed by means of size exclusion chromatography might be due to free radical reactions of Fenton type and/or acid hydrolysis caused by organic acids, in particular oxalic acid. Mechanical properties of VASA wood is studied by use of axial tension measurements and there is a positive correlation between the mechanical weakening and the extent of chemical degradation. The long-term changes of the wooden structure of the ship are monitored by use of a precise geodetic positional system. The changes are slow and most probably also not linear over time. Chemical degradation and mechanical weakening are important also in the deep interior of the timbers.

Lacks of knowledge; demands on specified themes

Still unknown key parameters are the exact nature of the various possible chemical degradation reactions, their individual rates and their relative contributions to the over-all ageing of the wooden material. These basic data will affect the expected life-time of the ship. Attempts to determine the time dependence of the chemical processes by oxygen consumption measurements are not conclusive due to the heterogeneity of the materials. Simulation experiments of the time-dependent changes of the real material by accelerated ageing experiments on fresh oak exposed to various well-defined chemical treatments have given some information, but are inherently difficult to interpret.

The heavy ship construction is subject to gravitational forces and its long-term preservation and stability will depend on the mechanical properties of the wooden construction details and their change over time. These in turn depend on the chemical degradation status, and the time dependence of the chemistry. Since this is still not sufficiently well known, the rate of the mechanical weakening of the hull is also not known. Moreover, mechanical properties have been determined on a microscopic level. To be practically useful, this knowledge has to be extrapolated to the complex, heterogeneous and heavy hull structure, which is not a trivial operation.

Forefront topics

Methods for evaluation of the precise nature and rate of the chemical degradation processes have to be developed, and methods to stop or at least decelerate these processes under museum conditions must be given high priority. Wet chemical methods for neutralization of acids, removal of iron compounds and preventing free-radical processes should be further developed, as well as gas treatments for neutralization or for exclusion of oxygen. Environmental parameters such as relative humidity, temperature, light, and support structure have to be optimized. Hi-tech climate systems in museums are a necessity for successful preservation.

Development of novel conservation and stabilization agents will also be of high priority. These could be based on spontaneous assembly to supramolecular structures, and be given properties allowing neutralization of acids, free-radical capture or complexation of detrimental metal ions. This is an important field for future research in organic synthesis and supramolecular chemistry.

The occurring chemical processes are inherently slow, and there is a big problem in determining their absolute rates, since accelerated ageing experiments and oxygen consumption measurements are difficult to interpret. An alternative would be to quench reactions for a long period of time by low temperature and inert gas for future analysis, comparing the result with wood aged under museum conditions.

Quantitative evaluation of the correlations between the chemical processes and the mechanical properties of the wood has to be further developed. The recorded microscopic mechanical properties have to be extrapolated to the properties of macroscopic timbers and the complex hull structure and have to be supported by systematic observa-

tions of the movements of the hull structure and with complementary experiments on creep properties of wood species under well defined loads. Computer simulations involving finite element methods will be important for decisions on future actions to support the hull.

New technologies

Chemical analysis of archaeological wood, based on a wide spectrum of instrumental methods, has been successfully developed during the last 15 years and has resulted in a lot of novel information. New technologies that might offer further possibilities for elucidation of the status of archaeological wood might involve fast laser spectroscopy, ultrasound studies, neutron diffraction, X-ray scattering and calorimetry. Technologies for long-lime storage of quenched wood samples under low temperatures and inert gas should be developed, as well as technologies based on novel consolidants.

Needs of interdisciplinary research

Successful preservation work necessitates close co-operation between scientists and practitioners. Preservation technology has become increasingly more advanced and is now based on front-line research. A successful knowledge transfer from scientists to practitioners will most certainly in the future necessitate increased recruitment of scientifically trained museum staff.

Conservation is by nature interdisciplinary. For VASA, close co-operation between specialists in wood chemistry and technology, molecular biology, physical, inorganic and organic chemistry, materials science, nanotechnology, mechanical engineering, computer science and conservation science will be of future increased importance.

Acknowledgement

Lars I. Elding, PhD, FRSC, is emeritus professor of Inorganic Chemistry at Lund university, Sweden. He has held positions as acting professor of Physical Chemistry at Lund, professor and chair of Inorganic Chemistry at Chalmers' university of Technology in Gothenburg and at Lund university. He is author of papers in co-ordination, bio-inorganic, organometallic and atmospheric chemistry, in particular reaction kinetics and mechanisms. He has been a member of evaluation committees for Swedish and Danish research councils, of EU evaluation panels for TMR and IHP networks and of a COST D6 management committee - Chemistry under extreme conditions. He is senior scientific co-ordinator at the Swedish National Maritime Museums, responsible for the international, multi-disciplinary research programs on the preservation and conservation of the warship Vasa in Stockholm, involving research groups in Sweden, Denmark, Finland, UK, Italy and Australia. He is a member of the Preservation Council of the Vasa Museum.

NIR SPECTROSCOPY FOR VISUALISATION AND MODELLING OF DAMAGE

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THE SAFEGUARD OF CULTURAL HERITAGE

Among the instrumental techniques for non-destructive heritage material characterisation, near infrared (NIR) spectroscopy with multivariate data analysis (MVA) is rapidly increasing in popularity. There is a variety of commercially available instruments available, from benchtop instruments, fibre optics instruments, to hand-held instruments, reflecting the large number of application areas. In the last couple of years, imaging components have also become commercially available in the spectral

Fig. 1: Applications of NIR spectroscopy on photographs include dating, provenancing, and stability prediction,and thus provide information for curators as well as collection managers.
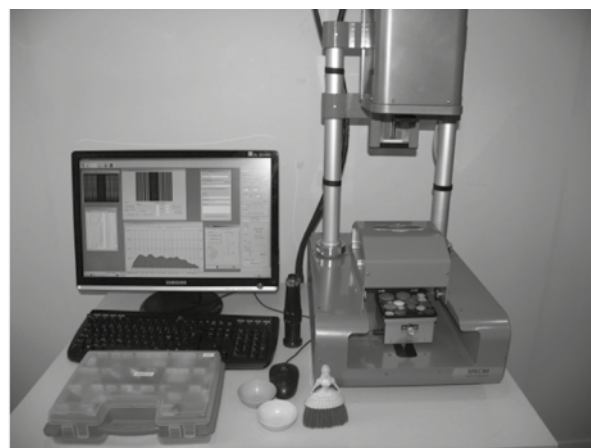
Fig. 2: NIR imaging in the region 970-2500 nm enables quantitative imaging of chemical information on a heritage object thus providing the information on degradation hotspots to a conservator.

NIR spectra are, especially compared with the mid-IR region, comparatively simple, exhibiting a small number of poorly resolved peaks reflecting overtones and combination vibrations. These mainly represent the vibrations of C-H, N-H and O-H functions, which is why NIR spectroscopy is most useful for characterisation of organic materials. On the other hand the spectra are particularly information-rich as vibrations of many bonds appear at several positions in the NIR spectrum, however, multivariate analysis (MVA) is often necessary to extract the useful information. Using chemometric tools, such as principal component analysis (PCA), partial least squares regression (PLS), and discriminant analysis (DA) it is possible to extract qualitative and quantitative information from the spectra. To do so, analyses of known samples need to be performed first – an obstacle, which is difficult to overcome because well characterised sample sets need to be available.

The number of research groups developing interesting and extremely useful NIR/MVA applications is increasing, and two SMEs already offer applications developed for heritage materials. Among the applications, those developed for

plastic heritage materials, paper, ink, parchment, textiles, canvas, and photographs currently prevail. Applications range from dating and provenancing, to modelling of material properties and future stability of heritage objects. Recently, NIR/MVA imaging has been developed (Fig. 2) [1]. The most common plastic materials can be identified and plasticizer distribution can be imaged. It has also been shown that, for the first time, chemical properties of a heritage object can be imaged, such as acidity and molecular weight. This enables the users to visualise damaged areas of an object.

The limitation of NIR/MVA methods is that they can only be applied to objects and materials that are similar to those that have been used in method development. Additionally, the uncertainties are necessarily bigger than those of the reference methods. However, NIR/MVA is often the only available method of quantitative analysis for organic heritage materials.

It is the application of NIR/MVA to modelling of material stability that is probably most interesting in assessing the related environmental risks to heritage collections. The application of NIR in collections appraisal, the latter becoming an integral part of some collection management standards, will thus be discussed.

Acknowledgement

Reference

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Matija Strlic joined the Centre for Sustainable Heritage, University College London as Senior Lecturer in Sustainable Heritage in 2007 and is am also the Course Director of the MRes Heritage Science. His research interests include development and use of damage functions and integrated modelling of heritage collections. He is the Principal Investigator of the UK AHRC/EPSRC Science and Heritage Programme project Collections Demography (2010-2013) and coordinated the EU project SurveNIR (2005-2008, "Near Infrared Tool for Collection Surveying"), scientifically coordinated Papylum (2001-2004, "Chemiluminescence – a novel tool in paper conservation studies"), and cocoordinated the 8th European Conference on Research for Protection, Conservation and Enhancement of Cultural Heritage, Ljubljana, Slovenia. He is a co-editor of e-Preservation Science and a member of the Editorial Board of Studies in Conservation. He is a member of ICOM-CC, ICON, and Fellow of the Royal Society of Chemistry. His bibliography includes more than 90 peer-reviewed scientific papers.

THE MATERIAL SCIENCES APPLIED TO CONSERVATION OF WOODEN CULTURAL HERITAGE: FUTURE PERSPECTIVES

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Conservation of wooden artworks belonging to Cultural Heritage needs a thorough understanding the material's nature, structure, properties, behavior, degradation processes.

Wood is a natural material, of biological origin, featuring an extremely large variability in the material itself (wood species, provenance, growth conditions, location in the trunk, singularities, etc.), in the processing methods (felling, sawing, axing, seasoning, treating, impregnating, connecting, gluing, painting ...), in the types of objects manufactured (ranging from load-bearing timber structures to music instruments, from foundation poles to panel paintings, from furniture to weapons, from ships to land or air vehicles, etc.), in the use and conservation conditions (indoors, outdoors, waterlogged wood, etc).

The interdisciplinary work carried out within COST Action IE0601 "Wood Science for Conservation of Cultural Heritage" showed the need of a deep interaction (communication, language, objectives, methods, techniques) between Historians, Conservators, Scientists in the fields of wood as well as of other disciplines.

Conservation includes many aspects, including study, assessment, diagnostics, restoration, maintenance and monitoring. Working on individual materials is inseparably mixed with working on whole objects, on complex structures, on tangible and intangible values to be conserved.

Among many others, the following research themes appear as most important in order to improve together basic knowledge and actual possibilities of intervention, in the broadest sense, for the conservation of wooden artworks belonging to Cultural Heritage.

Wood ageing can mean the consequences of "just" the passage of time, or of the action of other modification/degradation factors as well (biological, physical, chemical, mechanical, micro-environmental, ...) which act during the passage of time. A better understanding of the ageing processes and of their effects is needed, which is made difficult by the impossibility of having available identical wood samples, differing only their age (e.g. centuries ...). Up to now, "artificially accelerated" ageing processes have not provided fully satisfactory results.

Techniques/methods for detecting and evaluating processes related to ageing and degradation of wood, and to their effects, are needed. Processes may be very slow, but still serious enough after a few decades. If there is no ongoing process then the object is safe, at least for the nearest future.

Several non-invasive or minimum-invasive techniques, mostly based on optical or radiation methods integrated with computer processing, have been developed for examining and assessing the structure of the materials and of the objects at various scales, from the micro to the macro. Synchrotron light as well as other light sources have proved extremely effective. However further improvements are needed, mainly dealing with portability, effectiveness, resolution, cost, ease of use. One could say that they should become simpler, less expensive, and such that the re-

sults are available to the "client", not only to the scientist. This should apply also to methods and equipments for identification and early detection of hidden discontinuities, lacunas etc., both in the paint layers, in the wood-paint interfaces, and in the wood itself.

In painted wood, the conservation of paint layers is often at risk due to wood deformations, typically caused by the surrounding micro-climate and its fluctuations. Drastically controlling

such fluctuations is not always possible, due to external constraints such as quality of buildings, exhibition needs, cost and energy factors. To understand the connection between climate and deterioration is therefore extremely important, even more important in a world where the total climate is changing. The two following items elucidate research field which without doubt need to be further explored.

Understanding the relationships between local climatic fluctuations and the dynamic deformational response of wooden supports of painted artworks needs to be further developed, both in terms of in-situ monitoring techniques and equipment, and of computer modelling techniques. Monitoring equipment can provide actual data on individual artworks, and moreover allow for derivation of realistic parameters and validation of computer models; which on turn – if appropriately calibrated – will provide means of simulating experiments and evaluations which can not be performed on original artworks. Further knowledge on wood rheology (namely perpendicular to the grain) and developments of modelling techniques are therefore needed.

Understanding the mechanisms of degradation of paint layers, namely those produced directly and indirectly by the local climatic fluctuations, is a very difficult task due to the complexity and multidisciplinarity of the subject, and the extreme variability of the actual paint layers, made in different conditions and with different techniques, featuring different conservation histories and interventions. However, it is a theme on which a deeper knowledge is needed, in order to give Conservators some objective data on which to base conservation guidelines for allowable microclimatic variations for polychrome wood.

Managing environmental risks to wooden interiors, and to collections in buildings (historic and modern) and churches, is a subject of general interest, needing continuous improvements, in order to prevent excessively loose or excessively restrictive regulations, often unfeasible in practice or not compatible, as already mentioned, with constraints such as quality of buildings, exhibition needs, cost and energy factors.

Better techniques and materials for consolidation of degraded wood are needed, answering to multiple specialistic problems such as penetration, compatibility, re-treatability, strength, dimensional stability, aesthetics, etc. Since wood in itself is a naturally biodegradable material, the prevention of biological degradation of wooden objects is an ever present problem. The need therefore exists of improving preservation techniques and products, however not negatively affecting human health, environment, conservation and re-treatability of the objects. Open air museums, where original wooden buildings are exposed to weather, are a well known case, however not the only. Also studies on "de-conservation" need to be continued in greater depth, in order to develop methods for removing undesirable substances from objects treated in past times, when some of the above constraints had not the same priority as today.

Methods and procedures for assessing load-carrying capacity of timber structural elements, connections, whole structures (for restoration, adaptation to new requirements, strengthening, etc.) are already being studied, and documents prepared. Further developments are needed, concerning more effective non-destructive techniques, better knowledge for evaluating old timber belonging to selected species and building typologies, improvement of procedures.

Compatibility and durability, both on the short and especially on the long term, of techniques for strengthening structural timber should become an ever-increasing requirement; appropriate objectives and techniques for assessing such compatibility and durability should be developed, together with guidelines for normative documents.

Waterlogged wood, both in fresh or sea water or in wet soil, constitutes a very wide and diversified field of objects. Factors and forms of degradation are quite variable. Studies on waterlogged woods need therefore to be further developed, including basic studies to characterize degradation, appropriate procedures and methods for provisional as well as permanent conservation, materials methods and techniques for consolidation, etc. This extremely various and wide field also needs publication of appropriate guidelines, due to numerous findings taking place by not well prepared specialists.

Standards and guidelines, being fundamental normative documents which codify general rules and best practices in the field, need to be developed at European level, of course keeping in mind the diversity of individual situation, and the need for individual solutions.

Documentation and assessment of artworks, including new findings, surveys, archives, operational data-bases, phases of restoration, etc., can be carried out with many methods, techniques, physical supports, accessing criteria. Some kinds of general guidelines and methods need to be developed, not in order to impose an oppressing uniformity, but to improve quality and facilitate access to information an documentation.

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THE ON-SITE RAMAN ANALYSIS OF CULTURAL HERITAGE ARTEFACTS, PAINTINGS, ROCK ART, POTTERY, GLASSES... : DRAWBACKS AND SUCCESS!

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Portable instruments and non-invasive analysis

Experience gained in instrumentation for military and aerospace applications in combination with the PC capacity development led to a revolution in the scientific instruments: the instrument size and weight may be divided by one order of magnitude. Regarding the optical Raman technique, two major breakthroughs occurred. In the 90s Rayleigh elastic scattering could be rejected due to the photonic crystals (Notch filter) or multilayer coatings (Edge filters) in place of the big gratings stage(s). The sensitivity of CCD detectors improved by many orders of magnitude and allowed both cutting the counting time (mapping for fixed instrument) and reducing the illumination power (black compound analysis). Latest developments concern the miniaturization of laser sources and the replacement of electronic boxes controlling the CCD detector by software uploaded on a common laptop, leading to portable Raman instruments (Fig. 1), lowering the cost and made the technique more and more easy to use. The choice of convenient optics offers a sub-micronic spatial resolution and high magnification (up to x 2000 times) long working distance objectives allow analyzing samples, even through their protective glass cover (15-100 mm from the front lens to the focus).

Advantages and drawbacks

Among many interactions of light with matter, Raman scattering is particularly well suited to the multiscale analysis of ill-organized heterogeneous solids (Gouadec and Colomban, 2007). The Raman probe being for interatomic bonds themselves, the technique offers a "bottom-up" approach to nanomaterials and amorphous compounds such as glass or polymers. Very similar visual aspects may be obtained through different technical routes that correspond to different phases, microstructures and nanostructures (Colomban and Treppoz, 2001; Colomban, 2005; Ricciardi et al., 2009). Consequently, the residual information may trace the origin of the artefact. For instance the development of preparative chemistry step by step during 14th to 17th century and then more rapidly after the 18th led to new inorganic and organic pigments, giving reliable chronological markers (Bell et al., 1997; Caggiani and Colomban, 2011; Mancini et al., 2011).

Raman signal results from the interaction of a monochromatic coherent light (laser beam) with electronic and vibrational levels of atomic bonds. The interaction with the electronic levels is often described as virtual; it is true for non-coloured samples (non-absorbent for the excitation laser line) but wrong for coloured materials (as pigments). In the case of latter materials the (pre)resonance Raman features and signature enhancement are observed, allowing their detection, even in small amount (Colomban, 2003; Colomban and Milande, 2006; Gouadec and Colomban, 2007). Consequently peak intensity will be much stronger but dependent on the exciting wavelength. Raman scattering is complementary to infrared absorption, with the advantage of much narrower peaks, the Raman peak shape is thus

Remote optical head

1 CC 2

laser spot

microscope objective

remote optical head

CCD

laser

optic fibres : 1, from the laser, 2, to the spectrometer

Raman spectrometer
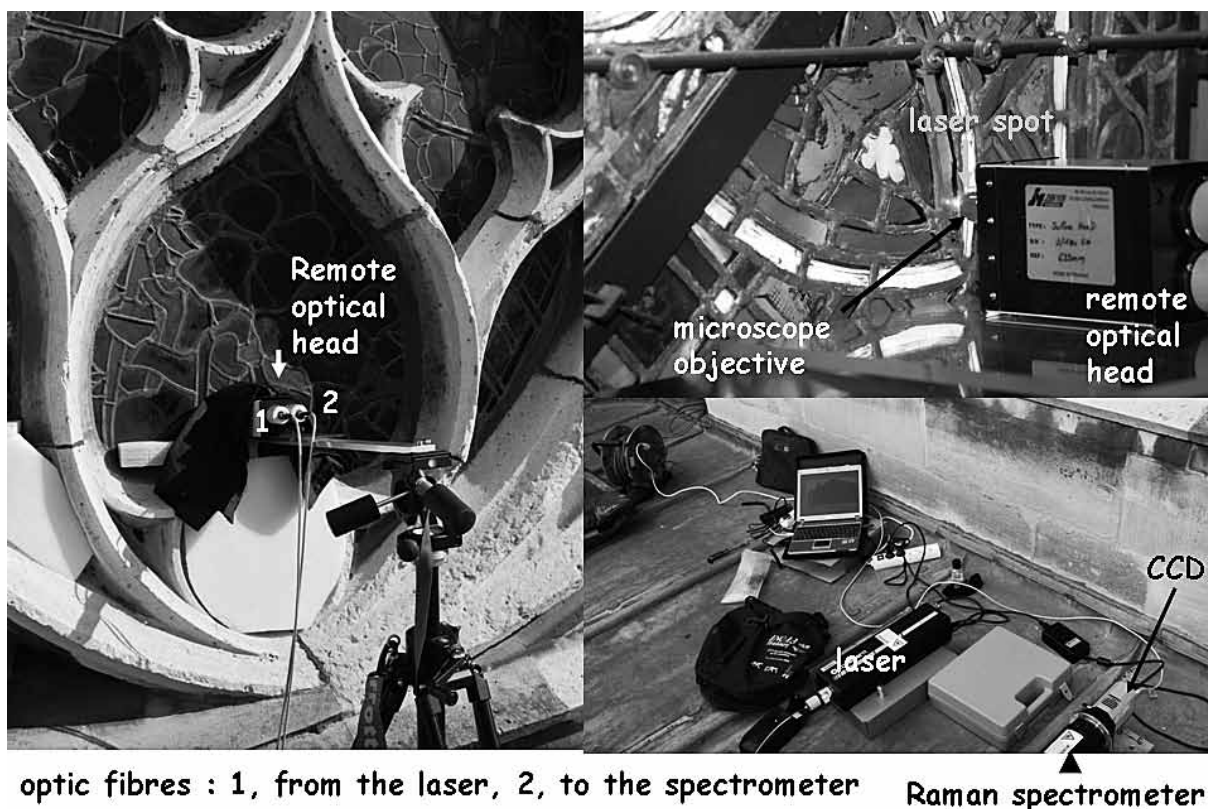
Fig. 1: Raman set-up for the Raman analysis of the internal and external sides of the Sainte-Chapelle stained glass windows (Paris).

very informative. Note, IR spectroscopy probes (the instantaneous dipole moments) are subject of much longer distance interactions than the atom vibration-modulated electronic cloud probed with Raman spectroscopy.

Raman intensity cannot be used to measure the relative amounts of different phases without a careful calibration. The scattering intensity varying by orders of magnitude depends on the polarizability (the more covalent the bonds, the higher the number of electrons involved and the higher the Raman peak intensity) and the exciting wavelength. Consequently minor phases (e.g. pigments in their matrix/medium, (Colomban et al., 2001; Kirmizi et al., 2010)) or even traces (e.g. carbons) could have a stronger Raman signature than some major phases. The absorption of the laser light by coloured phases can be very high and thus the penetration depth can be less than a few tenths of nm. However light absorption may involve strong local heating and consequently leads to the phase transformation towards more stable ones, the crystallization of amorphous ones or oxidation. Raman analysis may thus appear very sensitive to answer some questions on a given material while it will be useless to study some others. The comparison of the absolute Raman intensity allows the datation of ancient glass artefacts (Colomban & Tournié, 2007; Mancini et al., 2011).

If the sensitivity of the mobile instruments competes with that ones of laboratory, their resolution (directly function of the size of an optical instrument) is weaker and the phase identification from peak position is thus more difficult. It is necessary to take into account the band intensity that may depend on the material micro/nanostructure that requires good expertise in solid state physics and chemistry (Gouadec & Colomban, 2007). At present times, the laser wavelengths available for portable instruments are rather limited to green (e.g. 532 nm, perfect for inorganic sample) and red (632 or 785 nm, usually more suited for organic compounds) sources. If many spectra can be recorded at the laboratory with a power of illumination inferior to 0.1-1 mW, out-side measurements require power larger than 10 mW that limits the possibility to study coloured materials. Near-IR (1064 nm, optimum for the study of biomaterials such as ivory, bones, some papers) and UV to violet (265 to ~400 nm) excitations may not be obtained by portable sources but convenient miniaturized spectrometers will be available in the near future.

Conclusion

Using the mobile instruments the study of many materials and artefacts (minerals and gemstones (Ziemann, 2006; Reiche et al., 2004; Jehlicka et al., 2009), pigments, pastels, miniatures and drawings (Deneckere et al., 2010; Caggiani and Colomban, 2010; Mancini et al., 2011), pottery (Colomban and Treppoz, 2001; Colomban et al., 2001; Colomban, 2005; Colomban and Milande, 2006), glass (Colomban and Tournié, 2007; Ricciardi et al., 2009), enamels (Kırmızı et al., 2010), bronze (Colomban et al., 2012), stones (Martinez-Arkarazo et al., 2008; Prinsloo et al., 2011; Matovic et al., 2012), varnishes and natural resins (Daher et al., 2012)…) is possible in the museum rooms or even out-side, for instance on building parts (stained glasses: Colomban and Tournié, 2007) and rock art painting (Prinsloo et al., 2011). In the case of rock art paintings the out-side measurements appeared actually better, in a mountain shelter, than on the paintings previously deposited in museum because of the dust accumulated on the later art pieces! A great development of the method is expected.

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CHARACTERIZATION OF BLACK FUNGI ISOLATED FROM DETERIORATED AREAS OF TWO FAMOUS MARBLE STATUES

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One of the most common cause of blackening on artistic marbles and limestone is their colonization by the so-called dematiaceous fungi, a group of darkly pigmented fungi including black yeasts, meristematic and microcolonial fungi (MCF; Sterflinger, 2006). These microorganisms share common growth and morphological features, even if they can be phylogenetically distant. In many cases they form cauliflower-like microcolonies on and in rocks incrusted with melanin deposited in their cell wall, giving them a dark, blackish brown appearance. Some authors consider them the most harmful microorganisms for stones. The cause of damage seems due to a physical attack with cracks and fissures formation rather than to chemical dissolution of minerals (Sterflinger and Krumbein, 1997).

Here we report the characterization of black MCF isolated from deteriorated areas of two marble statues of significant cultural heritage both located in the Piazza della Signoria, Florence: the "Ratto delle Sabine" (RdS) sculpted in 1583 by Giambologna (Fig. 1A) and the copy of the original statue of the "David" (CdD) of Michelangiolo, sculpted in 1910 by Luigi Arighetti. During a monitoring campaign of RdS and a restoration intervention on CdD, we have investigated the origin of the dark-grey spots found in several areas of both statues. The aim of this work was to identify the possible biogenic origin of these spots and to characterize the organisms involved in this important alteration phenomenon.

Sampling was carried out by gently scraping few mg of superficial particulates from some of the blackish areas on both statues (Fig. 1B). Samples were put in sterile tubes and used for microscope observation as well as for microorganisms cultivation.

Marble powder was directly analyzed by ESEM. All the observed dark spots corresponded to microcolonies composed of clusters of yeast-like spherical cells about 5-7 μm in diameter (Fig. 1C). The microscopical analysis clearly demonstrated that the black discoloration on both statues was associated with black fungal structures and that dirt and fly ash were not present in any of the observed samples.

The marble powder samples were resuspended in sterile physiological solution and plated on 2% Malt Extract Agar (MEA, OXOID) medium. Plates were incubated at 27 °C for 1-2 weeks; black fungal colonies grew after 1 to 2 weeks. A black strain called M4 was isolated from RdS; two black strains, D1 and D3, were isolated from two different areas sampled from CdD. All black colonies showed cauliflower-like morphology typical of rock-inhabiting MCF. Colonies grown on MEA were observed by ESEM. They appeared constituted of predominantly spherical cells of about 5 μm in diameter, tightly packed, organized in chains and clusters (Fig. 1D) and a shape very similar to that of colonies observed on marble (Fig. 1C). Strains M4, D1, D3 were referred to black MCF on the basis of their morphology.

To confirm identification on molecular bases, the small subunit (18S) and internal transcribed spacer (ITS) regions of ribosomal DNA (rDNA) were amplified by PCR from the genomic DNAs of the fungal isolates and sequen-
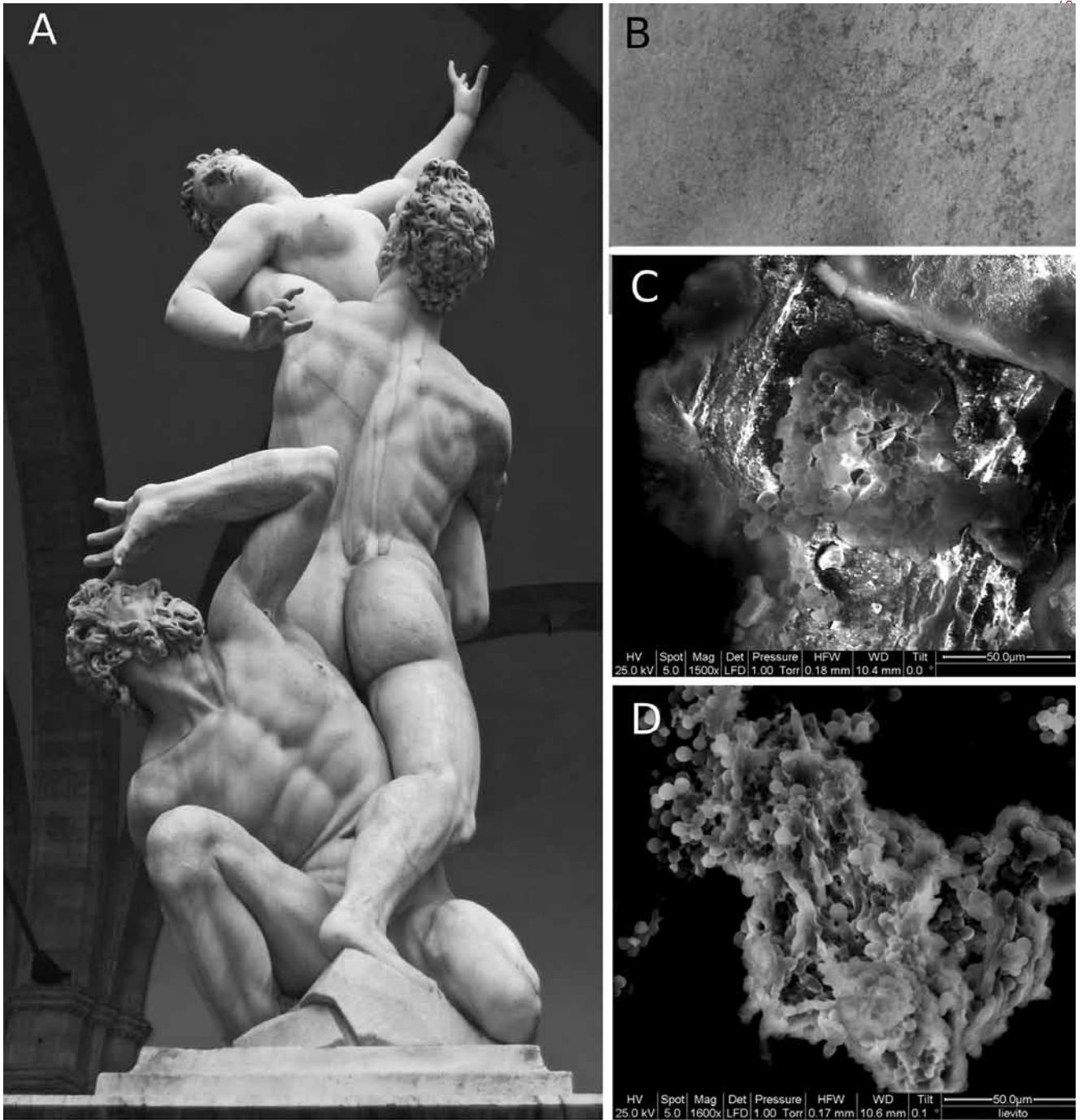
Fig. 1: Sampling from marble statues and microscopic observations. A, "Ratto delle Sabine", Loggia dei Lanzi, Piazza della Signoria, Florence (Italy); B, magnification of the sampled area showing dark-grey spots on the left lower abdomen of the Sabina; C, ESEM observation of the particulate from a sampled area of "Copia del David", a fungal microcolony is well visible; D, M4 colony grown on MEA observed at ESEM.

ced. The ITS region (ITS I/5.8S/ITS II) of all the black strains resulted 100% identical to that of *Sarcinomyces petricola*, a well-known rock-inhabiting MCF (Wollenzien et al., 1997) with high morphological similarity to M4, D1 and D3.

To determine the genetic distances between the black isolates and other related MCF strains, a phylogenetic tree was constructed using ITS sequences retrieved from the NCBI database (http://www.ncbi.nlm.nih.gov/). It confirmed that strains M4, D1 and D3 belonged to the cluster of *Sarcinomyces petricola* (not shown).

To better characterize the phylogenetic relationship among the isolated MCF, the genomic DNAs of M4, D1, D3 were examined by amplified fragment length polymorphism (AFLP) analysis (Vos et al., 1995). The results showed an high value of similarity (85%), indicating that the MFC strains belonged to the same species.

In conclusion, the fungus *Sarcinomyces petricola* is responsible for the formation of grayish dark spots on several areas of the two valuable statues "Ratto delle Sabine" and "Copia del David". Understanding the biogenic cause will aid new formulations for a proper scheduling of restoration and conservation interventions.

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THE TRITTICO DI SAN PIETRO MARTIRE BY BEATO ANGELICO: A PANEL PAINTING DEFORMATION BEHAVIOUR

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The climatic conditions affect the conservation of the painted panels: the thermo-hygrometric variations can cause damages on the painted layers (*craquelure*, buckling…) and on the wooden support (cupping deformations, cracks); therefore it is necessary to control the climate in the exhibition places for their preservation.

At DEISTAF (University of Florence) we have developed an apparatus able to measure the wooden support response to the environmental conditions, known as Deformometric Kit (DK). The DK is a low impact technique that provides quantitative information, such as the cupping angle and the painted wooden surface elongation.

This paper is centred on the study of a painting made by the Renaissance Florentine author Beato Angelico: the *Trittico di San Pietro Martire* (1425-1429); the support is made by Poplar wood (*Populus alba* L.). Nowadays this painting is exposed in San Marco Museum in Florence where it is monitored by three DKs, without altering the visitors experience. The DKs are mounted on three different areas: in the centre of a board without any anomaly (DK1); on the same board, near a crossbeam (DK2); and above a gap between two boards (DK3).

The cupping angle recorded by DK1 is inside a range of 0,4° and the painted surface elongation is 0,03% maximum; DK2 records deformations that are five times shorter than DK1 (probably because of the crossbeam) and DK3 records three times bigger painted surface elongation than DK1 (probably due to the moving of the gap).

This work started on June 2008 and it is still on going. The objectives of this work are to know the behaviour of this painted panel in response to the climatic variations, and to enlarge the knowledge on Poplar wood behaviour towards the environmental conditions. These data will be possibly used to validate a mathematical model that aims to better understand the effects of thermo-hygrometric variations on panel paintings conservation.

SELECTION AND CHARACTERIZATION OF BIOSURFACTANTS FOR THE BIO-CLEANING APPLICATION TO SURFACE DEPOSITS ON STONE ARTWORK

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Many historic, cultural and artistic objects and buildings are made up of stone. Stone is subject, like other materials, to deterioration, especially if exposed to the weather and located in urban areas or industrial sites. In this regard, a notable role is played by anthropogenic multipollution, which produces a surface blackening, mainly due to carbonaceous particles, originating from the incomplete combustion of fossil fuels. This work is developed in the contest of micro-biotechnology application in the field of the conservation and restauration of the monumental heritage. The aim of the work is the utilization of biopolymers of microbial origin, eventually new, for bio-cleaning applications, in order to facilitate the removal of undesirable surface deposits on outdoor stone artwork. To this purpose, ten bacterial strains, belonging to ENEA-UTPRA collection and originated from contaminated soils have been screened for biosurfactant production by the means of Emulsifying Assay (Test E24) (Cooper and Goldenberg, 1987; Fusconi *et al*. 2010). Out of them, *Flavobacteriales* bacterium (MCC-Z, 99% ID), non pathogen and non spore-forming, has been selected for providing the best emulsification activity (E24 55-65%). Such a strain species has so far not been described as a biosurfactant producer. The kinetics of surfactant production has been characterized as a function of the bacterial growth. The results of experiments, done in three replicates, show that the bio-product is stable, also after a first scaling up 1:10 of the system. Preliminary characterization of the crude biosurfactant are still made by GC-MS analysis.

The next steps of the study will be focused on *i)* improving the separation procedure and the protein component purification by column chromatography, in order to determine the chemical structure, and *ii)* defining a protocol for *in vivo* applications on stone samples, blackened by atmospheric pollution.

NANOCOMPOSITE SYSTEMS COMPOSED BY TEOS AND CA(OH)2 NANOPARTICLES FOR THE CONSERVATION OF ARCHITECHTONIC SURFACES

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The synthesis and characterization of $Ca(OH)_2$ nanoparticles/*tetraethyl orthosilicate* (TEOS) nanocomposites and their possible application to the conservation of limestone materials are presented. Various synthesis strategies have been followed in order to obtain stable systems. The nanocomposites materials have been studied after their deposition onto the surface of some microscope glasses. Optical and electronic (SEM) microscopy investigations have been performed in order to understand the influence of the amount of water and of the ratio nanoparticles/TEOS onto the morphology of the composites. The chemical characterization of the final products has been performed by means of Fourier Transformed InfraRed spectroscopy (FTIR).

LOW IMPACT POLYMERIC AQUEOUS SISTEMS FOR THE CLEANING OF PAINTED SURFACES

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The study concerning High Viscosity Polymeric Dispersions (HVPD) as new cleaning tools is here presented. The rheological properties of these systems have been investigated in order to characterize the mechanical behaviour of these new dispersions. Our purpose was to set up a cleaning tool capable to overcome those limits that traditional methods, as well as already adopted cleaning agents, present. In particular, the main target was to set up a system whose mechanical properties permit an easy removal from the painted surface without leaving meaningful residues. It has been demonstrated that the mechanical properties of these new polymeric dispersions can be modulated just varying the concentration of each component. In fact, the viscosity and the elastic character can be tuned, in relation to the needs of each case study, by increasing both the concentration of poly (vinyl acetate) and borax (crosslinker) as well as the concentration of organic solvent. Good results in terms of capability to soften degraded patinas and controlled cleaning action have been achieved onto a wood panel by Ludovico Cardi called "Il Cigoli". These systems are transparent and uncoloured, so that the conservator can monitor the cleaning action during the application; the total amount of organic solvent is reduced maintaining good performances, leading to a reduction of the impact.

DIAGNOSTICS OF EGG-BASED PAINTINGS IN CULTURAL HERITAGE: AN INNOVATIVE COMBINED DOT-ELISA AND UPLC-BASED AMINO ACID ANALYSIS APPROACH

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In this work we want to highlight the capability of two different techniques, a modified Dot-Enzyme-Linked ImmunoSorbent Assay (Dot-ELISA) and an amino acid analysis performed by the new methodology AccQ•Tag™ Ultra UPLC (Ultra Performance Liquid Chromatography). The Dot-ELISA is a highly versatile solid-phase immunoassay for antibody or antigen detection. The technique is based on the amplification of the immunochemical reaction between an antigen, dotted onto solid support, and a primary antibody, using an enzyme-conjugated secondary antibody that binds to the primary one. The addition of a precipitable, chromogenic substrate causes the formation of a colored dot on the solid phase which is visually read. The determination of colour staining was performed by a visible light spectrophotometer on the solid support.

The AccQ•Tag™ Ultra UPLC is a dedicated technology useful for amino acids analysis based on a pre-column derivatization method with 6-aminoquinolyl-N-hydroxysuccinimidyl carbamate (AQC). The techniques involves first an hydrolysis, a derivatization process and a separation/detection in UPLC. Moreover, the UPLC allows an increase in speed, operating ease, sensitivity, and resolution with respect to traditional HPLC of the oldest amino acid derivatization techniques. Different concentrations of ovalbumin, whole egg, and egg white samples and specially prepared specimens of various tempera paintings as model samples (not pre-treated) were used in both the techniques. Both methods were demonstrated to be valid in detecting protein binder in analysed samples.

HOW EXPERIMENTAL SIMULATIONS CAN ILLUMINATE OUR UNDERSTANDING OF ANCIENT TECHNOLOGICAL PROCESSES: THE EXAMPLE OF BRASS CEMENTATION

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Introduction

Given the complexity of most ancient metallurgical processes, and the frequent scarcity of related documentation, experimental simulations may help to both clarify and quantify the ins and outs of a given process. The nature of the issue in question will determine whether one attempts to reconstruct the whole or only part of the process, adhering more or less tightly to a given archaeological / historical framework. Such an approach is not new in the archaeometallurgical field: It was promoted by R.F. Tylecote in the 1980's, and since then, experimental simulation has come into increasing use in the archaeometallurgical community, as notably demonstrated by the success of the 2010 annual meeting of the Historical Metallurgy Society, which was entirely devoted to archaeometallugical experimentation. Yet, most experiments are still carried out exclusively in the field, trying to address the entire complexity of the processes to be investigated, while the potential of simpler laboratory-based approaches is largely neglected.

Laboratory versus field experiments

The C2RMF has been involved in the study of several ancient metallurgical processes, including protohistoric copper smelting (Bourgarit, 2002, Burger et al., 2010a, Burger et al., 2010b), fusion welding in antique large bronzes (Azema et al., 2010, Bourgarit and Mille, 2010), and brass making (Bourgarit and Bauchau, 2010). An integrated approach is systematically carried out for each research topic, comprising a thorough investigation of related material evidence, and experimental simulation more or less directly related to the reconstruction of the process. In order to optimize the efficiency and benefits of the experimental route, we have developed multiple-scale simulations -- from the modelling of the theoretical mechanisms underlying the processes, to the field reconstruction of the *chaine operatoire*. This paper aims to discuss the necessity of multi-scale experiments based on model systems in which the complexity is gradually increased, as a way to optimize the testing of all working conditions inferred for ancient metallurgical processes. In particular, small-scale modelling laboratory experiments may be necessary for a rigorous understanding of the basics, notably since the in-door reactors are much easier to instrument than the large-scale field furnaces. Moreover, such experiments prove to be very efficient in terms of time and money, notably as a predictive tool for larger-scale reconstructions. That said, the field remains the main approach for those who aspire to reconstruct all aspects of a given process, including the *chaine operatoire*. Examples will be provided here from the on-going experimental work that the author is carrying out to reconstruct ancient brass cementation processes.

Brass cementation

Prior to the mastering of metallic zinc production in the early 19th century, brass making in Europe used to be based

Fig. 1 : Main components of the multiscale experimental set-up showing one electrical laboratory furnace as part of the in-door experimental platform (up), and a wind-powered furnace at the out-door experimental platform of Barsy, Belgium (down)

on the so-called cementation process. Within a more or less closed vessel, the gaseous zinc produced by the carbo-thermic reduction of zinc ore at around 1000°C (+-100°C), simultaneously diffuses into metallic copper. As part of a broader project aimed at investigating the production modes of copper-based common ware during the Late me-

dieval period in Europe (see Bourgarit and Thomas, in prep., and www.laitonmosan.org) experimental simulations are carried out on two scales (fig. 1). Laboratory experiments are performed on the newly built in-door experimental platform of the C2RMF, by using electrical chamber furnaces and thermal analysis furnaces. These laboratory experiments allowed us to test in a quite comprehensive manner a variety of working conditions (almost 300 ones within the last two years), thus leading to the understanding of main basics of the process.

The laboratory trials were almost totally disconnected from any historically-documented technological environment: an electrical furnace, relatively small crucibles and charges were tested, and only materials of high-purity were used. This was a deliberate choice, in order to minimize uncontrolled interference, and to guarantee as much repeatability as possible. The reconstruction of ancient processes is clearly beyond the scope of such an approach. In the case of brass cementation, the nature and size of the reactor(s) – and likewise, the nature of materials -- are at the centre of the technological environment and may indeed influence greatly the process working conditions and the performances of the process. In addition, much information such as human and material costs, human skills required, etc., cannot be approached by laboratory experiments. Field experiments may help to address part of these fundamentals, although one shall take care on the number of working conditions to be tested. This number indeed shall not be too large, in order to adapt to the inertia of the field set-up. In our research program, given the prerequisites of the experimentation (building of the one meter-diameter furnace and preliminary tests, preparation of the tenth of kilograms of ores, charcoal and copper, etc), only eight different conditions – which meant sixteen experiments - could be reasonably looked at during a one-week field campaign. Yet, the question remains whether such small number of trials may yield exploitable results, whether it may be sufficient to properly understand at least some aspects of the process. We have addressed this issue by two means. On the one hand, one particular technological environment has been focused on (Thomas et al., 2010), which has greatly limited the number of working conditions to be tested. On the other hand, we took advantage of the results obtained in the laboratory in order to frame the optimal process parameters, and thus to restrict the range of conditions to look at.

Remarks

In the course of only two years of experimentation, the authors have had the opportunity to address a number of issues and misconceptions (Bourgarit and Bauchau, 2010, Bourgarit and Thomas, 2010). It is beyond the scope of this short paper to present the results obtained so far. One would rather like to conclude in discussing some "side-effects" of the experimental approach, and particularly its potential as a powerful didactic tool, whatever the scales at which the experimentations develop. The very reproduction of technical gestures, the careful multi sensorial recording of events and results, and more generally the unique momentum generated by the gathering of specialized interdisciplinary teams including archaeologists, historians, archaeometallurgists, founders, curators, restorers, metallurgists from the modern industry, and furnace designers may become a very efficient education medium: not only a medium towards education of specialized students, but also a medium able to heighten public awareness of a rich part of our immaterial cultural heritage, namely the technical and technological know-how.

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David Bourgarit has his Masters degree in Physics, he has done a PhD in Modern Metallurgy and Materials, and he has carried out his Research Habilitation on Ancient copper metallurgy. He has been head of the Metal group at the C2RMF since 1996. Besides short-term technical investigations on metallic objects stemming mainly from the collections of the French Museums, he develops international research studies on ancient copper metallurgy. Four areas are currently under study by the author: Protohistoric copper extractive metallurgy in Europe, Medieval copper metallurgy in Western Europe, Techniques of the Khmer bronze statuary, Techniques of the French bronze statuary from Renaissance to the Age of Enlightenment. The main tools used are macro- and microscopic imaging (endoscopy, metallography, X-ray tomography), elemental composition (ICP-AES, PIXE-RBS, SEM-EDS, handheld XRF), structural analysis (μ Raman, μ X-ray diffraction, μ XANES, Mössbauer spectrocopy).

THE ARCHAEOLOGY OF IRON PRODUCTION

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Iron is the more efficient metal for the production of tools and weapons and, in this respect, it is of high strategic and economic importance for pre-industrial societies. Above all, iron allows the production of efficient agricultural tools that have shaped the landscape of Europe (and the rest of the world) during three thousand years.

The production line for iron is complex. The ore must be mined. It is then smelted in a furnace. The process is based on the reduction at high temperature of the iron oxide by the carbon monoxide from the fuel burning. It can be obtained at low conditions by partial reduction in the solid state (bloomery process or direct method) or at higher conditions by total reduction in the liquid state (blast furnace process or undirect method). The solid iron bloom must be compacted and cleaned from residual slag before to be shaped into objets by smithing. The cast iron ingot must be decarburised (fining) to obtain wrought iron before smithing. Each step of the production line can be identified from specific archaeological remains, including structures (mining pits and galeries, smelting furnaces, smithing workshops) and typical wastes (mainly different types of slag).

The archaeometallurgical studies are typically interdisciplinar as they aim to assemble the different approaches on the metallurgical remains (archaeological field work and laboratory based analytical work) to reconstruct ancient technologies. At a regional scale the global approach offers the opportunity to reconstruct socioeconomic patterns and to describe the organization of the production. As the amount of slag is, to a certain extend, related to the amount of smelted ore (and produced metal), this allows a quantitative approach of ancient economy. The production of iron requires also hughe amount of charcoal and it has a significant impact on the environment. Various type of evidences can be used to tackle the environmental aspects (anthracology on charcoal, geochemistry of sediments, etc).

Early research on ancient metallurgy took place already at the end of the 19th century when mining engineers were confronted with ancient remains during modern exploitation but it is only during the last decades of the 20th century that archaeological excavations developed, accompagned by the development of laboratory techniques (geochemistry elemental and isotopic, petrology, metallography, etc). The general principle of the various smelting processes have been studied starting form well excavated remains, associated with detailed petrological and metallographical studies and sometimes experimental reconstructions. The survey for evidences of smelting (mainly slag heaps) has been intensive in many areas of most of the northern European countries. It becomes now possible to reconstruct production-consumption networks at the regional scale in several areas and to propose models for the organization of the production and the introduction of technological change. But on the other hand, very few sites are known (and even less are studied) in the Mediterranean basin. This is a significant gap in our knowledge as many aguments point out that the technology spread from the South (Middle East and the Greece) to the West and the North at some time during the first half of the first millenium BC. Also, during more recent periods (Roman and Medieval

times), the production of iron in the Mediterranean area remained at a high level and play a important role. Very few data are available to reconstruct the iron supply of the islamic world or of the byzantine empire.

Another major challenge is the provenancing of iron metallic artefacts. During the metallurgical process, the physical structure and the chemical composition of the ore is completely transformed, so it is not a simple problem to find a measurable fingerprint to identify the origin of the metal. Currently, several attempts are made to solve this question, using slag inclusions characterization or elemental and isotopic composition of the metal itself, both allowed by recent developpements in the analytical technology (LA-ICP-MS, SEM, EMPA). The problem still remains complex regarding the very numerous sources of iron ores, from far the most frequent metallic ore in Europe. It is a hughe task to build up a relevant databank for ore and smelting slag.

In the northern countries of Europe, mining and metallurgical remains, from iron or other metals production, are now on the way to be recognized as a significant part of the cultural heritage (15 sites on the UNESCO list involve mining or metallurgical remains). More and more frequently, old mines or smelting sites are taken into account and preserved or at least studied. Slag and other metallurgical debris form every step of the production line are identified and kept by professionnal archaeologists who are aware of their interest. In the southern Europe countries, attention has been paid only to the most ancient period. There are extensive and excellent studies on copper production and trade during the Bronze Age and a few other ones on precious metals. But it is a pity that very significant sites in southern Europe (and also outside of Europe) are not yet considered for their value and that little attention is given to the more recent metallurgical remains by professionnals in the field of archaeology and heritage conservation and valorization.

Vincent Serneels is professor at the Department of Geosciences of the University of Fribourg, Switzerland, responsible for the research and teaching in the field of archaeometry. He is interested in the history of the exploitation and use of the mineral ressources during ancient times, in the point of view of technology and economy. Its specific field of expertise is the study of iron production remains and specifically the chemical analyses of slag. He is interested in the reconstruction of ancient technologies and in the study of the impact of metal production on landscapes and societies. He has been working on metallurgical remains, mainly in Switzerland but also in Europe and Africa. Beside metals, he is also involved in archaeometric studies on stones, ceramics, mortars, mineral pigments, glasses, etc.

LUSTRE CERAMICS. A SOPHISTICATED DECORATION PROCESS UNRAVELLED WITH THE CONTRIBUTION OF IBA TECHNIQUES

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THE SAFEGUARD OF CULTURAL HERITAGE

Lustre is a process for decorating glazed ceramics. Metallic nano-particles are formed inside the previously existing glaze covering the ceramic object by painting a motive on the glaze with a specific paste containing metallic elements in the form of salts, and applying afterwards a heat treatment of lower temperature than the one needed to form the original glaze. A successful lustre decoration is characterized by colours reflecting light as strongly as metals, and the reflected light showing iridescent patterns when changing the angle of observation, and requires from the potter a careful control of the temperature and ambiance, oxidant or reducing, of this heat treatment (the third heat treatment in the whole process of manufacture of the ceramic object), and even the position of the ceramic inside the kiln. The buried nano particles are responsible for the colourful decoration.

Such a sophisticated process seems to have been first produced in the Middle East in early Islamic times (9thAD). During the Arabic expansion along the north of Africa and the Iberian Peninsula the Arab potters spread this decorating skill [1]. Islamic luster was well established in Spain especially in factories in Malaga and near Valencia, in Manises in the 14th century, being by the end of this century renowned in Italy, France, Holland, and England [2]. In the 15th century Italian Renaissance potters, especially in Central Italy, Gubbio and Deruta, in Umbria, succeed in applying this technique developing their own style of decoration. The name of majolica was coined in Italy to designate this technique as most of the trade of these artifacts was done through the island of Mallorca.

The metal nano-particles embedded in a silica-based glassy matrix are exclusively of copper and, or, silver, so the applied decorating paste must content, in some way or another, these metallic elements. Red-like, brownish, green-like, or gold-like colours, among others, may be obtained depending on the metallic element, and also on the dimensions and shape of the silver and copper nano-particles. This reflecting layer containing the metallic particles is called the lustre layer. It is below the surface and it may begin to form, typically, a few tens of nm underneath, and have a thickness of several tens and up to a few hundred of nm.

The lustred majolica artefacts with its vivid and long lasting colour, and its metallic like reflexion properties, that once attracted the attention of the noble and wealthy families, being its possession a symbol of distinction and refinement, have attracted in recent years the attention of archaeologists and natural scientists, and have been the object of an intense study. Efforts using a variety of analytical techniques have been dedicated to unravel the physical origin of the lustre. Techniques like the ones based on synchrotron radiation, such as extended X-rays absorption fine structure (EXASF) have been used to observe the oxidation degree of the metallic elements, that is, if the elements are forming metals or form a different compound, X-Ray diffraction to ascertain the proper nature of the metallic nano crystals, or transmission electron microscopy (TEM) to measure their size and distribution,

Ion beam analytical techniques like Rutherford backscattering spectrometry (RBS) and particle induced X-ray emis-

sion (PIXE) have been, as well, extensively used to characterize lustre ceramics. They are based on the use of MeV ion beams as the probing tool supplied normally by an electrostatic accelerator, and can be applied on an object held at external ambiance, that is not in vacuum conditions. Both techniques can be used simultaneously. One of the features that make RBS a useful analytical technique is its capability to measure quantitatively depth composition profiles, nevertheless the technique has low sensitivity in detecting light elements, especially in a matrix containing heavier elements. PIXE is a very well suited technique to detect, almost without ambiguity, the overall amount of the elements present in the sample above Na, even at trace levels. The features characterizing both techniques are very well suited for their simultaneous use in the study of luster ceramics, where the glaze contains many elements forming oxides (Na, Mg, Al, Si, K, Ca, Ti, V, Fe, Cu, Sn, Pb) more or less uniformly distributed, plus a region, the lustre layer itself, with sharp concentration gradients of heavy elements (Cu and/or Ag). For this reason, the complementary use of both techniques, PIXE and RBS, has been proved to be quite useful in this study. The complementary use of IBA techniques with other different techniques, like RBS and TEM allows for the unambiguous determination of the mean size of the metallic particles forming the luster layer, and its mean distance. It turns out that these two parameters, size and distance, are quite relevant for the metallic reflection effect of the lustre decoration.

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Aurelio Climent Font is Full Professor at Universidad Autonoma Madrid (UAM), Department of Applied Physics. Among his research interests is the use of ion beam analytical techniques in several areas of knowledge, like materials science, environmental studies and archaeometry. He was one of the promoters for the creation in the UAM campus of the Center of Micro-Analysis of Materials (CMAM), a center hosting a 5 MV electrostatic accelerator dedicated mainly to ion beam analysis, and inaugurated in 2003. He has been the director of CMAM from 2004 to 2009. From 1995 to 2005 he was a delegate of European COST actions G1 and G8 related to the use of non destructive analytical techniques for the characterization and conservation of cultural heritage artifacts.

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

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Laser properties are exploited as beneficial modern alternatives to a variety of research aims and applications in art conservation field. In this talk an overview of laser technologies development varying from analytical to structural and cleaning objectives will be given with specific examples and state-of-the-art instrumentation. Laser cleaning, LIBS, LIF, Holographic and Speckle pattern Interferometry, as well as Multispectral and Hyperspectral imaging techniques, endoscopy, 3D projection, etc will be presented with examples which demonstrate the potential they represent in art conservation practices and research.

Particular emphasis will be then given in designs of new, modular and hybrid optical geometries implemented during the development of new instruments and in the course of introducing laser coherent sources as powerful tool for the solution of long-standing problems in artwork and monument conservation and restoration.

The specific case of structural diagnosis will be presented as has been evolved the last decade through two specifically devoted projects of FP5 and FP6. The concept of the projects and the workplan will be discussed and the actual deliverables presented. The introduction of new applications ranging from direct surface monitoring to assessment of impact and trace of fraud art market will be presented as main results. The limitations encountered in market exploitations for art conservation in contrast to other fields of application and the lack of training and education capabilities in the new instruments and practices will set a fundamental questioning to the audience in regards to the market potential in the field which stands against the actual developments. The shortage of EC finding and the total shortage of funding towards Cultural Heritage and specific steps to overcome the shortages will be put for further discussions.

Future trends in laser forthcoming technology and instrumentation in art conservation will hopefully give the opportunity to open a broad discussion with the audience on advances and limitations of dissemination activities and the barrier of common standards in comparison to conventional conservation practices. Suggestions for synergetic actions and enforcement of educational promotion on new tools, methods and practices will conclude the talk.

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THE FUTURE FOR SAFEGUARDING THE PAST: 'NETWORKS FOR CONSERVATION SCIENCE'

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Introduction

Different as they are; an ancient unique book or a shipwreck, a statue or a historical building, a leaf from a herbarium or a filled archive, a musical instrument or natural history: they all need knowledge to be preserved for the future.

The conservation of cultural heritage is a duty for all nations, due to ethical reasons. Decision makers have only slowly started to understand that caring about cultural heritage and especially about museum, library and archival collections is also a valuable long-term investment for their economy and in the interest of their citizens. The accessibility of heritage depends not only on the direct conservation of it but also on the preventive conservation actions. Sensitive materials, displayed in an aggressive environment may suffer from chemical attack of pollutants, leading to irreversible damage within only a few weeks of inappropriate exposure.

At present within the EU Research Initiatives (from FP2, 1986 till FP 7, 2011) over the 150 projects have been dedicated to cultural heritage. Among these projects, over 20 years of European Research Initiatives are being carried out in the field of Cultural Heritage. The main goal is to reinforce the scientific basis for the establishment of measures and methodologies for the protection and rehabilitation of the European Cultural Heritage. Tools for stakeholders, to exchange knowledge and improve cooperation, can be found in cooperation and networking. One network instrument is provided by COST, European Cooperation in the field of Scientific and Technical Research, which is one of the longest-running instrument supporting co-operations between scientist and researchers across Europe. Within COST several actions have been dedicated to our Cultural Heritage, i.e., COST action 625, A27, C17, C20, G1, G7, G8, D42 and IE0601 and form the COST Heritage Interest Group (www.cost.eu and www.echn.net/cost-hig/).

Brief description of selected EU heritage networks

This section illustrates selected networks, dedicated to safeguarding cultural heritage, to show broad scientific cooperation. **COST action G7** was dedicated to the use of lasers in conservation and conservation science. 3D laser scanning of architectural sites, artworks were discussed. Serious attention was given for laser driven analysis like Fluorescence LIDAR and Raman spectroscopy. A novel application was investigated in depth: laser cleaning of artefacts, from paper to buildings.

To achieve a better preservation and conservation of our cultural heritage by increasing the knowledge of museum objects through non-destructive analysis and testing and by improving the synergy between art historians, archaeologists, conservators and natural scientists **COST action G8** was realised. The role of the indoor environment on the deterioration of artefacts was well discussed by **COST action D42** – ENVIART. D42 was dedicated to explore chemical interactions between cultural artefacts and typical indoor environmental conditions.

Fig. 1: Opening Pandora's box?

The output and dissemination of COST actions contribute to the safeguarding of our heritage significantly and many joint publications were established within the action running time. Training schools were organized frequently by all the actions and links were made to other networks as the European Standardisation Committee on Cultural Artefacts (**CEN TC 346**). This resulted in an increased number of experts who were able to discuss about the content of novel standards in conservation and preservation.

Within the 5th Framework Program of the EU, a thematic network (**MIP, Transition Metals in Paper,** EVK4-CT-2002-20010) was established contributing to the implementation of the key action "The City of Tomorrow and Cultural Heritage" (www.miponline.org). This network was dedicated to enhance knowledge to one dedicated subject and gained serious interest from SMEs in the field of services and preservation of our heritage. Within the European Construction technology platform (**ECTP**) a network dedicated to the strategic research agenda on priorities and strategies to support cultural heritage research activities (**CHRAF**), main topics are being discussed are heritage preservation: assessment, monitoring and diagnosis, materials, intervention techniques, environment and energy management, exploitation and maintenance together with city and land aspects (www.ectp.org/chraf).

The Future for safeguarding the past

Heritage networks improve the impact of heritage research and gain recommendations for needs in future research dealing with cultural heritage: movable and non-movable. Cross-fertilization of disciplines strengthens knowledge and application for heritage restoration and conservation. All networks agree that although good attention is paid on the dissemination of the sound scientific developments within the FP programs, improvements can be made for bringing the results to where they have most impact. The field that needs to apply the tools and answers in conservation and restoration. Extended dissemination awards to promote scientific and applied scientific results are therefore highly recommended.

Non-destructive techniques and sampling

There is a need to continue the focus on application and development of 'non-destructive' techniques. Within the field of 'non-destructive' techniques it is important to include the discussion on the meaning of the term 'non-destructive'. Is there a need to take a micro sample that will be evaluated non-destructively, or can analyse take place on site? Taking a micro-sample from a building may be accepted, but taking a micro-sample from the eyes of Mona Lisa is not. With the 'non-destructive' techniques we not only employed already existing front-line methods in physics and chemistry (e.g. synchrotron radiation) but have actively developed them further, extending applicability, decreasing weight and size (primary aspects of mobile instrumentation for field applications), setting up also application guidelines and rules for those methods. Within non-destructive analyses, developments in chemometrics remain needed.

Outdoor-indoor environment

There is no building without creating an indoor environment. The interactions between the environment and the artefacts are vitally important. Improved knowledge is needed on building performance, building physics, indoor air chemistry, analytical chemistry, modelling, statistics etc. Heritage research in relation with outdoor-indoor environment can be compared with 'the box of Pandora' as solving one problem can result in many questions and many challenges therefore remain in fundamental and applied research. The role of global climate change on the indoor environmental conditions for example, especially for historical buildings. Attention should to be given to risk and damage analysis as a changing environment results in changing chemical and physical parameters causing irreversible loss of heritage artefacts. Novel methods have to be developed to determine the deterioration by micro-biological species (mould, bacteria) and the long term effect of particles.

Assessment of materials performance including diagnosis

Knowledge and understanding of the performance of materials is essential in order to choose better materials or approaches, contributing to preventive conservation. In this respect, it is essential to understand the durability and the natural ageing behaviour of historic materials in monuments and heritage artefacts. This includes understanding of the accelerated deterioration by material interactions. Assessment and diagnosis of behaviour of materials used (over the past years) for restoration. This should include their degradation and material performance of competitive materials in heritage conservation and restoration, would allow evaluating the performance and durability of intervention techniques and materials and will allow industry to develop better products. Finally special care should be given to natural history collections. Many treatments to preserve these collections given in the past, seems to be a curse nowadays. Solutions are needed urgently to keep collections accessible.

Smart materials

Materials with additional functionalities, such as self-healing or self-cleaning, or materials with an improved resistance to degradation mechanisms should be a future focus point. The challenge is to develop smart, more durable and more effective conservation methods and materials that at the same time are really compatible with historic materials. It should be assessed whether their durability and their contribution to durability and sustainability of monuments, paintings, statues, historical collections etc. are better than traditional materials and treatments.

Harmonisation

There is a continuous need for verification research on standards and methods and the development of harmonized applications in the field of safeguarding cultural artefacts. It is recommended to include a dedicated section to standardization and harmonisation. The work should be in agreement with the focus of the technical committee on cultural heritage of the European Standardization Commission, CEN TC 346.

John Havermans, born on June 15, 1956, studied analytical chemistry in Utrecht and organic chemistry in Delft where he received his Ph.D. degree. Since 1988 he is involved in multidisciplinary research projects dedicated to safeguard cultural heritage within the Netherlands organization for applied scientific research, TNO (Delft, The Netherlands). He coordinated several European research projects. Since 2010 he joined the TNO Team on Conservation Technology.

Rob van Hees is senior scientist at TNO (team Conservation Technology), where his work is dedicated to restoration and renovation of monuments. He is involved in many European research projects. Since 2004 he holds a professorship on Conservation Technology within the Technical University Delft, at the Faculty Architecture.

Annemie Adriaens is professor in Analytical Chemistry at Ghent University (Belgium) where she leads the research group "electrochemistry and surface analysis".

SPECTROSCOPIC ANALYSES ON ROCK ART PAINTINGS FROM EAST CENTRAL ETHIOPIA

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Introduction

The Hararghe region is placed in the East central Ethiopia. The major concentration of the whole Ethiopian prehistoric rock painting examples was found in its territory. Actually, in this region there are a great number of archaeological interesting sites, constituted of artistic evidence, kept under shelters or caves. They were found in the first half of the XX century, and since then they have been described and studied. The majority of the sites show patterns referred to domestic animals, in particular to cattle, while in some localities only depictions of wild faunas were found. However, despite this richness and variety of artistic expressions, the Horn of Africa art is still today substantially not much known.

This research work is aimed at the study of various colored samples from the Hararghe rock art paintings, found in recently documented sites. The sites are shelters keeping paintings belonging to a stylistic current named Ethiopian-Arabian, spread on the whole territory of the Horn of Africa between the third and the second Millennium BC.(Clark,1954) This study was carried out in order to characterize the pigments employed in the realization of caves paintings, as well as to verify the likely presence of organic material, to better evaluate the pictorial execution.

Techniques

The analyzed samples come from the shelters and were carefully drawn from 64 rock painting sites, most of them recently discovered in Ethiopia. They have reduced size, from about ten microns to some millimeters. Some of them are in form of powder, whereas the others consist of very small fragments.

The samples were subjected to different micro-destructive spectroscopic techniques, such as micro-Raman microscopy (µR), Attenuated Total Reflectance (ATR) and Laser Induced Breakdown Spectroscopy (LIBS), furnishing appreciable results by means of a reduced amount of material. Micro-Raman as well as LIBS analyses were executed to determine the coloring material used as pigments, whereas FT-IR spectroscopy in the Attenuated Total Reflectance (ATR) procedure was applied as a comparison investigation technique in order to obtain greater information about the whole materials and to search for organic material, probably employed as binders.

Results

Pigments

µR and LIBS analysis, performed on red, black as well as white paintings, permitted to identify the pigments used for the mural paintings (fig.1): hematite for red, goethite for yellow, gypsum and calcite for white, whereas amorphous
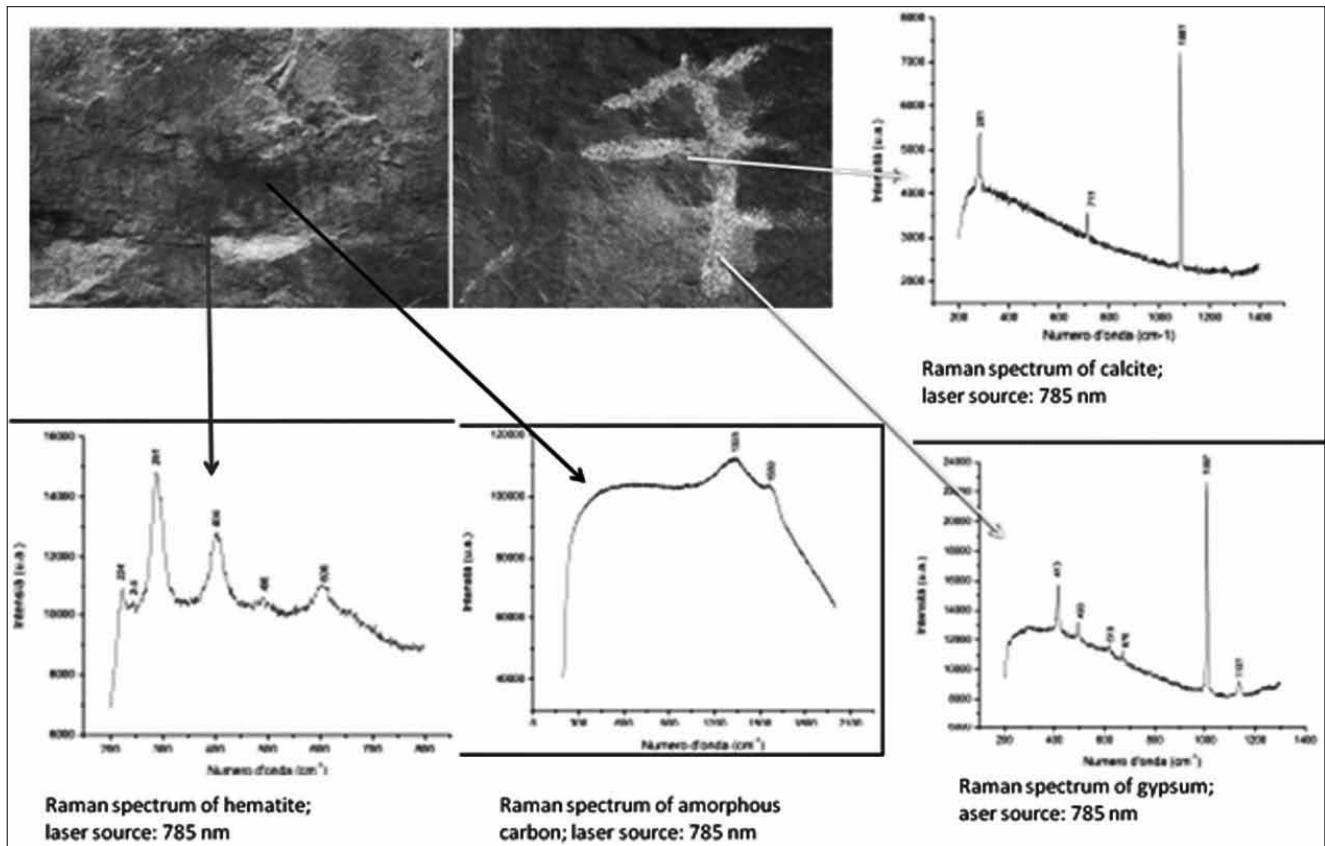
Fig.1 Micro-Raman spectra of the pigments present in the rock art paintings

carbon, which has probably a vegetable origin, for black. A surprising result comes from the green pigment of sample nr.54. Raman spectra evidenced that the coloring is due to the mineral celadonite, indicating an early use of green earth in African rock art.

Organic materials

The search for organic matter was accomplished by µR, which revealed the presence of beeswax in one sample, and by ATR, that exhibited the same organic material in manifold samples. The origin of beeswax is not univocally defined yet, but it may be utilized as a binder mixed to water, where pigments were dispersed or applied in a subsequent period to better observe the drawings.

Neoformation products

An important result was the presence of monohydrated calcium oxalate, in the form of little crystals dispersed in the almost all pigmented areas of the paintings, especially the red ones, and detected with all the techniques on the totality of the samples. Its origin could be biological or due to the chemical transformation of a natural substance containing a source of oxalic acid (Zoppi, 2010), such as cactus extracts, used as a pictorial binder. In order to furnish an experimental check of this hypothesis, the inner matter of a cactus leaf was extracted; the gathered stuff contained aggregates of white crystals, identified as whewellite crystals by µR.

Conclusions

The results obtained in the present study have highlighted some important issues regarding rock art pictorial technique. First, it was possible to describe the palette of the local artists; it was constituted of hematite, mixed with the

white pigment calcite for red, calcite for white, whereas carbonaceous material was used for black coloration. The origin of gypsum is not very clear, due to the fact that it could arise from calcite as an alteration product or used as pigment. Second, a consistent amount of Ca-oxalate was found particularly on red samples as well as on the white ones. Former studies attributed oxalates origin to a biological substrate attack, whereas in the present case Ca-oxalate is ascribed to the use of an organic stuff to spread properly the pigments on the substrate. An absolute chronological collocation attempt could be estimated through radiocarbon dating, as beeswax, carbonaceous material as well as calcium carbonate represents an important carbon source.

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ANCIENT AND MODERN MORTARS: KNOWING THE PAST TO PLAN THE FUTURE

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In Cultural Heritage mortars play a fundamental role in masonry, plasters, substrate of mural paintings and mosaics. Therefore their study and characterization is essential in terms of identification, documentation, conservation and restoration. Particular relevant is the study finalized to the consolidation of building structures damaged by seismic events.

A well done chemical, mineralogical, petrographycal, physical and mechanical characterization allows to achieve those information useful to answer to the above mentioned problems.

The nature of the binder and of the aggregate allows to understand the level of know-how in terms of burning, slaking, composition, application and utilisation of local materials. Concerning the final properties, type of binder and characteristics of the aggregate (nature, composition, shape, grain size distribution, ratio with binder) have a large influence on the durability of the mortar itself. Characterize the performances (elastic modulus and compressive strength) of the mortars, by means of on-site and laboratory tests, it is necessary in order to understand the mechanical role played in the masonry.

At least any intervention requires the compatibility between modern and ancient mortars not only for ethical issues, but also for the conservation practice (chemical, mechanical and physical aspects) especially when the substrates to be restored are particularly precious or injection mortars are to be used for the consolidation.

Concerning the optimal mix-proportions adopted by the Romans to realize mortars much has been discussed; good raw material and mixing were to be adopted favouring high durability and good technical mortars characteristics that ancient structures still nowadays show. Vitruvius emphasizing the importance of using pozzolana or tuffs in addition to a careful use of well washed sand and lime - derived from burning pure, compact and hard stone as white limestone or siliceous limestone - for creating a good concrete (Pecchioni *et al.*, 2008). A representative case is the Augustus Bridge at Narni (Terni - Italy), 27 b.C. (Cantisani *et al.*, 2002) where even four different type of mortars were used for bedding the well cut travertine ashlars of arches, abutments, piers and their inner cores.

The mortar of the foundations (up to a height of 7 m over the rock basement corresponding to the ground level) have been made hydraulic with abundant tuff fragments, producing a material highly porous; the overlying mortar (from 7 to 17 m) is also hydraulic, but with a lesser amount of tuff fragments. Its hydraulic characteristic is justified by the necessity to offer a good resistance in case of river floods. The upper mortar (from 17 to 22 m) is completely different and characterized by the absence of tuff, a notable lower porosity, a higher cohesion and a high hydraulic index. Those features should be referred to the necessity to stand the strong tensions in the piers located directly under the arch. The upper mortar (from 17 m) to the edge), with a lower cohesion and an earthy appearance, had the function of filling of the top of the pier.

Fig.1: Damages produced in the earthquake 2009 in Abbey of Santa Maria Collemaggio in L'Aquila.

Some of these mortars show a really strong cohesion and mechanical characteristics similar to that of the modern concrete. The Romans could realise high-quality mortars choosing a binder of high hydraulicity, realized from the burning of a siliceous limestone with/or tuffs, mixed with good raw materials; for these reasons after many centuries the Roman structures stand still nowadays in good condition.

Well different is the case of the Medieval buildings severely damaged by the earthquake of the 2009 in L'Aquila. The studies show that the low quality of the mortars is correlate with the characteristics of raw materials, the mix proportions and the mechanical features. Local carbonatic aggregates, highly sharp-edged and bad sorted, produced in the mortars shrinkage phenomena and low workability (Quaresima *et al*., 2006). To increase the latter property, the addition of water, produced materials highly porous and mechanically weak. Moreover, in several cases as binder, instead of lime or in addition, raw earth has been used. At least, during time, the mortars, due to weathering and to their pristine low durability (Corpora *et al*., 2007), were strongly decayed. These common features, referred to the local tradition (characteristics of raw materials, economic reasons, reconstructions after the past earthquakes), could justify the weakness of the masonries and of the structures stricken by the earthquake. Moreover, the practice of using incompatible repairing mortars (portland cement injection grouts), has produced furthers heavy and severe damages (Quaresima *et al.*, 2010).

In conclusion the study of the ancient mortars is strictly necessary and crucial not only to understand the "Material Culture", but also to plan architectonic and structural interventions in seismic context. What we must learn from the past? Plinio the Elder warning about this in the Naturalia Historia (77 AC): "*Where the earth shook, it tremble again*".

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MICRO-INVASIVE TEXTILE SAMPLE TREATMENT FOR SERS ANALYSIS

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Surface Enhanced Raman Scattering (SERS) is a powerful analytical tool for the study of organic substances in works of art, such as dyes, which are extremely fluorescent and poorly detectable by means of traditional Raman technique. The study of this class of compounds is very difficult because of a series of factors which influence the analyses, as well as: low concentration at which these compounds are used, interference due to the presence of the binding media in pigment and glaze samples, contamination by materials used for conservation purposes.

Our work regards a micro-invasive and non-extractive hydrolysis sample treatment procedure, which has been applied to the study of dyes for textiles. With the aim to better evaluate the capability of the technique, a series of analyses have been performed on fragments of textiles dyed with standard substances; two solvents, water and ethanol, have been tested as extractive agents, in order to break the complex dye-mordant. SERS effect has been accomplished putting a drop of a silver colloidal dispersion, prepared according to Lee-Meisel method, on the textile fragment, previously treated with ethanol or water, and let dry. Good outcomes have been obtained in both cases, even if the best extractive performance has been showed using water.

New extractive methodologies, such as matrix transfer technique, will be tested in order to achieve a completely non-invasive approach for the study of the works of art, avoiding any sampling assay.

DESIGN AND SYNTHESIS OF NEW CONSOLIDANTS FOR THEIR USE IN WOOD CONSERVATION

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Introduction

The synthesis and characterization of novel compounds provided with a chemical structure similar to the main components of wood were studied, in order to obtain a structure consolidation of waterlogged wood without producing an alteration of the physical characteristics.

Results

In the past, several compounds and methods have been studied and used for the treatment of waterlogged wood. PEG (polyethylene glycol), at different molecular weights, is still today the most used compound for wood consolidation. However several problems appear consequent to the presence of PEG into wood, so the study of different consolidants is required.

In the wood lifetime various agents alter the chemical structure of its main components. In detail, water and biological agents can favour hydrolysis reactions which cause the prevalent loss of hemicelluloses and cellulose, which represent the backbone of the ligneous structure. The goal of this study is the synthesis and characterization of wood consolidants provided with a chemical structure similar to the wood, in order to maintain its aesthetic, mechanical and physical characteristics. Several hydroxylated compounds were synthesized and characterized in order to obtain water soluble compounds with a high affinity for polar materials as wood, paper and natural fibres. The interest for the synthetic procedures is the use of renewable resources as starting compounds as cellulose, L-tartaric acid, D(+)-glucose, oligosaccharides.

In order to restore the polysaccharides components in the degraded wood, different compounds were designed and synthesized. Water-soluble polysaccharides as Allyl-carboxymethylcellulose and Allyl-hydroxypropylcellulose were obtained from cellulose using etherification reactions. Oligosaccharides were obtained from polycondensation reactions of glucosidic monomers opportunely functionalized. Hydroxylated oligoamides (m,n) as polyethylene-L-tartaramide, polyethylene-D(+)-glucaramide and polyethylene-α,α-trehaluronamide, were obtained using natural compounds or their derivatives as diacids.

Therefore several compounds were synthesized and characterized with the aim to obtain a library of molecules suitable for their use as consolidant agents. All the synthesized compounds have a structure similar to those of polysaccharides and in particular to cellulose in order to restore wood backbone and to improve his mechanichal strength.

In order to design new consolidants for wood impregnation it is necessary a rapid screening, and a diagnostic protocol was used in order to select the consolidant with the best performance between the synthesized products.

The chemical affinity with degraded wood was studied using beech lignin recovered from the recent wood. After im-

Consolidant libraries

Polysaccharides:

Cellulose derivatives

Oligosaccharides derivatives

Polyamides I

R= H ; —CH₂—CH=CH₂

Polyamides II (polytartaramides)
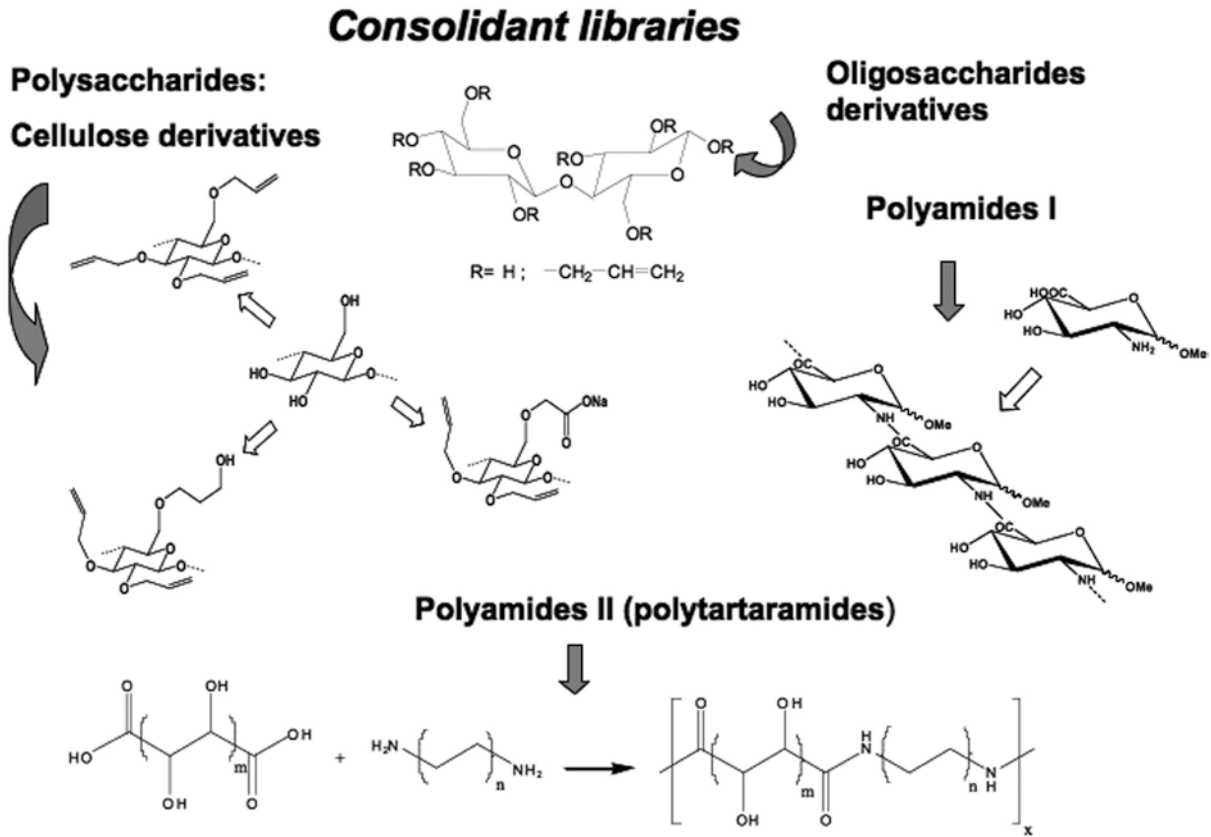
Fig.1: Synthesis scheme

pregnation with a consolidant in water solution, FT-IR spectra were recorded and compared with those of the starting lignin.

Preliminary tests of application of the synthesized polymers on archaeological wood samples were performed in order to verify their ability to penetrate inside cellular walls. The penetration in wood was evaluated using cubic specimens (volume 1 cm³). After a treatment of 45 days, wood flours obtained from internal and external sections were analyzed using FT-IR spectroscopy. The spectra obtained were compared with that of an untreated specimen and a high penetration was observed for oligoamides.

After the treatment with polyamides, some physical wood properties were evaluated. The specimens were subjected to gravimetric and volumetric analyses to determine their physical properties. The determination of the specimens' weight was carried out by using the gravimetric method referred to the UNI ISO 3131 normative while specimens volume were evaluated with the water displacement method.

The physical properties of wood, as hygroscopic equilibrium, basic density and dimensional stability, were evaluated obtaining very interesting results. In fact the basic density of the treated wood appear similar to that of recent wood, while the volume shrinkage is reduced respect that of an untreated sample.

Conclusions

A series of functionalized polysaccharides and polyamides potentially useful for wood conservation were synthesized and characterized.

All the synthesized consolidants showed high affinity for lignin. The penetration in the wood samples was high with polyamides.

The hygroscopic equilibrium and the dimensional stability obtained with all polyamides were very interesting.

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EXPERIMENTAL STUDIES ON THE WOODEN SUPPORT OF THE "MONA LISA"

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The "Mona Lisa" (Louvre Museum, Paris) has been painted during the period 1503-1514 by Leonardo da Vinci on a panel of Poplar (*Populus alba* L.) ~79 x 53 cm, ~ 13 mm thick.

The panel, which features a complex double curvature, is affected by a ~11 cm-long crack, possibly dating not long after the painting was made, running through the whole thickness, tightly connected with the pattern of permanent curvature. The panel is inserted in an Oak frame ("châssis-cadre"), and is slightly forced against it by means of four cross-beams, which hold it flatter than it would be if unconstrained.

Since the "Mona Lisa" was going to be moved in a new display case in the "Salle des États", in 2004 the Curators of the Louvre Museum asked us the main following questions:

– evaluate climatic specifications for the new display case

– assess the risk of crack propagation

– suggest possible modifications to the frame ("châssis-cadre")

– improve the monitoring procedure (the display case gets opened yearly, to check the conditions of the painting).

Our group studied the panel's geometry, the anatomical and physical properties of the panel's wood, and evaluated the constraint conditions produced by the frame. We also designed and implemented, among others, techniques and equipment:

for manual measurements, to be performed on the panel, on the occasion of the yearly opening (weight, shape, forces exerted by the cross-beams).

for automatic monitoring deformations and forces exerted by the cross-beams, during the normal stay of the panel in the display case, where the climate is tightly controlled, but however some slight variations of T and RH inevitably occur and produce some very small distortions.

In 2006 a Book was published, summarizing the results of the several researches carried out on the "Mona Lisa" in that period.

Among several other results, the following were obtained and described in such book.

The observed trend for deflection of the Panel could be well predicted by a heat & mass transfer + hygromechanical computer model.

The risk of crack propagation has also been assessed, on the basis of the computer model and by means of Griffith theory.

This study keeps ongoing, every year we are present at the opening of the display case.

Data obtained so far provides valuable information on this Panel's behaviour; data analysis and mechanical modeling provide promising results also for Panel Paintings in general – work is still in progress.

FUTURE CLIMATE AND POLLUTION PRESSURES ON STONE HERITAGE

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

Stone monuments degrade by climate and pollution. Some decay mechanisms for stone are the dissolution by rainfall and SO_2, blackening by soot deposition, frost shattering, thermal damage, degradation by soluble salts and biological colonisation (Brimblecombe, 2011). Deterioration by pollution was especially intense from the 1700s. In the late 19th and early 20th centuries the dominant impact of air pollution was the sulfation of surfaces. The parallel deposition of soot caused the blackening of surfaces and the formation of black crusts (Brimblecombe and Grossi, 2010). The decrease of sulfur and soot from coal combustion during the last decades of the 20th century led to cleaner air in cities, a decrease of pollution-decay rates on building stones and a public desire for cleaner buildings. The future offers a potential for further variation in the colour of buildings (fig. 1), from different biological growth under changing climates or the presence of different pollutants (Brimblecombe and Grossi, 2007).

Although there was an improvement in traditional air pollutants such as sulfur dioxide and smoke, they have been replaced by ozone, nitrogen oxides and particles richer in organic compounds (Brimblecombe and Grossi, 2010). Much of the change in the nature of air pollution was the result of the extensive use of the automobiles. Recent research projects such as CULSTRAT, MULTIASSESS and TEACH focus on the effect of multi-pollutant environments on heritage materials and the development of strategies for maintenance and conservation (de la Fuente *et al*., 2011).

Deposited organic compounds can oxidise in modern urban environments. The resulting products exhibit yellowish or brownish colours rather than black. This *yellowing* process is gradually more noticed at stone heritage sites such as the Tower of London (Brimblecombe, 2011). A change of colouration due to biological staining is also expected in the future. Moreover, sulfur dioxide is phytotoxic, so in urban atmospheres with less sulfur, biological growth is more effective. A greater rate of delivery of nitrate to building surfaces that acts as "airborne fertiliser" (Adamson *et al*., 2010), also increases biological colonisation. Depending on climate, different colouration processes (e.g. *greening* or *reddening*) might be expected. In Northern Ireland (Adamson *et al*., 2010) a *greening* effect, due to the growth of green algae, is increasingly observed in locations that experience longer time of wetness in winter, and this is having a negative public response. However, in other geographic areas experiencing hotter and drier summers a developing of orange-brown weathering layers characteristic of Mediterranean climates might be expected (Urzi and Reallini, 1998). Changing biology and colouration in buildings within changing environments is an area of further research. Future brownish/yellowish colours or biological staining may also raise aesthetic issues.

The appearance of colouration patterns in the future might also vary with changes in pollutant deposition and rainfall patterns. The removal of pollutants by rain can create patterns of rain streaking that disfigure buildings and promote public disquiet (Grossi and Brimblecombe, 2004). The mechanism and dynamics of removal of black crusts from buildings over time as pollution decreases is poorly understood. This is an important area for future research.

Fig. 1: Cathedral of Oviedo (Northern Spain) cleaned during 2000. The limestone façade shows no evidence of blackening in 2011.

The investigation should include the development of computer simulation techniques, which can be realistic and verified experimentally. The changes under way have both aesthetic and economic implications for the cleaning and maintenance of historic buildings. Building management will depend on anticipating future colouring patterns and public perception and integrating them with other considerations such as finance or physical damage (Brimblecombe and Grossi, 2010).

Cleaner atmospheres also mean that climate is a factor of increasing importance in the weathering of monuments. There is a growing research on the impact of climate change on cultural heritage, such as the pioneering NOAH's ARK and the out-going "Climate for Culture" projects. The climate/heritage research led to the development of the concept of Heritage Climatology by Brimblecombe (2010) that can be seen as the study of climate parameters that affect monuments, materials and sites. These parameters concentrate on aspects and combinations of meteorological variables that relate to material damage. For instance frost and salt damage can be assessed by estimating the frequency of phase transitions of temperature and relative humidity. Precipitation can combine with wind to create wind-driven rain that can force water into porous stones or remove pollutants from stone facades (Brimblecombe, 2011).

The Köppen-Geiger climate classification can be a good approximation for some heritage risks (Brimblecombe, 2010). Studies on climatology of salt damage suggest that the frequency of salts transitions strongly depends to the monthly relative humidity and temperature (Grossi *et al.*, 2011). The number of transitions shows distinct seasonality which can be related to Köppen-Geiger climate types and their change during the 21th century. A similar approach may be used to proxy biological colonisation and or dissolution by the karst effect.

The study of climate change impacts on heritage stone needs the output of climate change models. However, climate models are prone to uncertainties. The use of multiple climate models or ENSEMBLES may improve the accuracy and reliability of the predictions. This approach has been used in other areas of research (e.g. energy demand or forest fire risk -Morse *et al.*, 2009). Lately it has been introduced to predict the future climatology of salt transitions (Grossi *et al.*, 2011). Additionally, more work in uncertainty to manage stone heritage and downscaling to specific sites needs to be done. There is public availability of downscaling facilities and data access, but not always user-friendly for heritage researchers. The UKCP09 user interface is a good example of friendly-availability for probabilistic projections and downscaled climate change data, but available data are limited to the UK.

Potential research on climate change and stone heritage should include: exploring stone vulnerability to climate (proxies for damage, climate parameterisation and damage functions); monitoring the change in the long-term; access to high spatial and temporal climate resolution models and downscaling; including urban areas; estimates of reliability and uncertainty; developing of long-term strategies to prevent damage (see Sabbioni *et al.* 2009).

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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

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Below the surface of paintings from Old Masters such as Rubens and Rembrandt but also from more recent artists of great renown such as Van Gogh and Ensor, often a wealth of information is present. Underlying layers may include underdrawing, underpainting and alterations [1]. In a growing number of cases, conservators have discovered abandoned compositions on paintings, illustrating the artists' practice to re-use a canvas or panel [2]. Additionally, knowledge about the stratigraphy of a painting often is highly relevant in conservation when stability problems such as paint discolouration or delamination are studied.

Thus, the study of a painting and its stratigraphy is a common research theme shared by curators, conservators and conservation scientists. Traditionally, the visualisation of the inner structure of painted cultural heritage (CH) artefacts relies on penetrative, two-dimensional imaging techniques such as Infra-red reflectography (IRR) and X-ray radiography (XRR), optionally complemented with microscopic analysis of cross-sectioned samples [3]. However, there are significant limitations to this approach because on the one hand the imaging techniques are sensitive to a limited number of materials and only provide flat, 2D images of complex, 3D-structured systems while on the other hand the use of cross-sections requires destructive sampling that upon analysis only provides local information.

Recently, macroscopic scanning x-ray fluorescence (MA-XRF) has been introduced as a novel and more powerful method of visualizing the distribution of pigments in superficial and buried layers constituting paintings. Next to opening up new avenues of scholarly (i.e. art-historical) study of painted works of art, this method is also eminently suitable for use by paintings conservators and for authentication of works of art. In this contribution, after outlining the principle of this new method, we discuss its possibilities and limitations for extracting information about the inner structure of painted works of art.

Non-destructive imaging by means of X-ray based methods

Traditionally, the art and museum world heavily relies on XRR for inspection of overpainted layers and of the invisible inner structure of paintings and statues. However, conventional (X-ray tube based) XRR [2] has a number of important limitations. First, the observed X-ray absorbance is a summation of all element-specific absorbances, implying that the contributions to the overall image contrast due to (low quantities of) weakly absorbing elements will frequently be obscured by heavier elements that are present in higher concentrations.

Thus, the absorption contrast in XRR images is mostly caused by the heavy metal components of the pigments present (lead in lead white, mercury in vermillion, …). Second, since prior to the application of the paint layer, a canvas is usually primed with a homogeneous lead white layer, an overall absorbance background is present in XRR images.

Thirdly, the polychromatic character of an X-ray tube reduces the contrast. As a result, conventional XRR imaging of paintings frequently provides only a fragmentary view of their substructure, severely hampering the readability of hidden compositions.

Microscopic investigations

Bertrand et al. [4] list the most important X-ray based methods that allow for imaging of archaeological and artistic materials. X-ray fluorescence analysis (XRF) is one of the most frequently employed methods in this field, next to X-ray diffraction (XRD) and Xray absorption spectroscopy (XAS). During scanning mode investigations, a X-ray microbeam is gradually moved over an area of interest of a sample while various material-specific signals are recorded. Next to recording the total amount of transmitted, reflected and/or scattered photons, energy-dispersive detectors are employed that capture the spectrum of fluorescent photons emitted by the sample. Cotte et al. [5] have reviewed the use of X-ray microbeam-based methods for the investigation of various type of cultural heritage materials employing monochromatic and energy-tunable synchrotron radiation, among which (partially) altered paint layer stratigraphies. Recent studies involve the alteration mechanism of the yellow pigments cadmium sulphide (CdS) [6] and lead chromate (PbCrO4) [7,8] and of the red pigment vermillion (HgS) [9].

The increased insight into the alteration mechanism of (these) mentioned pigments is highly relevant for painting conservators in order to establish optimal conditions (relative humidity and level/type of illumination) for long-term preservation of works of art.

Macroscopic XRF

When during XRF investigations, a X-ray pencil beam is employed to excite the atoms in/just below a small area on the surface of a larger specimen, information on the local elemental composition can be obtained via detection of the characteristic radiation that is emitted by the different types of irradiated atoms. Usually, the fluorescent signals are not only generated at the surface of the irradiated materials but can also emerge from extended depths (several 10s to 100s of micrometers) below the surface. This phenomenon can be exploited for subsurface visualization of painted works of art by employing energetic millibeams of primary X-rays that are scanned over large areas of a painting; this method is referred to as macroscopic XRF (MA-XRF) scanning. The covering surface layers will not significantly attenuate the high-energy fluorescence signals from heavy elements in the buried layers; in this manner, the distribution of both minor and major components in the painting can be visualized. The use of high intensity X-ray beams leads to sufficiently small data acquisition dwell times per pixel that large, decimeter-sized areas can be scanned.

To demonstrate the feasibility of this type of analysis on an authentic painting, 'Patch of Grass', a canvas by the Dutch painter V. Van Gogh was examined at the DORIS-III synchrotron (Hamburg, Germany) [10]. XRR of this painting suggested that below the multicoloured landscape, painted by Van Gogh during his Parisian period, another painting, likely to be a portrait was present. Next to chemical elements corresponding to the landscape in the upper layer, such as Cr (chromium-oxide green), Fe (prussian blue, ochre), Zn (zinc white), the element Sb (antimony) was present, due to the use of the pigment Naples Yellow [lead antimonate, Pb(SbO3)2.Pb3(Sb3O4)2] in the covered portrait. The Sb-map revealed in detail a female portrait. The Sb distribution corresponded to the lighter tones of the portrait while in the Hg map, it was possible to establish where red touches (via the use of the red pigment vermillion, HgS) were applied by Van Gogh.

The approximate reconstruction of the portrait based on the Sb and Hg maps presents a significantly clearer and more detailed image of the hidden composition than the XRR and IRR images. Individual brushstrokes and all physio-

gnomic details, such as eyes, nose, mouth, and chin could be visualized. The reddish intensity of the flesh tones of the lips, cheek, and forehead adds to the readability of the portrait. In order to permit the MA-XRF method, next to being used at synchrotron facilities, also to be employed in-situ (i.e., inside galleries and musea in which the paintings to be examined as normally kept/displayed), a prototype moveable MA-XRF scanner [11] was developed. Recently, several important works of art by painters of various periods such as Memling, Rembrandt, Caravaggio, Goya, and van Gogh have been successfully examined in this fashion. These results demonstrate the great potential of the method, both for art-historical studies as well as for conservation studies of painted works of art and associated valorization actions. It is also a scanning method of analysis than may be easily combined with other types of macroscopic types of imaging such as optical spectroscopy and infra-red investigations.

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Koen Janssens studied Chemistry at the University of Antwerp, Belgium and is currently the Chairman of the Department of Chemistry of this university. His research interested are centered on the use of X-ray microbeams for non-destructive materials characterization, especially of cultural heritage and environmental materials. Next to table-top X-ray sources (X-ray tubes), very frequently, experiments are performed at synchrotron X-ray sources. The use of synchrotron radiation allow the use of submicroscopic X-ray beams and the combined use of X-ray fluorescence, X-ray absorption spectroscopy and X-ray diffraction for state-of-the-art materials characterization. The penetrative radiation is employed for characterization materials at but also below their surface, e.g., via the use of tomographic imaging strategies.

MICROCLIMATIC MONITORING FOR ARTEFACT CONSERVATION IN NATURAL HISTORY MUSEUM OF FLORENCE

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In order to guarantee the best conservation of objects exposed inside museums and to evaluate the museum environment suitability to conserve artworks, microclimatic monitoring is of great importance together with evaluation of lighting level and sampling of indoor air pollutants.

The stability of temperature and relative humidity plays a key role in the deterioration processes of the cultural heritage.

Sometimes the presence of an HVAC system is not enough to guarantee the best conservation of the exhibits; this for many reasons: bad systems design, poor maintenance and not proper operating procedures. Sometimes the museum management too can be cause of artefacts damage.

Furthermore in historical buildings turned into museums is very often necessary to carry out a compromise between objects conservation and protection, on the basis of damage risk acceptable for the exhibits, and environment fruition and visitors comfort.

In order to know and control the conservation conditions, and to define the thermohygrometric parameters values that can cause alterations of artefacts, an on going experimental monitoring system has been used in the Anthropology Section and in the Zoology "La Specola" Section of the Natural History Museum of Florence.

On each Section, the monitoring system consists of several wireless data loggers (for temperature and relative humidity measure) located in different rooms and showcases, chosen on the basis of the following parameters: importance of the artefact, building orientation and openings presence, kind of HVAC system and of lighting system. At regular intervals the values monitored by each data logger are downloaded by LAN network and shown in a central PC server, located in the Conservators Area. From here only the data of each Section are displayed directly in the bookshop PC and in the Section Manager PC, in order to control in real time the parameters variability and to take precautions.

SPECTRAL AND TIME RESOLVED LASER INDUCED FLUORESCENCE IMAGING AS A DIAGNOSTIC TOOL IN CULTURAL HERITAGE

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The masterpieces of ancient and modern painters still evoke the astonished admirations of contemporary observers for the combination of artistic capabilities and technical expertise that led to refined artworks, which resisted the challenge of centuries.

But will the most valuable masterpieces preserve their wonderful appearance in the future without a properly designed maintenance program? Luckily, in contemporary times, we assisted to a great improvement in conservation capabilities and diagnostic techniques.

Indeed, the development of non-invasive methodologies and portable instrumentation for in situ studies of works of art has been a subject of great interest in recent years. Optical and laser spectroscopy techniques can surely play an important role in the study of art. In fact, they offer the possibility to identify both the inorganic and organic components of artistic objects with high sensitivity and reproducibility of analyses.

Nowadays many examples of spectroscopic portable devices, with features almost comparable to those of standard laboratory equipments, are available. An interesting illustration of this evidence is provided by the European Transnational Access MOLAB, where a mobile laboratory composed of a collection of portable equipments has been set up for in situ non-invasive measurements on works of art [1].

Moreover, the possibility to operate with spatial resolution has allowed important issues to be addressed: in fact, the compositional heterogeneity of any artwork, which is very often an important part of the author's message, make imaging techniques more suitable than point measurements since they preserve the morphology of the object.

The activities at the Physics Department of Politecnico di Milano for the analysis of Cultural Heritage represent the introduction of cutting-edge laser and imaging technology for the optical non-invasive analysis of works of art. In the last decade different spectroscopy imaging techniques have been applied to the analysis of important works of art, including Renaissance wall paintings by Masolino da Panicale [2-3], Michelangelo's marble sculptures [4], a Van Gogh watercolour, as well as Design plastic objects.

In the present work, it will be shown how spectroscopy imaging investigations have allowed us to highlight degradation phenomena and traces of organic and inorganic materials on the artistic surfaces. In addition, maps of the presence of different inorganic and organic pigments have been produced.

UV induced fluorescence is a well-established technique to reveal retouches and other anomalies in paintings, thanks to two important features: it is completely harmless and it provides a direct image of the analyzed surface. Yet, the visual inspection under UV light carried out by restorers lacks of any quantitative assessment, that is indeed strictly required in any scientific approach to conservation. In our laboratory two advanced fluorescence imaging techniques have been developed to overcome this limitation, still preserving the advantages of fluorescence inspection.

The first technique, called Fluorescence Lifetime IMaging (FLIM) [5], allows one to recover the spatial map of the emission decay time in all the points of a wide field of view (∅ 50 cm), immediately following UV pulsed excitation. This map gives important insight into the nature of the fluorescing substances and is complemented by the map of the emission amplitude, which provides an estimation of the amount of fluorescing materials [2].

The second technique, named Fluorescence Multispectral Imaging (FMI) deals with the measurement of the fluorescence spectrum in each point of the surface under

investigation [6]. A further measurement, called Diffuse Reflectance Multispectral Imaging (DRMI), completes the dataset and gives the reflectance spectrum, under white light, in all the points of the field of view [3].

One of the most interesting applications of the FLIM technique was devoted to monitor the conservation status of Michelangelo's David within a diagnostic program aimed at supporting the conservative work carried out on the marble sculpture in 2004. Unquestionably, the analysis of David by FLIM was a challenging task for our research unit. Michelangelo's masterpiece is in fact astonishing for its size: it is more than 5 m tall and its surface area is about 20 m2, a large area can be conveniently mapped with a the aid of a wide-field imaging system only.

The extensive measurement campaign revealed that a large amount of organic material is absorbed into the marble. In particular, the presence of beeswax residues concentrated in small drops or permeated into the marble surface or into the small dips that characterize the sculpture marble finishing was mapped. An example of this finding is provided in Figure 1, where beeswax drops on the right forearm of the David are mapped with a fluorescence lifetime of ca. 6 ns. The presence of this organic contaminant can be related to the ''encausto'' treatment carried out in 1813, aimed at protecting the statue from rainfall and other atmospheric precipitations. According to the recipe reported in ancient treatises, the encausto was based on hot wax; after about 200 years, not withstanding several cleanings, wax is still widely present on the statue.
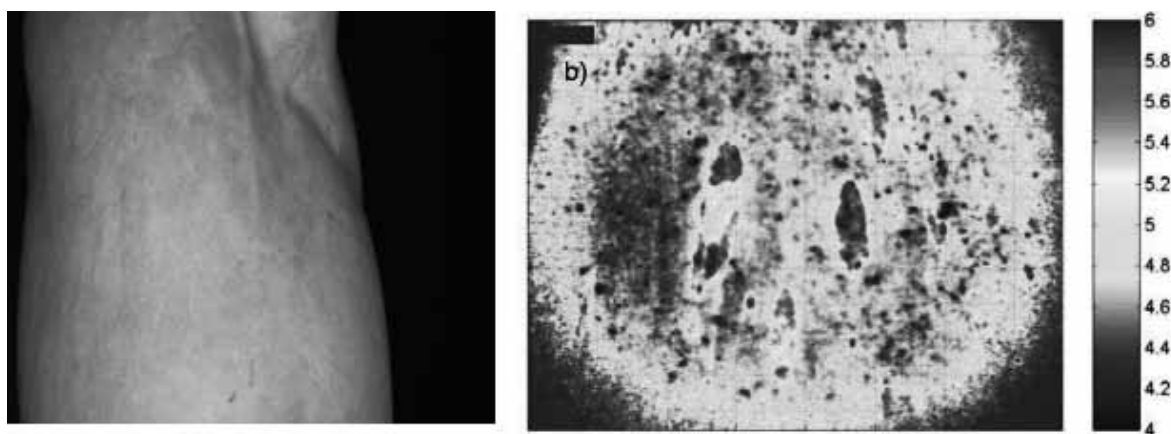
Figure 1 - Fluorescence lifetime analysis performed on the right forearm of the David's sculpture revealing the presence of fluorescent spots with an emission decay close to 6 ns: (a) color picture of the area; (b) fluorescence lifetime map.

FLIM analyses on brownish areas of the sculpture allowed us to further map most of the inorganic deposits present on the sculpture, which resulted to be mainly arranged in vertical stripes and were highlighted thanks to the decrease in the lifetime of the underlying fluorescence emission. The presence of inorganic deposits, better identified with FT-IR measurements as containing gypsum, weddelite, calcite and quartz, can be ascribed to the outdoor exposition of David sculpture until 1873, when the statue was finally placed inside the museum ''Galleria dell' Accademia''.

A further application of our imaging spectroscopy devices was dedicated to the in-situ analysis of Renaissance fre-

sco paintings by Masolino da Panicale in Castiglione Olona. In Figure 2, results from the application of the fluorescence multispectral imaging (FMI) technique on a selected frescoes scene are shown: the analysis reveals the presence of an intense red emission from Salomé's dress and headdress. The spectral shape of this red emission, outlined in Figure 2c and characterised by an intense and well-defined emission band at 640 nm, can be ascribed to the presence of a red lake, which has been documented in various panel paintings by the artist. Further measurements performed on a microsample taken from the artwork (which include Raman spectroscopy analysis), indicate that this lake is based on kermesic and/or carminic acid.
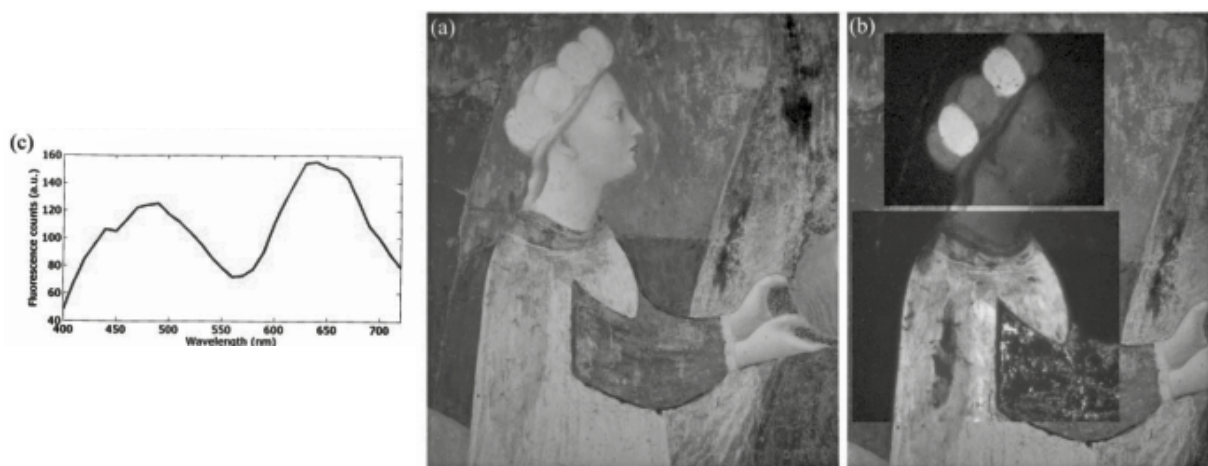
Figure 2 - Fluorescence multispectral analysis on a detailed area of Masolino's frescoes, depicting the character of Salomè: (a) color picture of the area; (b) reconstructed image of the colour of the emission following UV excitation; (c) typical emission spectrum measured from Salomé's fluorescent red dress.

In order to extract more refined information on this red emission, the FMI dataset of the Salomé's head was simplified with the aid of Principal Component Analysis. The second component (PC2), which inversely relates the emission in the blue with respect to the emission in the red highlights details on Salomè's headdress not easily discernible from the direct observation: as it is evident from the PC2 score map (Figure 3a) in the two fluorescent ovals of the headdress it is possible to observe a central spot. These spots, in terms of their fluorescence spectrum, are characterised by a higher intensity in the red band with respect to the surrounding oval areas, and hence can be correlated with a higher content of the red lake pigment. A comparison with a historical photograph taken in 1932 by Anderson (Figure 3b - copyright Alinari) revealed a fascinating finding, i.e. in the centre of the ovals round dark spots were visible at those times to the naked eye. The FLIM map of the fluorescence decay time (Figure 3c), thanks to its very high sensitivity, easily confirms the presence of these details,. Likely, these round spots has been removed during an inappropriate cleaning procedure carried out during the past century.
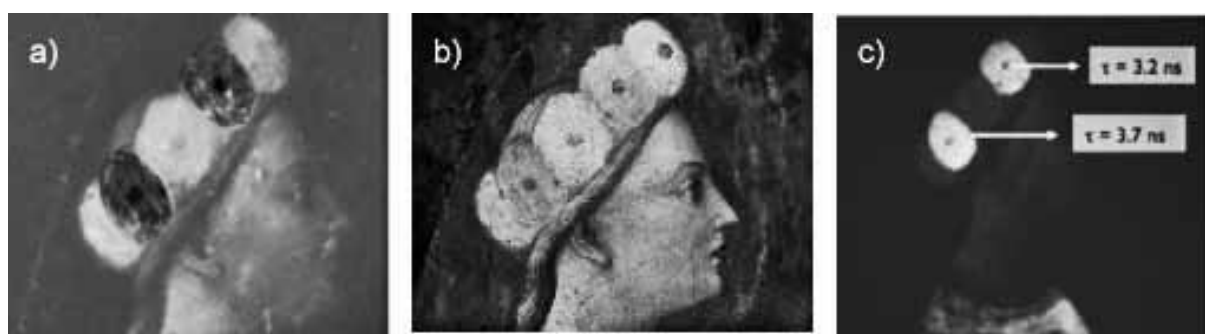
Figure 3 – Fluorescence analysis performed on Salomè's face, highlighting the presence of hidden decorating spots on the headdress of the character. (a) PC2 map obtained from principal component analysis of the FMI dataset; (b) historical black and white photograph of the upper figure of Salomé taken in 1932 by Anderson (copyright Alinari); (c) Fluorescence lifetime map.

As a general and conclusive comment, time-resolved and spectrally resolved fluorescence and reflectance imaging techniques can provide valuable information on materials present on a work of art, which include colorants, inorganic pigments, as well as conservative treatments and organic or inorganic contaminants.

Undoubtedly, the effectiveness of these techniques can highly benefit from the integration with other non-invasive and selected invasive measurements, but also from the application of refined data analysis methods. Nevertheless, it is worth noting that no one technique can face alone the complex problems encountered in cultural heritage analysis, while the synergic combination of in situ measurements and laboratory techniques allows one to gather the information required for a well designed conservation intervention.

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NEW CHALLENGES OF GROUND PENETRATING RADAR FOR ARCHAEOLOGICAL SURVEY

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

Introduction

In relatively small land of Japan, we have many historical areas, and archeological survey is important not only for academic purposes, but also for development of road and housing. More than 460,000 archaeological sites are known in Japan and more than 9,000 locations are excavated every year. Considering the cost and time of excavation, effective non-destructive archaeological survey methodologies are important.

Ground Penetrating Radar (GPR) is a subsurface sensing technique, which uses electromagnetic wave reflection from subsurface objects. The maximum depth of the detectable buried objects and its size is opposing parameters, and they can be determined by the operation frequency. 1-3m depth and 20cm resolution is typical parameters in current GPR survey for archaeology. Although it has a good potential for archaeological survey, and used since 1980's, it has some difficulties in actual applications. When the ground surface is not flat, the image will be distorted. In order to achieve fine resolution, we have to acquire high density GPR data sets, but it requires longer survey time. There are still many technical issues that have to be solved for practical use for GPR for archaeology.

In this abstract, we describe some examples of GPR applications to archaeology, and summarize the scope for future.

Detection of Hidden Stone Walls of Sendai Castle

We conducted archaeological survey for stone walls in Sendai castle in 2000. The wall of the castle was built on a natural ground by filling soil and the stone wall was covering the structure about 400years ago. We had idea that there will be some inner structure inside the wall, but we could not find the evidence from literatures. In 2000, Sendai city decided to renovate the wall, because it was deformed by traffic around the wall, and decided to remove all the stone pieces from the original location. We used borehole radar in a vertical water well drilled from the ground surface, and by analysis, we detected the existence of inner stone wall. We informed it before the excavation. We think this kind of survey will help to preserve the archaeological structure. In addition, conventional GPR survey was conducted on the surface of the excavated soil, and we could detect the existence of buried foundation of the castle.

3D GPR for Burial Mounds

I order to achieve high resolution GPR survey, We developed 3DGPR system together with University of Miami. This system acquires the accurate position of the GPR antenna by a laser positioning system simultaneously with GPR signal, on the uneven ground surface, we found that processing this data gives us very accurate focused image of subsurface structure. Also, we found that the image reconstruction signal processing improves the quality of the reconstructed images.

We have demonstrated this system for archaeological survey in Saitobaru archaeological area in Miyazaki, Japan, where we could have high accurate shape of a subsurface grave build in the 5-6th Century. The depth of the grave from the ground surface was about 3m (Fig.1). Then we demonstrated at Sakitama archaeological area, Saitama, Japan, where burial mounds were surveyed, and inner structure of 6the Century was detected. The detected object will be a stone structure, which is about 5m below the top of the burial mound. These archaeological sites are registered by the Japanese government, and we may not excavate the area without permission, However, normally, it is very difficult to get this permission, Therefore, practically, non-destructive survey method is the only way to understand the archaeological sites.

Road Construction in Nara, the Old Japanese Capital City

More recently, we are surveying area around Ishibutai-kofun (burial mound) in Nara, Japan. Nara is one of the former Japanese capitals in the 8-9th century. This archaeological area is very well studied, and many archaeological sites are already known around this site. Due to the increase of visitors, the local government planned to construct a new road, but at the same time, they worried about the destruction of the any archaeological survey by the construction of roads, and asked us GPR survey. We applied 3DGPR in this site. The area is farming field, with uneven topography and conventional GPR survey was very difficult. 3DGPR could image buried stones and image the location of ancient wooden buildings, and could validate the accuracy of the position by comparing the excavated data.

Tohoku Region Pacific Coast Earthquake

Gigantic earthquake and tsunami (Tohoku Region Pacific Coast Earthquake) attacked northeast part of Japan on the 11th March, 2011. The tsunami reached more than 15m in many coastal regions in Japan. In order to avoid any future damage, many of these towns are planning to move the houses from coastal areas to high areas. By the regulation of Japan, archaeological survey is mandatory for any development for roads and houses, and we expect we need quite a lot of archaeological survey very soon. GPR has been used in many local towns, but its use was very limited. However, in order to survey the vast area in a short time, we propose to use array-GPR systems. An array-GPR is a system which combines several GPR antennas and configures an antenna array. Conventional single GPR can scan a strip having about 50cm width, but the array-GPR can have 1-2m strip width. This is not only having wider scanning area at one scan, but also provides us a strip image of the subsurface structure. It provides a high accurate subsurface image, which is equivalent that acquired by 3DGPR system, in this strip area.

Other Radar Methodologies

Radar technology for archaeology is not limited to GPR. Satellite space borne synthetic Aperture Radar (SAR) can observe the ground surface from the space. Thanks to the properties of electromagnetic properties, it can reach to the ground surface though vegetation. Low frequency micro wave around 1GHz can even penetrate into shallow soil up to a few meters, if the condition is satisfied. Therefore, SAR has a good potential to find a new archaeological structures, which is covered in forests or in sand.

Ground-Based SAR (GB-SAR) is another type of radar sensor. Small antennas mounted on a rail are moved and acquire electromagnetic reflection from targets, and we obtain re-constructed image by signal processing. This is a compact system, non-destructive, and can be applied to many different type of targets of different sizes. We think observation of inside cultural heritages such as paintings and sculptures are unique and effective. Observation of inside structure of buildings and walls and floors will also be very useful.
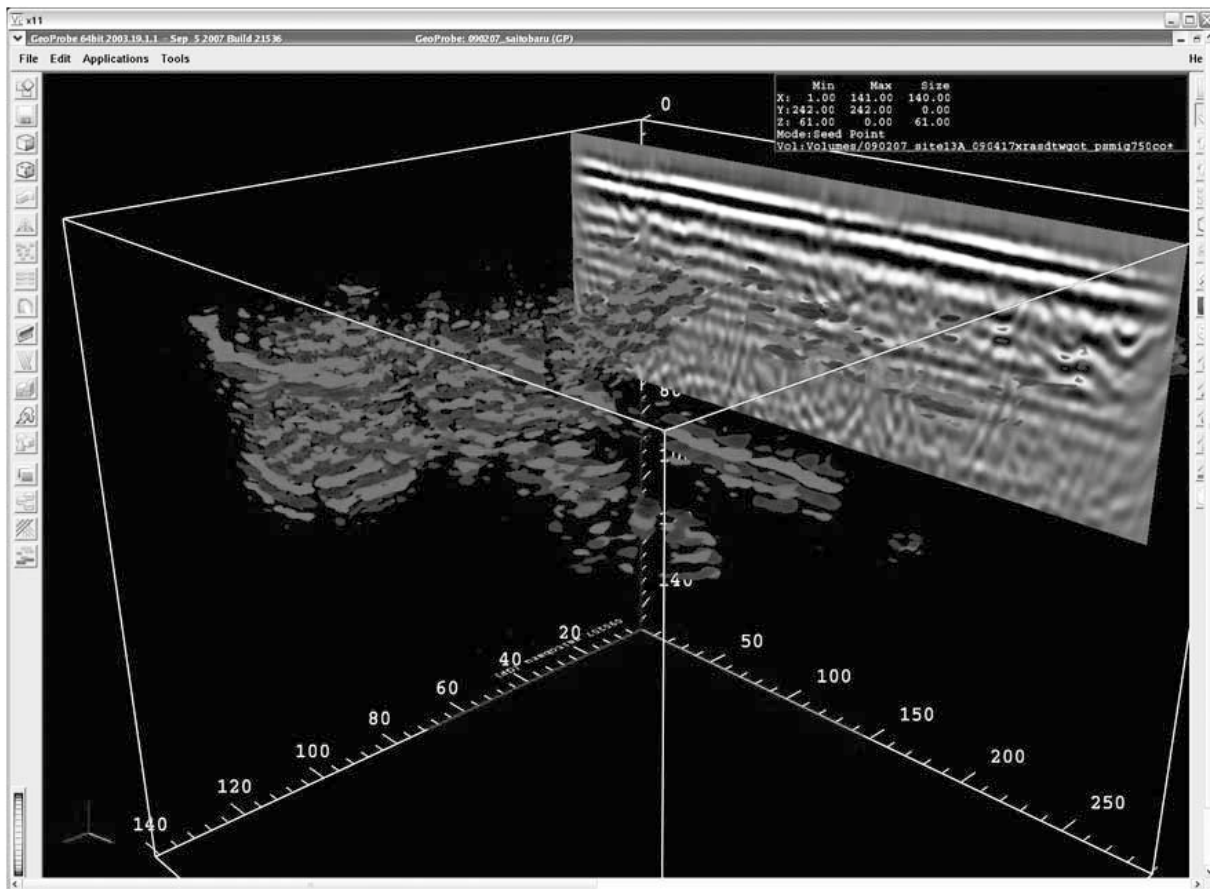
Fig.1: 3D image of subsurface grave obtained by 3DGPR, Saitobaru, Japan

Future Scope of GPR in Archaeology

GPR has been accepted for archaeology, however, we believe we can provide more useful information, if we can use the GPR equipments more effectively. The limitation of detectable depth and resolution cannot be changed, because it is physics. However, given the same operation frequency, if we provide accurate position information and signal processing, we could demonstrate much better images in many locations.

We believe further development of technology contribute to the preservation of cultural heritage.

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HYPERSPECTRAL INSTRUMENTS AS POTENTIAL TOOLS FOR MONITORING DECAY PROCESSES OF HISTORICAL BUILDING SURFACES

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Introduction

The effects caused by weathering on historic buildings and outdoor artefacts impose new strategies for their sustainable preservation. The large scale monitoring of the decay evolution of exposed surfaces, using non-destructive and relatively low cost techniques, is the first condition to:

(a) contribute to construct semi-empirical alteration models of artefacts;

(b) plan suitable conservation strategies and assess their efficacy.

Among non-destructive technologies for "in situ" analysis, hyperspectral instruments, like portable spectroradiometers (PS) and imaging spectrometers (IS), provide information on the characteristics of different materials, as well as the identification and discrimination of different compounds on the basis of their patterns of absorption at specific wavelengths (Clark *et al.*,1993).

The spectral range usually covered by commercial and prototypal hyperspectral sensors is generally comprised between 400 and 2500 nm.

Hyperspectral analyses may be used to:

• detect degradation products, i.e. gypsum, on surfaces of stone artefacts and monumental buildings;

monitor the presence of restoration/conservation treatments;

produce compositional maps of specific phases/compounds;

provide information on the characteristics and properties of crystal phases, such as their grain size.

Our research group has started a project aimed at verifying the suitability of hyperspectral analyses applied to the field of Cultural Heritage (Vettori *et al.*, 2008; Camaiti *et al.*2011).

Hyperspectral sensors

In this study we employed: a) a commercial instrument (FieldSpec FR Pro by Analytical Spectral Devices, USA, Fig. 1) that is a compact PS designed to acquire Visible and Near-Infrared (VNIR: 350–1000 nm) and Short-Wave Infrared (SWIR: 1000–2500 nm) punctual (about 1.5 cm^2) reflectance spectra with rapid data collection time (10 spectra/sec), and spectral resolution of 3-10 nm; b) a prototypal spectrometer (SIM-GA by Selex Galileo, Italy, Fig. 2), an IS consisting in two electro-optical heads (EOH) operating in the VNIR (400 – 1000 nm) region and the SWIR bands (1000 – 2500 nm). The spectral sampling ranges between 1.2 nm (VNIR) and 6.3 nm (SWIR) with a digital resolution of 12-14 bits.

ASD-FieldSpec FR Pro applications

The potentiality of this instrument has been tested on laboratory standards and on historic carbonate surfaces in order to verify:

• effects of pollution. The marble sepulchral arches (Avelli) aside the façade of Santa Maria Novella church in Florence (built at the end of 15th Century) have been selected as case study. The normalized reflectance spectra obtained in several areas show peaks due to calcite (substrate) and gypsum (precursor symptom of stone decay). The signal intensity of gypsum peaks is related to its abundance, indicating the potentiality for a semi-quantitative analysis;

• cleaning efficacy. Three different methodologies of cleaning were tested on a marble column belonging to the Loggia di Baccio D'Agnolo of Florence Cathedral, heavily affected by sulfation. Different gypsum concentration was found depending on the cleaning methodology used;

• permanence of conservation treatments. Synthetic compounds, such as acrylic, perfluorinated and silicone based polymers, have been identified and detected on stone samples. This technique may be also considered a powerful tool for monitoring the permanence of protective treatments on historic surfaces;

• decay evolution of stone. In consequence of the influence of mineral grain size and surface roughness on the signal intensities of the reflectance spectra (Clark, 1995), information on changes of the characteristics of stone surfaces might be exploited.

Distribution maps by Hyper SIM-GA

Preliminary results in the production of compositional and semi-quantitative maps of historic surfaces have been obtained on the first 'Avello' on the left side of the Façade of Santa Maria Novella church by Hyper SIM-GA. An example of "target detection" is reported in Fig.3.

Fig.1: Acquisition of the VNIR/SWIR *spectra* from the Avelli tombstones using an ASD *FieldSpec FR Pro* spectrometer by Analytical Spectral Devices

Fig.1: Identification of different materials on the first 'Avello' on the left side of the Façade of Santa Maria Novella church (Florence-Italy). The result has been obtained by Spectral Angle Mapper (SAM) classification.

CALCITE

GYPSUM

CALCIUM OXALATE

Pixels unclassified

Fig.2: Monitoring campaign in Santa Maria Novella square using a Selex Galileo Multisensor Hyperspectral System (SIM-GA).

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CHARACTERISATION OF SYNTHETIC VARNISHES AND PAINT MATERIALS BY ANALYTICAL METHODS BASED ON PYROLYSIS AND MASS SPECTROMETRY

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The wide use of synthetic polymers in art and in restoration makes mandatory the assessment of their stability and degradation pathways, and the development and evaluation of adequate analytical methods for their characterization.

This knowledge is extremely relevant for the selection of preventive conservation conditions as to reduce frequency and invasivity of restoration work.

In the context of the PAR-FAS Regione Toscana COPAC Project - *Preventive Conservation of Contemporary Art* (2011-2013) we applied two analytical methods based on pyrolysis and mass spectroscopy, namely direct exposure mass spectroscopy (DE-MS) and pyrolysis coupled with gas chromatography/ mass spectrometry (Py-GC/MS), to characterize a series of synthetic resins used as paint binders, varnishes and consolidants, before and after natural ageing (1-12 months): acrylic resins (Paraloid B67 and Acril 33), alkyd resins (Ferrario and Griffin, Windsor &Newton alkyd paint), an hydrocarbon resin (Regalrez 1094), an aldehyde resin (Laropal A81), and a polyethyl-oxazoline (Aquazol 500).

Characteristic pyrolytic profiles and mass spectra of significant pyrolysis markers were collected for each of the investigated materials. Principal component analysis was performed on the DE-MS spectra, proving this approach a useful tool for a fast and efficient comparison of the results obtained on raw materials, reference varnish layers and samples collected from works of art.

The proposed analytical methods do not require previous treatment of the sample, and, due to their high sensitivity, only a small sample amount in the microgram range is required. This makes them particularly attracting for applications to works of art, to characterise new materials, and analyse samples of unknown composition.

Case studies relative to artworks from Keith Haring (Mural painting *Tuttomondo*, Pisa), Anselm Kiefer (*Die Grosse Fracht*, Biblioteca Comunale San Giorgio di Pistoia) and Fernando Melani (*Bandiera* and *Teatrino*, Museo Casa-Studio Melani, Pistoia) are discussed.

NEW CHALLENGES OF GROUND PENETRATING RADAR FOR ARCHAEOLOGICAL SURVEY

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The main aim of the MEMORI project (EU FP7 Supported Collaborative Project: 265132) is to provide the conservation market with innovative non destructive early warning technology for easy assessment of environmental impact on indoor cultural heritage, including a preventive strategy to secure the conservation of movable cultural assets in protective enclosures.

Three major objectives are:

- To perform assessment of degradation risk to a range of types organic heritage objects due to indoor pollutants. Particularly, the project will investigate the effect of acetic and formic acids, on the degradation of natural and synthetic resins, aimed at understanding the best conservation conditions to be used for paintings and to chose appropriate mitigation methods to suppress aggressive pollutants in museum environments.
- To facilitate integrated in situ measurements and evaluation of indoor environments for cultural heritage by new instruments development and marketing.
- To optimize methods to mitigate degrading indoor pollutants.

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

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In the last decade, thanks to the important advancements in the solid-state based sensors, imaging techniques emerged as one of the most attractive research areas in the field of conservation (Fischer and Kakoulli 2006; Kubik 2007). In particular Hyper-Spectral Imaging (HSI) demonstrated to be a powerful tool for both non-invasive diagnostics and high-quality documentation of paintings and polychrome surfaces. HSI combines the potentialities of punctual techniques, such as the fiber optics reflectance spectroscopy (FORS), with the advantages of digital imaging (Bacci 2000, Casini *et al.* 2005). HSI consists in the acquisition of a sequence of quasi-monochromatic reflectographic images over an extended spectral range of a given surface suitably irradiated by means of a broadband light source. The data-set acquired, called *file-cube*, contains both the spatial and spectral information of the imaged scene. It can be elaborated to extract high-resolution RGB images, or other images in the desired spectral bands (e.g. IR reflectography, IR false colour, etc.). Moreover, it is possible to extract from the data-set and to visualize the reflectance spectrum corresponding to every pixel of the imaged area. Depending on the spectral range investigated (typically the UV-Vis-NIR) the reflectance spectrum can be exploited for a non-invasive identification of pigments, pictorial materials and alteration products, as well as for colorimetric analysis. Moreover, by processing data with multivariate methods (e.g. the PCA), it is possible to obtain 2D maps which allow a straightforward visualization of hidden characteristics (retouches, *pentimenta,* etc.) (Baronti et al.1999). Thanks to these potentialities HSI is by now a well-established technique for applications in conservation field; nevertheless, a number of open problems are still topics of on-going studies (Cucci *et al.* 2011, Delaney *et al.* 2010). For example, both the spatial and spectral sampling rates are key parameters to increase the informative content of the data-set. Indeed, a high spatial resolution is crucial to improve the quality of images, whereas the possibility of discriminating pigments strictly depends on the spectral resolution. On the other hand, when both the spatial and spectral resolutions are increased, the size of the data-set is dramatically enlarged (data files can reach sizes of about 100 Gbytes) and the acquisition times are lengthened. Thus, several questions related to data-handling and processing and to the practical consequences of long measurement times are risen. These topics have been tackled in the recent research activity carried out at the IFAC-CNR Applied Spectroscopy Image laboratory, where a prototype of hyper-spectral scanner, designed for diagnostics and documentation on artworks, has been recently upgraded. This system, based on a prism-grating-prism line-spectrograph, operates in the 400-900 nm range, with high spectral resolution (about 2 nm) and a spatial sampling of 0.1 mm. The system is optimized to operate on valuable artworks, thus guaranteeing safe operational conditions for the objects under analysis. Thanks to these characteristics the scanner is one of the most cutting-edge devices available for diagnostics and high-quality documentation of paintings. The scanner is routinely used for applications on va-

Fig.1 An application of the IFAC-CNR hyper-spectral scanner to the painting "Sacra Famiglia", or "Tondo Doni", (1504 -1507 ca.) by Michelangelo Buonarroti, belonging to the collection of the Uffizi Gallery (Florence).

luable items from the collections of the prestigious institutions (like the Uffizi Gallery in Florence). Noticeable results from selected case-studies are illustrated.

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TERRESTRIAL LASER SCANNING FOR ADVANCED ANALYSIS ON HISTORIC HILLTOP SITES AFFECTED BY GEOHAZARDS

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Introduction

Slope instability phenomena threatening cultural heritage built on hilltop sites are frequently due to a combination of environmental factors and geotechnical/geomorphologic features of the foundation substratum. Prevention measures can be efficient if based on a preliminary characterization of the ongoing phenomena and a reliable estimation of the associated direct and indirect risk. While conventional geomechanic survey techniques could be quite time-consuming and not easy-to-use in areas with limited accessibility, terrestrial laser scanning (TLS) represents a promising remote sensing device to retrieve high detailed 3D models of an entire site, with shorter time and huger amount of geometric data. Site-specific analyses carried out on different case studies with similar methodologies confirmed the TLS potentials for semi-automatic extraction of rock mass discontinuities and identification of critical sectors.

Terrestrial laser scanning for instability analysis

Time-of-flight laser scanner collects the geometry of an object, calculating the round-trip time the laser pulse takes to reach the scanned surface from the starting point and comes back. For each surface point, the Cartesian coordinates (X, Y, Z) and reflectivity values are obtained. Processing of the point clouds provides 3D models for (semi-)automatic extraction of rock mass discontinuities and analytical classification of geometric features of the rock surfaces (Fanti *et al.*, in press). Recent experimentations of TLS point clouds numerical manipulation have demonstrated the effectiveness of such remotely-sensed surveys, to perform 2D and 3D geo-structural analysis of unstable rock masses (Gigli and Casagli, 2011). The capability of documenting extended natural/artificial environments also allows the production of holistic models including both the rock mass and the overlying buildings. Consequently, structural relationships and direct exposure of the monuments built on unstable sectors can be estimated, along with specific surveys of crack patterns affecting the masonry surfaces (Gigli *et al.*, 2009).

Rockfall hazard assessment in Pitigliano (Southern Tuscany, Italy)

The historic town of Pitigliano is built on a tuff cliff constituted by a superimposition of pyroclastic formations with different grade of coherence and resistance to weathering. Debris accumulated along the cliff toe and the historical evidence of past rockfalls and masonry collapses testify the chronic exposure to slope instability, as well as structural hazard due to the presence of a huge underground network of chambers and corridors underneath the buildings. The research project carried out in co-operation with the Municipality of Pitigliano and supported by World Monuments Fund foresaw a TLS campaign on the cliff, combined with scanline method surveys. The latter also included inner
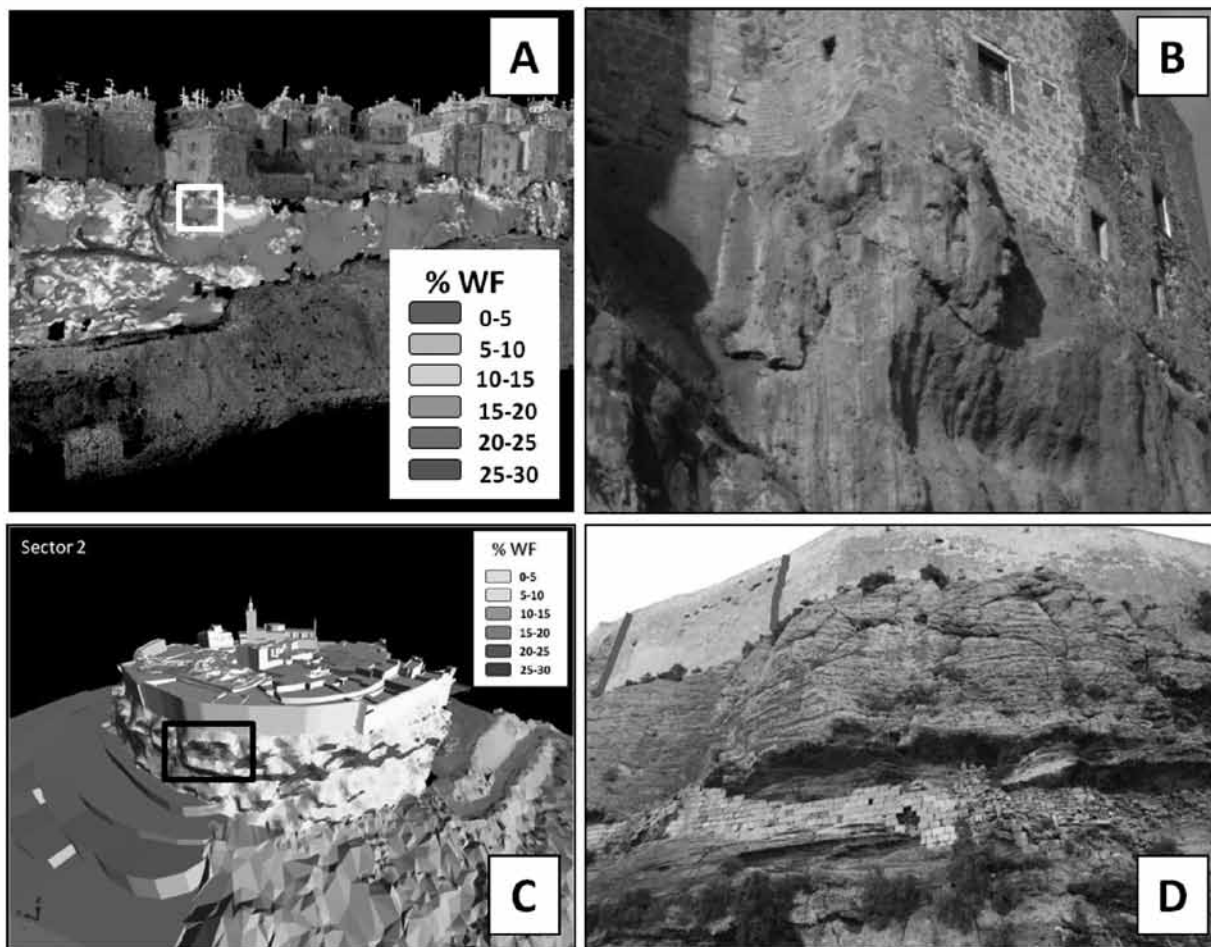
Fig. 1: A) Results from the quantitative kinematic analysis on Pitigliano cliff with regard to wedge failure (WF) hazard. The white square marks a sector of the cliff surface actually prone to WF, with potential direct impact on the overlying buildings (B). C) Classification of the rock mass of Citadel, Gozo, in relation to WF kinematic index. D) On site inspections confirm the results of the kinematic analysis, showing huge isolated blocks prone to slide. Red lines indicate the boundaries of a restoration masonry, presumably built up to repair a sector damaged by a past collapse.

walls within the accessible cavities. Adopting the procedure set-up by Lombardi (2007) and following the definition of *Kinematic Hazard Indexes* for each investigated instability mechanism according to Casagli and Pini (1993), TLS point clouds and related 3D models were processed to semi-automatically extract joint sets and results were compared with scanline method data. The two main joint sets controlling the structural setting of the cliff were identified and the probability of occurrence for the main instability mechanisms was calculated. Flexural toppling and wedge failure were found as the most hazardous mechanisms in Pitigliano, with a good accordance with the direct inspections of the rock surfaces (Fig. 1A-B). The updated mapping of the condition of the cliff was finally used to select a pilot area to install an easy-to-use on site monitoring system, to evaluate the cliff evolution in the near future.

Quantitative kinematic analysis for the Citadel fortifications in Gozo (Malta)

The military heritage of the Citadel fortifications is built on a rock slab – soft substratum system, constituted by a relatively stiff and brittle limestone plate overlying a thick Blue Clay layer. The upper part of the outcrop is highly fractured by extended sub-vertical joints that isolate blocks prone to slide or topple, exposing the masonries located along the edge to collapse and structural damages. Differential wind erosion also creates large niches undermining the overlying plateau. The last event of rockfall (2001) encouraged the execution of a site-specific kinematic analysis,

combining field and laboratory investigations with numerical analysis and rockfall simulation on the 3D model of the rock mass provided by the Restoration Unit, Works Division - Ministry for Resources and Rural Affairs, Malta. Using similar analytical procedure as the previous case study, all the exposed sectors were classified with regard to features that could contribute to trigger rock detachments and failure (Fig. 1C). Kinematic index for each instability mechanism and the related probability of occurrence were calculated, mapping the sectors prone to slope instability. As hypothesized from direct inspections, the wedge failure hazard was found as the highest probable (Fig. 1C-D). Among the immediate mitigation interventions, an on site monitoring system was specifically designed to continuously monitor the most critical joints and warn the local conservators in case of suspicious movements.

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MICROTREMORS: FROM THE BUILDINGS TO THE OBJECTS

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We present results from a seismic vulnerability assessment study on the Basilica of the Holy Sepulchre in Jerusalem (Fiaschi *et al.*, 2011). The study was conducted by the Centro di Ateneo per i Beni Culturali (CABEC) of the Università degli Studi di Firenze and the Fondazione Prato Ricerche, on behalf of the Franciscan Custody of the Holy Land. The monumental church, about 1700 years old, is formed by a series of architectural works built at different times, with different design solutions and heterogeneous materials.

The seismic vulnerability assessment of a such complex construction requires the knowledge of regional and local seismicity integrated by the study of geological and stratigraphical features in order to evaluate the local seismic response.

This was investigated with instrumental, single-station seismic noise acquisition processed with HVSR approach, which allowed to obtain the natural frequency of oscillation of the foundation soils (Bonnefoy-Claudet *et al.*, 2006). The study did not identify significant site amplification on the Basilica area by topographical and stratigraphical effects.

This type of instrumental analysis has been extended to the whole building in order to assess the presence of double resonance phenomena of land / building and to obtain a modal instrumental support for subsequent engineering analysis (Todorovska, 2009). Furthermore, no area of the building was in resonance with the soil.

Finally, the measurements were used to derive the longitudinal and transverse sections through the cathedral at points of particular archaeological interest allowing the reconstruction of seismic stratigraphy based on the different impedance of the buried layers (Castellaro and Mulargia, 2009). Geophysical results (Fig. 1) are in agreement with archaeological evidences provided by the reconstruction of the substrate (Corbo, 1982).

The same technique can be also usefully applied in an optimized procedure for the assessment of the seismic vulnerability of the museums. It is a well-known fact, from the history, that many Mediterranean countries are continuously threatened by earthquakes that endanger lives as well as the preservation of material heritage; earthquakes have caused significant damages, even in the last decades, in southern Europe, northern Africa and Middle East.

Furthermore, studies of both the historical and contemporary seismicity – performed over the Mediterranean areas – support the expectation of major earthquake in the future. In particular, considering the proximity of great towns to seismically active areas, it is quite evident that many museums could be damaged in case of strong earthquakes.

In this regard, it should be emphasized that earthquakes threaten not only the museum buildings, but also the artifacts on display and all objects kept in storage (Erdik *et al.*, 2010). Starting from the classic work of Agbabian et al. (1991), increasing efforts have been made, during the last years, in order to evaluate earthquake damage mitigation methods for museum objects and to develop new effective solutions (Podany 2008).
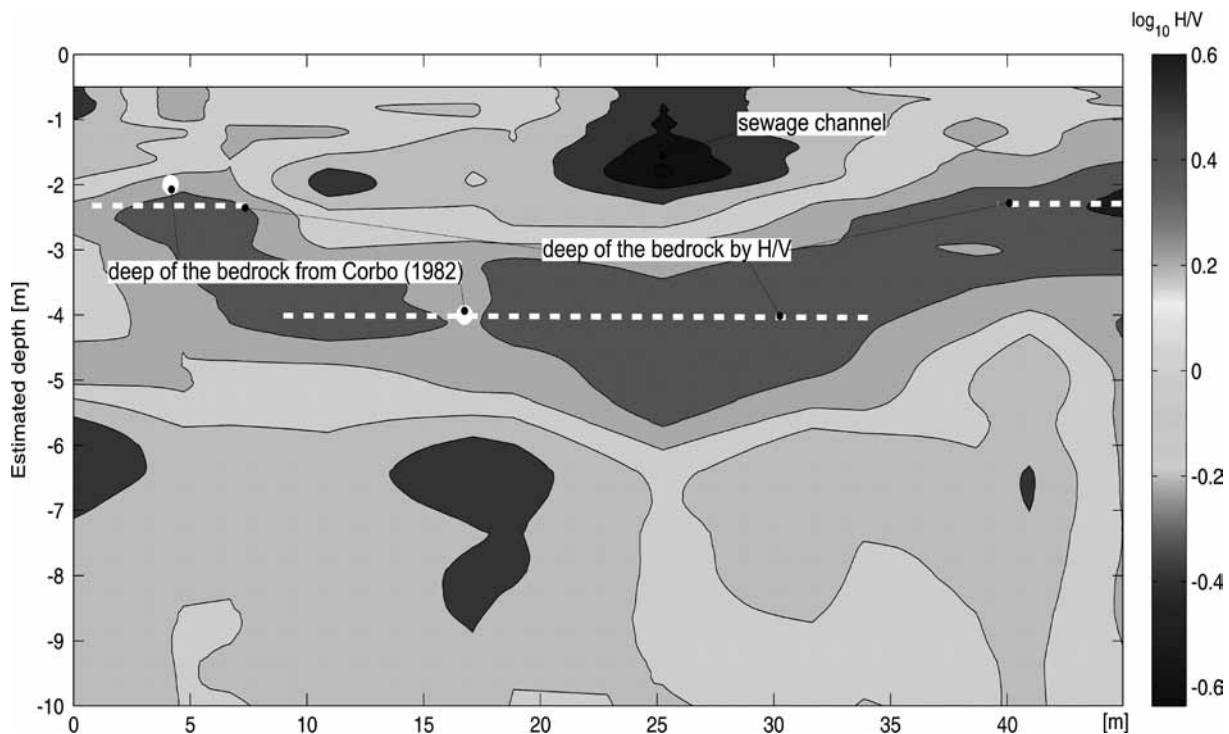
Fig. 1: Transversal geophysical section (N–S) of the Basilica of the Holy Sepulchre by H/V inversion.

Nevertheless, although several projects have been approved and financed by the Community Research and Development Information Society (CORDIS) under different programmes, that target on Climatology, Natural disasters and Risk, less is known and developed with respect to the safety and protection of museum collections and little advancement has been made toward development and implementation of solutions and mitigation schemes for collections. Therefore, we propose to develop and implement a method that is capable of combining the usual earthquake vulnerability evaluation of museum buildings (site-dependent deterministic assessment of expected earthquake scenario and ground motion at the site; assessment of structural properties and vulnerability of these buildings) with the earthquake vulnerability assessment of the museum contents (inventory: characterization of the types and characteristics of the objects on display and in storage; assessment of acceleration and drift sensitive objects; shake-table tests; determination of the critical level of ground motion for the various categories of objects).

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TERAHERTZ IMAGING METHODOLOGIES APPLIED TO THE INVESTIGATION OF ARTWORKS

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Stone monuments degrade by climate and pollution. Some decay mechanisms for stone are the dissolution by rainfall and SO_2, blackening by soot deposition, frost shattering, thermal damage, degradation by soluble salts and biological colonisation (Brimblecombe, 2011). Deterioration by pollution was especially intense from the 1700s. In the late 19th and early 20th centuries the dominant impact of air pollution was the sulfation of surfaces. The parallel deposition of soot caused the blackening of surfaces and the formation of black crusts (Brimblecombe and Grossi, 2010). The decrease of sulfur and soot from coal combustion during the last decades of the 20th century led to cleaner air in cities, a decrease of pollution-decay rates on building stones and a public desire for cleaner buildings. The future offers a potential for further variation in the colour of buildings (fig. 1), from different biological growth under changing climates or the presence of different

Introduction

The frequency band in the terahertz (THz) region typically refers to the 0.1-30 THz range (3-300 cm^{-1}). Terahertz Time Domain Spectroscopy (TDS) imaging system has a variety of applications as a new emerging non-invasive methodology for the investigation of a wide range of materials. In recent years THz-TDS technology has been applied to the study of artworks in the reflection and/or transmission modes because of its capacity to distinguish compounds of multilayered painting systems (Köhler *et al.*, 2006; Fukunaga *et al.*, 2007; Jackson *et al.*, 2008; Adam *et al.*, 2009; Fukunaga and Picollo, 2010; Abraham *et al.*, 2010).

THz-TDS reflection imaging uses THz pulses that propagate in specimens: with this technique pulses reflected from the surface and from the internal boundaries in the reflective index of the specimen can be detected. THz-TDS imaging makes it possible to fill the information gap on panel paintings between IR reflectography and X-ray radiography, as it provides useful data on the internal physical structural information of non-metallic objects without contact with the investigated artworks. This non-invasive cross-section image of the object is acquired by extracting the reflected pulse from a particular interface of two media with different refractive indexes without the need to collect any samples.

Case Study

The *Polittico di Badia* by Giotto at the Uffizi Gallery was investigated with the T-Ray™ 4000 system by Picometrix (Fig. 1). It worked approximately in the 0.5-1.2 THz range with a scanning time of about 10 minutes to investigate an area of 150 mm² at a distance from the panel of approximately 20 mm. The intensity of the reflection is reported as gray scale, the highest appearing as white/high gray levels and the lowest as black/low gray levels.
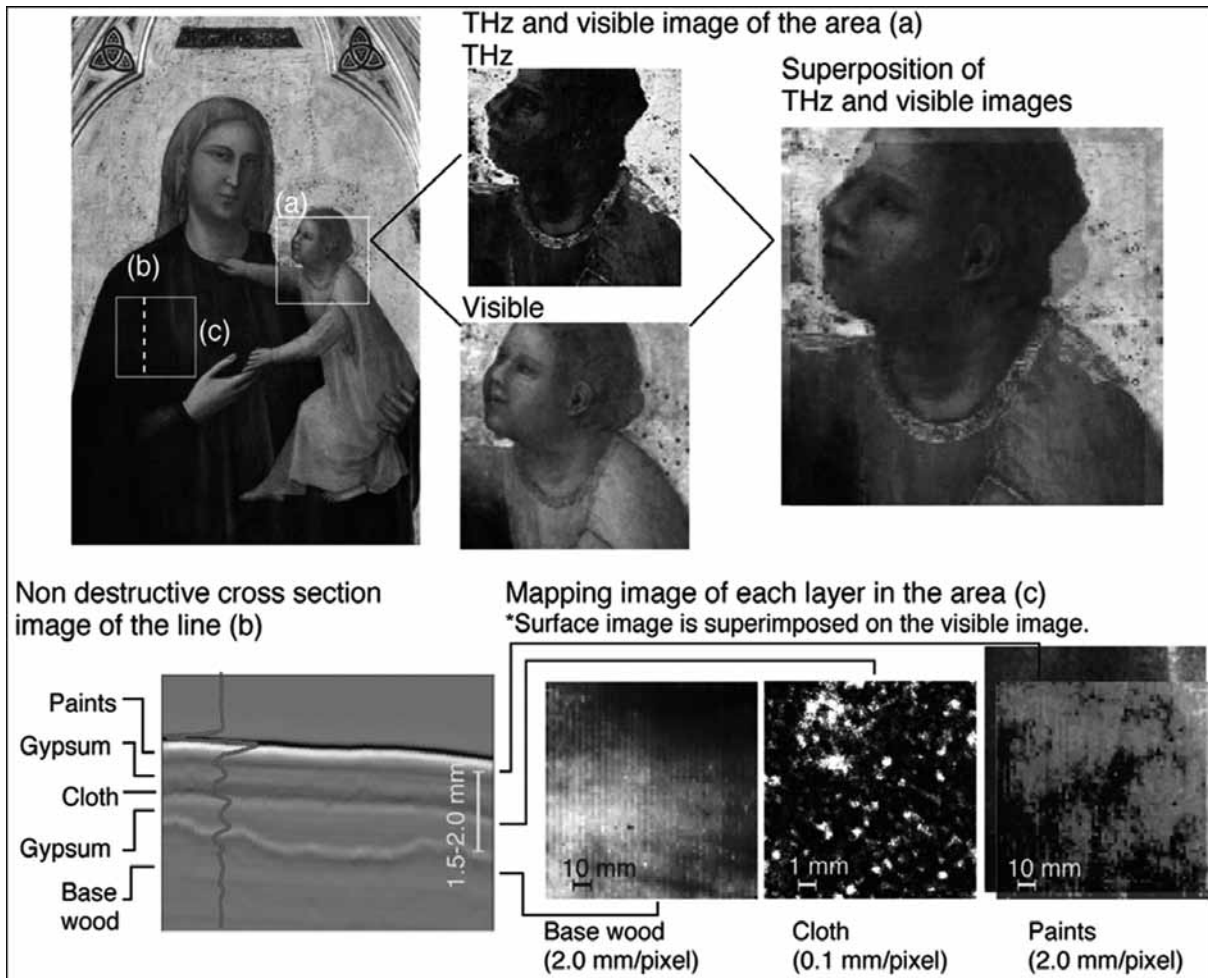
Fig. 1: THz reflection imaging and tomography of the *Polittico di Badia* (detail). See text for explanation. pollutants (Brimblecombe and Grossi, 2007).

Although there was an improvement in traditional air pollutants such as sulfur dioxide and smoke, they have been replaced by ozone, nitrogen oxides and particles richer in organic compounds (Brimblecombe and Grossi, 2010). Much of the change in the nature of air pollution was the result of the extensive use of the automobiles. Recent research projects such as CULSTRAT, MULTIASSESS and TEACH focus on the effect of multi-pollutant environments on heritage materials and the development of strategies for maintenance and conservation (de la Fuente *et al.*, 2011).

Deposited organic compounds can oxidise in modern urban environments. The resulting products exhibit yellowish or brownish colours rather than black. This *yellowing* process is gradually more noticed at stone heritage sites such as the Tower of London (Brimblecombe, 2011). A change of colouration due to biological staining is also expected in the future. Moreover, sulfur dioxide is phytotoxic, so in urban atmospheres with less sulfur, biological growth is more effective. A greater rate of delivery of nitrate to building surfaces that acts as "airborne fertiliser" (Adamson *et al.*, 2010), also increases biological colonisation. Depending on climate, different colouration processes (e.g. *greening* or *reddening*) might be expected. In Northern Ireland (Adamson *et al.*, 2010) a *greening* effect, due to the growth of green algae, is increasingly observed in locations that experience longer time of wetness in winter, and this is having a negative public response. However, in other geographic areas experiencing hotter and drier summers a developing of orange-brown weathering layers characteristic of Mediterranean climates might be expected (Urzi and Reallini, 1998). Changing biology and colouration in buildings within changing environments is an area of further research. Future brownish/yellowish colours or biological staining may also raise aesthetic issues.

The appearance of colouration patterns in the future might also vary with changes in pollutant deposition and rainfall patterns. The removal of pollutants by rain can create patterns of rain streaking that disfigure buildings and promote public disquiet (Grossi and Brimblecombe, 2004). The mechanism and dynamics of removal of black crusts from buildings over time as pollution decreases is poorly understood. This is an important area for future research.

From the non-destructive cross section image the layered structure of the painting was clearly seen (with an example of the waveform shown as a red line, Fig. 1b). It revealed the structure of the painting: wood - gesso layer - canvas - gesso layer - paint layers.

THz-TDS tomography makes it possible to obtain a map of the layer of interest and construct a 3D model of the internal structure of the painting (Fig. 1a). From the reported images, the amplitude of the reflection from the upper surface was used to provide information about the pigments and/or the presence of metallic leaves, in this case gold.

Fig. 1c was dealt with the stratigraphy of the painting, with particular emphasis on the wood support, the canvas used between the two preparation layers, and the pigments of the inner paint layers. The image of the wood shows the contours of tool marks (Fig. 1c left). The middle layer, analysed at higher resolution, shows the rough surface of the canvas (Fig. 1c middle). The third image shows traces of lead white that give high reflection values on the surface of the paint (Fig. 1c right).

Conclusions

Due to the potential of the commercial use of THz imaging systems, although at still rather high costs, THz imaging is a promising emerging technique for the non-invasive analysis of artworks. Indeed, the first experiments in the use of THz imaging in the field of art have provided very encouraging results.

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ASSESSMENT OF VIBRATION REDUCTION ON THE BAPTISTERY OF SAN GIOVANNI IN FLORENCE (ITALY) AFTER VEHICULAR TRAFFIC BLOCK

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A microwave interferometer has been employed to remotely detect the oscillations induced by vehicular traffic on the dome of the Baptistery of S. Giovanni in Firenze (Italy). The measurement has been carried out to assess the structure oscillations reduction after the ordinance issued by the Major of Florence forbidding all kind of vehicular traffic in the square around the Baptistery (Figure 1) starting from October 25, 2009.

A simplified preliminary finite element model of the structure, using average literature mechanical parameters, has been used to determine the best instrument installation position and the structure area to be surveyed. Subsequently, the dome oscillations have been recorded for two consecutive weeks starting one week before the traffic block.

A spectral analysis on the acquired data has been then performed (Figure 2: Welch spectral estimation) and a more complex FEM model has been built (Figure 3: FEM model of the Baptistery.) to interpret the physical meaning of the acquired data. The material mechanical parameters have been finely tuned to reproduce the lowest spectral component found which was very close to the main mode oscillation frequency predicted by the simplified model. The obtained values of mechanical parameters are reasonable for the monument materials and slightly different from average.

Measurement results indicate that the traffic block caused a reduction of the daytime maximum oscillations power of around 50÷60% and a decrease by approximately 33% has been observed in the peak component particle velocity (Figure 4: Up: oscillations power at dome). The residual measured oscillations are attributable to human activities around the square.

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Figure 1: View of San Giovanni Square with the Baptistery in the foreground. The street closed to traffic is the one on the left side

Figure 2: Welch spectral estimation of the dome oscillations acquired throughout the measurement period.
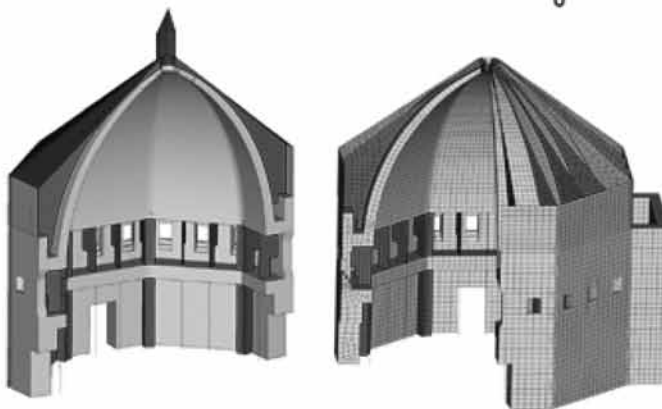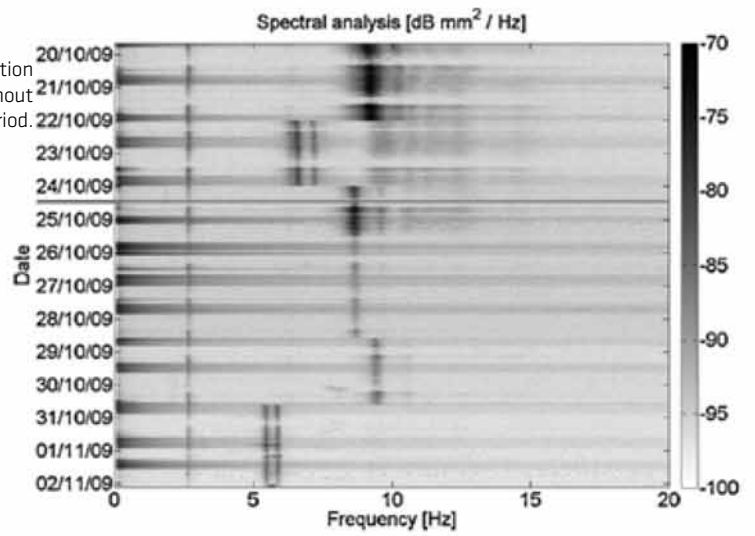
Figure 3: FEM model of the Baptistery

Figure 4: Up: oscillations power at dome resonance frequency. Down: peak component particle velocity along instrument line of view (vs. time during all the measurement period).
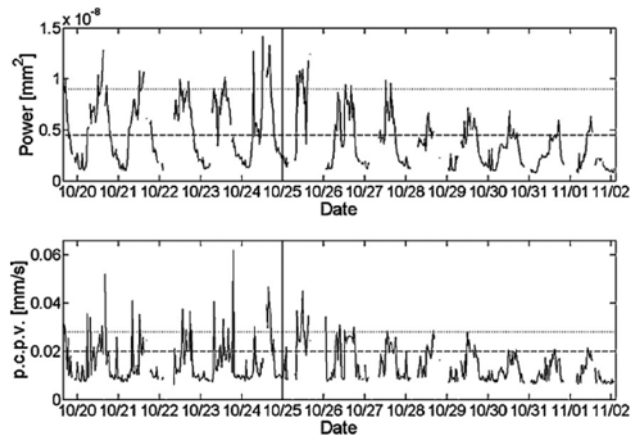
IRT-PHOTOGRAMMETRIC PROCEDURE FOR 3D RENDERING

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THE SAFEGUARD OF CULTURAL HERITAGE

The proposal of research line is the integration between ranging, imaging and Infrared Thermography sensors for the investigation of Built Cultural Heritage. The combination of laser scanner survey, photogrammetric imagery and IRT allows the generation of 3D multispectral models useful for the localization, visualization, and analysis of anomalies such as damage of finishing, corrosion of the concrete reinforcement, heating loss/ lack of insulation, moisture diffusion, etc. The proposal of research focuses on the emerging need of more effective images for gathering the thermal anomalies where the geometry of the object strongly affects the thermal behavior. Such conditions can be due to reflecting materials, non planar surfaces, geometrical pattern of surface decoration and finishing, partial shadows, reflection effects due to fixed objects close to the surface which are under investigation, and places where movement is restricted for data acquisition. Scientific literature refers to studies in progress to define the best conditions to recapture depending on the kind of defects, orientation, and building characteristics [1, 2]. As the state of the art comprehends some basic techniques for mapping IRT imagery on 3D models, many developments are required to increase the automation and reliability of testing procedures to localize/quantify specific defects on finishing materials [3]. This application of IRT has often been required for the maintenance of facades: the integration of IRT, NIR and visual photogrammetry is much more convenient for the localization, detection, measuring, of defects and, in the meantime, producing the digital documentation to support the project and maintenance steps (texture 3D models, vector rasters maps of facades, sections, elevations, technical details) [5].

Expected results are the improvements of diagnostics and survey as well as shortening the time from data analysis to preliminary design. Moreover, the availability of results in the preliminary phase allow to address the executive projects since the beginning, avoiding expensive changes of orientation in the further steps of the study/projects.

Another result is the possibility of applying the method for monitoring the damage in the preservation plan and to prioritize the interventions in a full scale economy (e.g. the preservation of an entire historical center/villages, sites).

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DIAGNOSIS OF DETERIORATION IN CULTURAL HERITAGE SITES: PROMISING PERSPECTIVES FOR MONITORING AT DIFFERENT SCALES BY RADAR INTERFEROMETRY TECHNIQUES

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Introduction

Remote sensing technologies are quite suitable for applications on cultural heritage because of their non-invasiness. The condition report for a monument/site could be updated, with identification of damages occurred, detection of ongoing deterioration processes and mapping of unstable sectors. In this perspective, radar interferometry techniques can offer new diagnostic tools, thanks to the high resolution, multi-spatial coverage and multi-temporality of analysis (Evans and Farr, 2007; Tapete *et al.*, 2011). The successful results obtained for the archaeological areas of Rome (Italy) encourage a wider exploitation of both satellite and ground-based radar interferometry for preventive diagnosis, opening to further developments for conservation purposes.

Synthetic Aperture Radar Interferometry (InSAR)

InSAR techniques are based on multi-interferogram processing of huge archives of images, acquired for the interest area at different times collecting the backscattered echo from the surfaces irradiated by microwave electromagnetic waves sent from active radar sensors, and processed exploiting *Synthetic Aperture Radar* (SAR) principle (Rosen *et al.*, 2000). Satellite and terrestrial configurations are currently available to measure displacements occurred within the observed scene, retrieving for each point the measurement of superficial deformation vs. time (*deformation time series*).

Satellite radar interferometry

The wide-area spatial coverage of the satellite techniques allows monitoring activities on urban/suburban sites extended up to hundreds of kilometres, with metre cell resolution and millimetre precision on single measure (Cigna *et al.*, 2011). Deformation occurred can be reconstructed in correspondence to radar targets (columns, masonry walls, buildings), which are recognized as *persistent scatterers* (PS) within the SAR images during the processing. As displacements are estimated along the Line Of Sight (LOS) of the satellite, the acquisition geometry and the ascending/descending mode along the orbit determine the component of the real displacement vector that is actually measured. Due to roughly monthly sampling frequency several deterioration phenomena are detectable, such as natural hazards (e.g., landslides, subsidence, uplift), structural instability (collapses, toppling) and human-induced phenomena (pumping, effects of restoration works).

Ground-based radar interferometry

Based on the same principle as satellite techniques (Casagli *et al.*, 2010), the Ground-Based Interferometric SAR (GB-InSAR) is used for real-time monitoring of displacement field affecting single/group of monuments. Its terrestrial
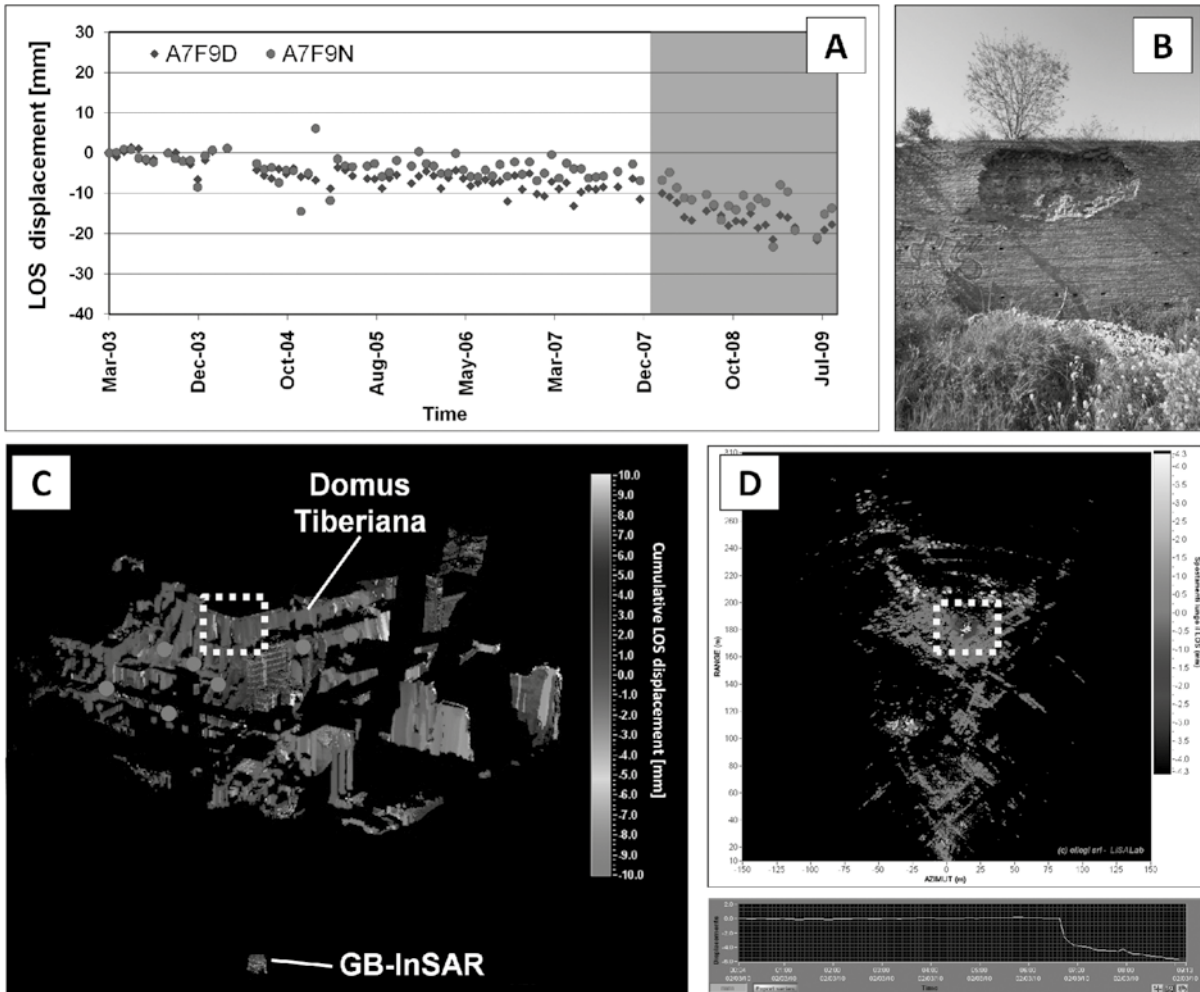
Fig. 1: A) Time series of two PS RADARSAT1 descending (2003-2009) identified in a sector of the Southern Aurelian Walls, Rome (Italy), with acceleration of LOS velocity assumed as an alerting signal (*precursor*) of the collapse occurred few months later (B). C) Cumulative LOS displacement map for the period Apr'09-Mar'10 visualized on the 3D model of Domus Tiberiana. Some control points (red dots) were used for the extraction and analysis of deformation time series, to reveal sudden movements/anomalies, as discovered on the upper substruction arcades (dashed yellow square) (D).

configuration facilitates the on site installation, matching the optimal acquisition geometry with logistic and conservation needs, as desirable for cultural heritage sites, especially in case of opening to visitors. Thanks to the high sampling frequency (up to 1 SAR image every few minutes), constantly updated time series for each point of the observed scene are retrieved with millimetre accuracy of the LOS measurements, to evaluate the structural behaviour and its temporal evolution.

Back-monitoring at 'entire site scale'

Satellite radar monitoring performed on the Roman archaeological heritage in co-operation with the Italian Ministry of Cultural Heritage and Activities, led to correlate deformation observed from the satellite with the local geohazard factors and active deterioration phenomena. The comparison of PS data stacks from ERS1/2 (European Space Agency - ESA) and RADARSAT-1 (Canadian Space Agency - CSA) satellites highlighted a relative stabilization of the movements in correspondence to Domus Tiberiana, Palatino Hill, after the consolidation works, while a worsening resulted for the Temple of Magna Mater due to a general instability of the toppling-prone tuff basement. Conservation criticalities were found on the terrain overlying the Nero's Golden House (*Domus Aurea*) and the masonry struc-

tures of the Baths of Trajan, confirming the hypothesis of the local conservators and suggesting the execution of stabilization works. PS time series analysis also demonstrated the capability of InSAR techniques to predict upcoming deformation events, as discovered for a sector along the Southern Aurelian Walls. LOS velocity accelerations recognized within the displacement trend (Fig. 1A) were found as alerting signal (*precursor*) of the curtain collapse occurred few months later (Fig. 1B).

Real-time monitoring at 'single monument scale'

Exploiting the higher sampling frequency of GB-InSAR, the continuous monitoring of the structural stability of Domus Tiberiana, Palatino Hill, clarified the absence of any significant conservation criticality appreciable along the LOS during the period April 2009 – March 2010 (Fig. 1C). The evidence of not relevant cumulative displacements, also confirmed by the results from the contemporary satellite monitoring, was combined with detailed time series analysis on some control points. It just revealed occasional displacement anomalies not associable with real ongoing deformation damaging the structures (Fig. 1D). Such a surveillance activity foresaw the establishment of a shared early warning procedure involving the local conservators. The latter was demonstrated quite suitable for monitoring campaigns focused on single monuments, encouraging its export to similar archaeological contexts.

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ACTIVE IRT APPLICATIONS TO THE CULTURAL HERITAGE ANALYSIS

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Active infrared thermography (IRT) is a non-destructive technique for the investigation of the cultural heritage (Mercuri et al., 2011). More specifically, by monitoring the heat diffusion process within the sample, it provides information on the material and on the structure of the artifacts. By means of the IRT, we have performed investigations on different artistic and historical artifacts from different cultural heritage areas. In particular, library and archive materials have been studied, enabling the detection of subsurface features of the bookbinding structure, defects, texts hidden beneath the surface of glued paper leaves in several volumes (Mercuri et al., 2011) and the monitoring of the preservation state of collagen-based materials (Riccardi et al., 2010). Moreover, many kinds of archaeological findings and materials have also been analyzed by IRT. We have reported on the analysis of the concretions on Roman earthenware, of the corrosion effect on ancient coins and weapons, of the structure of Phoenician jewellery (Mercuri et al.). Finally, some thermographic investigations have been carried out on bronze sculptures allowing to perform thickness maps of the bronze (Scudieri et al., 2001), to characterize the thermal properties of the alloy and to detect and analyse several workings normally carried out after the casting on those bronze obtained by the so called lost wax method. They include repairs of the sculpture, the filling of holes and imperfections and the cold working of the surface, all of which appearing concealed beneath the polished and patinated surface of the sculpture (Orazi et al., 2011). Recent developments have enabled the integration of thermography with 3D scanning technique, providing a new method for 3D IRT analysis.

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Fig. 1: thermographic 3D model of a 17th- century volume (patent pending)
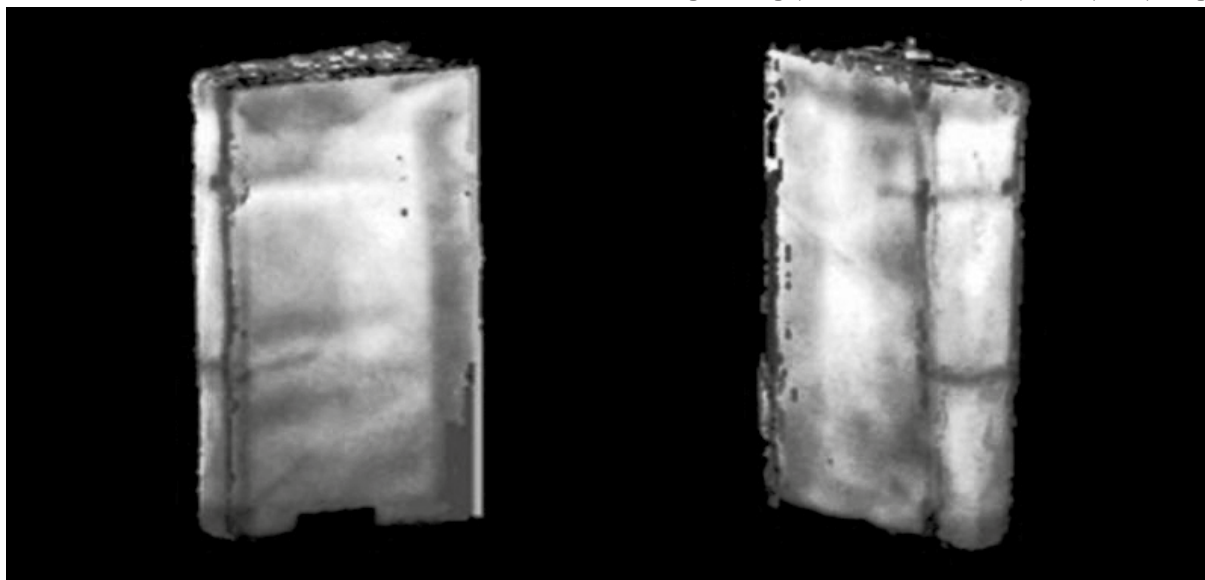
Session 3
**Technology and ICT for conservation
of Cultural Heritage**

INFORMATION COMMUNICATION TECHNOLOGIES AND CONSERVATION OF CULTURAL AND ARCHITECTURAL HERITAGE

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

The third session of the workshop, with its articulations, faced the challenging relationship between the so called "Information Communication Technologies" 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. The presented papers offered a wide range of contributions and an updated panorama of the researches in different contexts developed about the general topic of the session and, especially, on the first side of the problem.

A propos, it is important to immediately point out a need of clarification for the benefit of the all participants and readers of these acts. We are so accustomed to using the acronym ICT that we often forget that each of the terms to which it refers should be, every time, clarified for the use made of it in that context. We should, in essence, explain what kind of "information" we refer to such work, and for which "communication" purposes we intend to use these "technologies". None of these terms is in fact neutral and each of them leads to complex conceptual frameworks, to rich and complex theoretical reflections as well to equally vast and constantly evolving field trials and operational. We cannot ignore this fact and instead we have to fulfill a requirement for clarity also to check if the ends, ways and means of each application of these technologies are appropriate to the primary objectives that the protection of Cultural Heritage should pursue. Means should never take the prevalence over the goals, in fact, as the contemporary philosophical and epistemological thinking denounce.

And in this regard, I believe that all the participants and all those who move in these areas of reflection, research and experimentation, at least agree on one basic fact. All efforts and all the resources we use to exploit the capabilities that modern ICT offers to broaden the knowledge, understanding, appreciation and enhancement of cultural heritage would be unnecessary costs if, in the meantime, the assets we are dealing with fall into disrepair or disappeared. 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), thanks to the theoretical and applied research, "virtual field trips", conceived to visit museums, monuments or archaeological sites, without having to move from where we are. Changes so radically our sense of time and space. It is argued that move, touch, see and experience in direct relationship with places and objects that are far and different from us is no longer necessary. 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 enga-

ging 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

With this short premise, it is important to remember that, from the panel and from the final discussion of the session, some problems emerged and, in particular, a series of lacks has been denounced, such as:

lack 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 that emerged during the session can cause a lack of consistency of any product conceived and realized for a real safeguard of our Cultural Heritage perceived as a crucial "challenge that arrives from the Past and invest the Europe of Tomorrow".

Needs

For these reasons the different contributions to the session and its final discussion highlighted some emerging needs and suggestions that can help us in over passing the above mentioned difficulties:

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 which we are as well interested in, 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, basing on the papers presented during the session and on the final discussion that followed two days of common work, the participants think it is important to stress the following recommendations to those who are concerned by the duty to decide "where" and "for which goals" to allocate the future finances in this field. These recommendations can be summarized as follows:

Launching a COST action 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 artifacts, 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.

The complex of actions here briefly outlined could in fact help us in ensuring the permanence of this Heritage and its transmission to the future generations. It is even more crucial that that 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.

DIAGNOSTICS FOR RESTORATION. SCENERIS, ISSUES, AND AN EXEMPLIFICATION

Donatella Fiorani

In these last years technological innovation gained the greatest interest for the research in conservation. This fact appears inevitable, for the huge development in operating technology in every area and the consequent need for maturation of specialist skills.

During the past times the practice of construction provided the tools for technological devices in architecture, meanwhile today technology often plays a dominant role not only in the building-system but also in the spatial and figurative configuration of the contemporary edifice.

This issue is particularly significant in the restoration of historic buildings, where it is necessary to ensure the persistence of the instrumental role of technology in comparison to the primary purpose of understanding and conserve the ancient architecture

Many recent applications seem to forget this fundamental assumption and confuse the goal with the means of restoration; the fact, then, that many methods of investigation have been set up in other operational areas (especially medical and industrial) has encouraged this trend.

The first applications of intervention technologies for conservation of historic architecture dates back to little more than a century ago, but the past three decades register an exponential increase of materials, technologies and products for the restoration, all generally presented as odd, even if only 'the test of time' can really witness their real effectiveness. The contemporary debate on restoration has accepted this change in different ways, collecting in itself prejudicial rejections and enthusiastic openings but, in the most moderate positions, especially by invoking the need to link each step of the conservative operation to the deep understanding of architecture and to an evaluation of the intervention results in all its possible consequences.

Important innovations have been introduced in the field of knowledge of the buildings (survey, data management, characterization of materials, dating of the components of the architectures and so on) and in the sector of diagnosis (allowing for monitoring of the edifice and of the environment, structural or humidity control, characterization of disease). Also the fields of valorization, security and documentation have been substantially changed by the entry of new technologies. Today, the elaboration of a comprehensive framework of new technologies seems still impossible.

A recent experience of structural monitoring of an important Orthodox religious complex in Kosovo has allowed, inter alia, to verify the application of a method to produce an efficient reading of technical data coming from the sensors on the building. The complex, composed by three churches, a chapel and a narthex, suffers by a complex crack pattern. Structural monitoring is one of the oldest and well-established methods of control of the historic building, which was perfected by the availability of increasingly sophisticated equipment.

Generally, a rigid separation between diagnostic work and knowledge of the historical building is merged during the drafting of the restoration project, which is born on the summation of distinct and separate data.
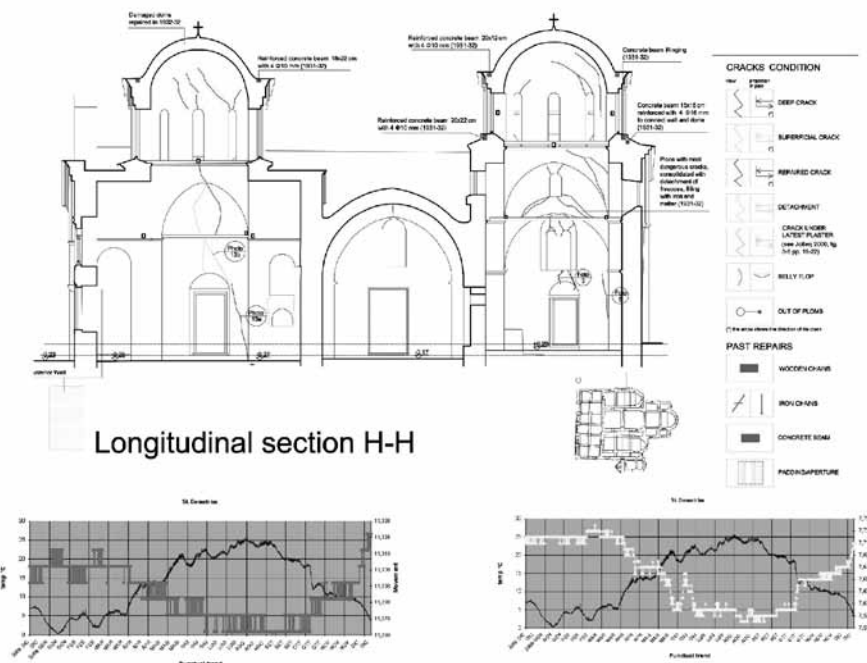
Patriarchate of Peć, Kosovo: inner section of the complex with cracks and historical consolidations and graphic with registration of sensors' movements.

In normal practice, the organization of professional work can hardly ensure effective sharing of information and strategies, which remains confined just to few 'excellent' monuments.

Paradoxically, the scientific research shows the same problem; the research, in fact, is usually involved separately in the screening of analytical methods and of diagnostic technology or in the knowledge of historic and architectural nature of the building.

Careful analysis of scientific and technical information through the critical knowledge about geometric-figurative, historical and constructive nature, however, may change substantially, and guide the final interpretation of the data. This is precisely what we experimented in the Patriarchate of Peć, where the numerous cracks, especially evident along the rich frescoes that cover the interior walls of the complex, have found an interpretation (fig. 1). The real check of them could here just come from the intersection of data deriving from annual monitoring with the deep comprehension of the building transformations and of the significant restoration realised in twentieth-century.

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INNOVATION IN CONSERVATION OF ARCHITECTURAL HERITAGE

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It is more and more important to recognize that, nowadays, the crucial and essential question for the Safeguard of Cultural Heritage, and in particular for Architectural Heritage, is perhaps: "why do we research, teach or practice, within the field of conservation/restoration"?

The contextual use of these two words, in this occasion, simply tries to avoid any preventive selection connected to the meanings that they can assume in different cultural contexts, while everywhere a great interest as regards tutorship, safeguard and management of architectural, urban and environmental Heritage seems to grow up. The question "why?" regards, on the other hand and in a broader sense, the deepest reasons of our present attitude and of our efforts toward the destiny of several artifacts that were conceived and built by other men during the past ages. In this perspective, an outstanding role has been acquired by the themes related to the knowledge, or better to the many forms of nondestructive studies and inquires we can develop about what we want to take care of. On this level, we must thus highlight the crucial role that analytical and diagnostic apparatus (historical, artistic, archaeological, structural, chemical, biological and so on) has assumed during the past years. A sort of satisfaction exists, a propos, because a common language has certainly been acquired on this field, with evident and appreciable fallouts. Nevertheless, some worries emerge as regards the risk of a kind of consolidated "orthodoxy", which may hide a simply formalistic respect for some apparently inescapable rules accompanied by a certain passiveness of our way to handle conservation/restoration interventions.

In any case, we are always intent in achieving the sure capability to develop:

rigorous architectural surveys, supported by adequate technological devices and, first of all, clearly based on methodological geometrical basis recurring to traditional methodologies of longimetric nature, to topographic devices, to analytic or digital photogrammetric instruments and tools till the most updated laser scanning possibilities;

serious historical inquiries, grounded on strong critic and analytic apparatus as well as on rigorous studies of indirect archive sources, always compared with deep archaeological inquires of the artifacts considered as first and direct sources to reconstruct their past history;

meticulous analytical and diagnostic studies, collecting and organizing data concerning the physical state of the artifacts, as regards the building materials, the techniques for their construction, their state of deterioration/conservation, conducted with rigorous empiric methodologies supported by sometimes very sophisticated laboratory tests and simulations, faithfully visualized and synthesized in "thematic maps" of sure communicative and perceptive impact;

refined and reliable "virtual simulations" of the designed interventions, regarding the built materials and elements, but also the spaces and the layout of the ancient buildings we are working on;

more and more accurate systems for monitoring the conditions of our monuments, in strict relation with the environment in which they are inserted in, which must be studied and understood as a fundamental condition to explain their present status and to design their future.

Every day, on the other hand, we discover that is almost impossible (dangerous or even un-useful) limiting our look to the conservation's culture, considered as a withdrawn, self-sufficient or self-related world. It tracks a route between searching and understanding marked by profound connections, polarities and reflected images. This deals with a today's reality in which architecture and conservation often look like "poor neighbors", not reciprocally communicating and subjected to the perennial contraposition between the exaltation of pure (or abstract) "creativity", on one hand, and the research for "analytical rigor", on the other hand, that is between the tension towards "knowledge" and "professional pragmatism", in a time of deep transformations which would rather demand their profound integration.

The emphasis should thus be placed also or mainly on the need for a "programmed conservation" and on the "conservation of the whole", more than on the need of intervention on single artifacts or, as sometimes is still declared, on some outstanding "masterpieces of art", especially if the intervention intends to bring them back towards ancient and lost splendors (impossible, fake and always obtained by destroying their present status and values). These concepts have remarkable implications because they pay attention to the "system" of goods that constitute our built heritage (from the single artifact to the city, till the rich and irreplaceable landscapes we are living in), going beyond its single and separate elements. This situation requires, with all the evidence, new competences and professionalisms, which we have to create both in the University and in the world of professional training and formation. In front of the challenges proposed by the destiny of our monuments, cities and cultural landscapes, on the other end, what is actually really needed is not only some new and secure "technical professionalisms" (analytical, diagnostic and design oriented). We rather have to avoid that this crucial field for the future of the world be reduced to a simple and indistinct sum of separate responses to the various emergencies every day occurring. These last, in fact, could be at the end acceptable but they are always arguable (on the cultural, economic, technological, technical, functional, political field). It is therefore necessary that the "training" sector and the Universities identify and create new professionalisms, or better, new professional competences promoting a strong sensitivity for the strategic aspects of the tutorship, in terms of structural and long term governance of the "system" of goods of our interest. This will not reduce the spaces devoted to the cultural and scientific debate in this field or to our experimental and professional work, as architects, even out the technical side of the question that remains crucial in the quest for a more open and shared quality of future interventions. This goal, nevertheless, will be easily achievable only thanks to the existence of new professionals capable of facing the pre-existing problems together with the new ones emerging during and after the single interventions, by rationalizing the employable resources, improving the possible technical solutions, exploiting the unexpected but fundamental synergies between different attitudes and capabilities, accepting and capitalizing the several confrontations and corrections that can only result from a clear, recorded and widely shared accumulation of experiences. The work to be made in this direction, in fact, is every day more urgent, facing the new challenges our Heritage will be invested by, like those proposed by the needs for a true environmental and energetic sustainability of its recovery and uses, for a real universal accessibility of our monuments and sites, for their effective defense against the risks of fire, earthquake or other natural and human disasters.

A clear example, in this perspective, can be found:

in the several computerized systems applied to surveying and cataloguing the existing cultural goods (if they are not self-centered or exclusively directed to a passive administration of tutorship bonds);

in the progressively developing technical databases used as a necessary reference by the operators (in the analytic, diagnostic and intervention areas, but only if they are not self-directed and interpreted as simple collections of meaningfulness data);

in the emerging expressions of interest for their practical experimentation towards a real and efficacy management and improvement of the goods themselves (in the planning, administrative, didactic and divulgation fields.

If we will really work within such a perspective, should perhaps emerge the full recognition of the global (systemic) and not occasional nature of any intervention (yet in the respect of the local specificities) but, above all, a new awareness regarding the quality of the interventions themselves carried out on the existing artifacts (small or big, famous or unknown), maybe considered insignificant by our traditional but insufficient means of evaluation, while they are certainly important for the communities they belong to.

All this will be, of course, rich of real meanings only if we agree at least with some basic statements:

every effort, on the technical level of the instruments we use, will be acceptable only if the objects we are dealing with will survive;

this means that everything will be useful only if the "meta-data" will not eat or metabolize, till their disappearance, the data (taking in count, of course, the naïf distinction between these two only apparently well separated categories and concepts).

Unfortunately, one of the main problems, at this point, is represented by the circumstance that the few problems that have been here highlighted should require, to be really faced, a new and real attention and commitment that the world of the University, of the Institutions and of the professionals which are involved within the field of Conservation/Restoration of our Built and Cultural Environment and Heritage still find hard to express loud and clear. This simply means that we still have to hardly work in the suggested directions, if we agree with the initially recalled goals of our activity and duty.

INNOVATIVE SYSTEMS FOR THE CONSERVATION, DEVELOPMENT AND MANAGEMENT OF LOCAL KNOWLEDGE SYSTEMS

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I - Innovative systems for the conservation, development and management of local knowledge systems:

• explore the state of local knowledge systems,

• identify present lacks of local knowledge systems,

• identify present demands on specific themes,

• forefront topics to be used for conservation and valorisationvalorization,

• identify new and promising technologies to be applied to conservation and valorizsation of Cultural Heritagelocal knowledge systems.

II - Medicinal Plants - Pharmacology

• Conservation, management and exploitation of medicinal plants and traditional knowledge, database, networks,

• Associate traditional practitioners/healers in policy making,

• Integrate traditional knowledge into school systems,

• Transmit and make sustainable use of botanical resources,

• Evaluate traditional systems of medicine,

• Build national indigenous science and technology capacity.

III –World Heritage properties: innovations and trends for research to do with traditional local knowledge systems

• World Heritage MNet operate in order to:

• Identification offigure out needs for interdisciplinary research and try to bundle and promotione of interdisciplinary cooperation in these fields,

• CC Climate Change impacts on WH World Heritage Sites: mapping, measuring and forecasting,

• Co-management of Aboriginal Traditional Owners with Parks Australia,

• Tourism: statistics to measure impact of World Heritage inscription iusc: define a set of indicators (matrix) to measure how World Heritage properties evolve across time: before, upon and after inscription,

• Management of WH World Heritage propertiesSites: Innovative tools to monitor conservation, tourism visitation and other aspects of site management plans.

IV – Case Studies

Medical Plants

Conservation, management and exploitation of medical plants and traditional knowledge,

database

networks

associate traditional practicioners/healers in policy making

integrate traditional knowledge into school systems, transmit and make sustainable use of botanical resources

national indigenous science and technology capacity to evaluate traditional systems of medicine

1. Ininterterdependencedipendence of people and nature (Climate Change and risk preparedness)

• Fish and turtles (Nicaragua/Honduras)

• Andaman Islands: Tsunami warning systems

• Adaptation of African pastoralism:

• linking indigenous knowledge systems for weather forecasting and policy response

• Interactivity between climate services providers and local pastoralists.

• Climate service providers may help pastoralists to make appropriate decisions based on the long-term and on scientific forecasts while pastoralists on their turn may provide traditional knowledge which is complementary and site specific, long term and long range data based on oral tradition transmitted from one generation to another since immemorial times. This synergy should provide weather forecasts which more accurate information locally.

• Anchor Climate Change adaptation policy within both science and traditional knowledge

• Intangible Cultural Heritage : ICT tools use for inventorying, recording and transmitting : some examples

2. Indigenous local knowledge systems used in managing World Heritage properties

• **Kakadu National Park, Australia**

   • slash and burn agricoulture

   • geological knowledge

   • resilience to climate hardship and changes

   • Cultural mapping : languages and rock-art sites

• **Golden Mountains of Altai - Russian Federation**

   • Archaeological site – Scythian culture

   • Permafrost zone – mummies

   • Vulnerability to Climate Change – Glacial lake outburst

   • Satellite techniques to monitor change, anticipate and mitigate threats and establish conservation strategy.

• **Timbuktu – Mali**

   • Identify factors responsible for desertification

   • Cultural impacts of droughts and extreme precipitation events

   • Model changes and ways to mitigate sand encroachment through traditional practices.

KNOWLEDGE TECHNOLOGIES FOR THE ENHANCEMENT OF THE CULTURAL HERITAGE

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The Lisbon Information and Communication Technology (ICT) agenda, launched in 2000, states that the European Union should become, by 2010, the most competitive and dynamic knowledge-based economy in the world. The enhancement of the Cultural Heritage (CH), aimed at providing a wider and more involved contact to the values carried by the cultural assets, has been deeply affected by the Lisbon agenda, since its fundamental role in growing the collective memory side of the future knowledge based society. Knowledge technologies, in turn, are at very core of any attempt to promote the Cultural Heritage through ICT. Whatever information is stored in a digital archive or whatever human-interface technology is used to interact with the end-users, specific knowledge technologies are required to structure the information related to the cultural assets and to apply it in a suitable way for the task in use.

The present Cultural Heritage Information and Communication infrastructure is rapidly moving from a world of statically and partially connected central servers located on few reference institutions, to an intricate web of millions of information sources loosely connected one to another. Systems which support the site excavation allowing for the creation of virtual team, systems which provide users with immersive virtual experiencing of the cultural artifacts as well as systems which foster the deep understanding of the cultural values brought by specific assets must combine consistently a large quantity of information collected from sparse patchy repositories.

The integration of digital archives for the purpose of making them interoperable is therefore one of the main theme of applied knowledge representation research in CH. In fact, accessing digital resources stored in different database requires the harmonization of their representation schema. This means, in other words, that their thesauri and their ontologies must be cross-referenced. Unfortunately this is still an open issue either theoretically and pragmatically. Despite there is an increasing agreement among the web community members about the standards for knowledge representation languages that, simplifying, we can summarize with the triple XML, RDF, OWL, things dramatically change moving to the semantic side, especially to the Cultural Heritage semantics side.

The art and cultural heritage communities have increasingly made use of controlled vocabularies and other standards as they seek to provide access to information that was previously held in paper files or isolated in local systems. A controlled vocabulary, called also a metadata set, is an information tool that contains standardized words and phrases used to refer to ideas, physical characteristics, people, places, events, subject matter, and many other concepts. Metadata sets allow for the categorization, indexing, and retrieval of information. A number of de facto information standards are available today for the art and cultural heritage communities. The Dublin Core (DC), the Categories for the Description of Works of Art (CDWA) and Cataloging Cultural Objects (CCO), the Library of Congress Subject Headings (LCSH) and the Library of Congress Authorities, the Art & Architecture Thesaurus® (AAT), the

Union List of Artist Names® (ULAN), the Getty Thesaurus of Geographic Names® (TGN), Robert Chenhall's Revised Nomenclature for Museum Cataloging, the Thesaurus for Graphic Materials (TGM), and the Iconclass system, are some of the most relevant among others. This is indeed a wide range of metadata standards, each providing hundreds or even thousands of terms, that are applicable by cultural heritage institutions from item to collection level description, from digital preservation to emerging multimedia specifications. The current experience demonstrates that managing the cross-referencing of this large and inherently complex set of descriptive standards is, in fact, a very difficult task. Indeed the steep learning and application curve of a single standard becomes even harder when the standard becomes a cross-related network of many complex thesauri.

One of the most significant recent achievements in the field of digital CH archive integration has been that of the finalization in December 2006 of the ISO version of the CIDOC Conceptual Reference Model, which is a reference ontology for the interchange of cultural heritage information (ISO 21127:2006). The CIDOC CRM is the culmination of over 10 years' work by the CIDOC Documentation Standards Working Group and CIDOC CRM SIG. A second initiative worth's mentioning is Europeana, which enables people to explore the digital resources of Europe's museums, libraries, archives and audio-visual collections through the integration of cultural heritage digital archives in Europe. To this aim the Europeana initiative introduced the Europeana Data Model (EDM), which is aimed at being an integration medium for collecting, connecting and enriching the descriptions provided by Europeana content providers.

In the Digital Library community, much of the metadata standardization in use, at present, is based on or mapped to the work of the Dublin Core Metadata Initiative (DCMI) and their DC Library Application Profile (DCMI Library Community Web page). The Library of Congress has defined mappings from their systems to and from the Dublin Core Metadata Element Set (ISO 15836). The Library of Congress also uses the METS (Metadata Exchange and Transmission Standard) as an interchange standard for metadata resources. As the name implies, the Dublin Core, however, only seeks to address a core set of elements and is intended to provide standardized definition of the elements likely to be included in the core metadata of library entries. Indeed, interoperability of information is often obtained by reducing it to Dublin Core (DC). However, DC was devised for different goals, and does not preserve the richness of existing museum repositories. Hence many institutions have chosen to use so-called 'qualified DC' with the result that every 'qualification' is going to be different from the others and again no standardization will result.

The growing experience of the web community and of the social networks, which, at present, represent one of the main catchment area to grow a consistent user basis (e.g. all the main museums in the world have today a social net presence or identity), opens the Cultural Heritage to a variety of cultural level, living styles and purposes as never seen. In order to keep this opportunity, knowledge technologies underlying the CH digital archives interfaces must able to match the high dynamicity of the social web, to adapt to the different sensorial, cognitive and cultural qualities the new user basis, and in general to evolve on the basis of their activity.

Adaptation is a property which defines the systems' ability to change their own behavior in order to suit to different working conditions. The process of adaptation is based on a representation of the operational context and of the users' goals and preferences, which is usually represented by a *context* and a *user model*. A fundamental part of a user model concerns the qualification of the users' knowledge background and goals. Profiling and assessing personal knowledge and identifying users' goals require systems with a knowledge background that can be compared with and communicated to end users. Given the high diversity of the cultural profiles (consider for example how diverse are the cultural profiles and expectations of the visitors of a museum), the definition of the knowledge background able to suit users with the right information at the right time, is a fundamental and still an open research issue. *Emergent semantics* technologies, which refer to a set of principles and techniques analyzing the evolution of decentrali-

zed semantic structures in large scale distributed information systems, are one of the most promising approaches for the development of adaptive knowledge technologies in the present scenario.

The overall picture we can draw from this discussion is that, despite the knowledge representation research in the CH domain is a fundamental research field, it is still in its steep development phase. The archives interoperability and the growing social dimension of the cultural heritage are posing challenges that still require mid-term efforts in order to provide sustainable solutions. The integration of digital archives requires new sustainable technologies that are able to implement effective solutions, providing, possibly modularized, knowledge schema that are much easy to learn, use, communicate and whose application cost less. The social web dimension is on the other side posing the challenges of being able to manage folksonomies, that are candidates to be the future of our shared knowledge. On this side, very promising 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. Pierre Levy's with is visionary collective intelligence concept anticipated all that: "*The Collective Intelligence Ontology (CIO) is structured like an open, hypertextual, fractal, peer to peer (P2P) network of concepts. As an universal ontology, the CIO values and promotes cultural diversity (memory), cultural differentiation (exploration) and cultural evolution*".

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GEO-SEISMIC CHARCTERISATION OF OUTSTANDING CULTURAL HERITAGE MONUMENTS: FIRST APPLICATIONS AT FIRENZE, ITALY

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Firenze is a worldwide well know city and its historical centre was under the UNESCO protection as a Human Cultural Heritage. In the last dozen of years it was launched a joint study project between the Department of Earth Science of University of Fiurenze and the Geology Office of the Firenze Municipality regarding the geological setting and the seismic characterisation, both in terms abutments and seismic behaviour, of the Firenze area.

The most recent geological interpretation of the underground geological setting of the Firenze area is based on a geo-database consisting of ~2,000 stratigraphic logs. These data outline the presence of the following litho-stratigraphic units above the bedrock: i) Synthem of the fluvio-lacustrine Firenze-Pistoia basin; ii) ancient fluvial and alluvial deposits of the Arno rivers, and its tributaries; iii) recent alluvial deposits of the Arno river, and its tributaries.

The maximum seismic intensity historically suffered in the Firenze area was of the VII grade of the MCS scale in the 1895 relative to an earthquake of 4.8 Magnitude located in the Impruneta area at about 30 km southeast from Firenze. The maximum PGA expected (OPCM 3519/06; DGRT 431/06) is between 0.11g and 0.13g on the bedrock. Recent seismic microzoning of Firenze district reveals that the city is sitting on a relative soft and shallow (<30 m) sediments of the recent alluvial deposits of the Arno river, which amplify the PGA of about 1.4 in the downtown area.

On this basis, it is vital in this frame, in the last years a special attention was paid to collect data for a better management and conservation policy of the Firenze historical centre and monuments in respect to civil protection and to understand the effect of a possible earthquake on both historical and civil infrastructures.

At present state, in agreement with the Opera del Duomo di Firenze and the Fabbriceria di Palazzo Vecchio, a series of seismic surveys on the Brunelleschi's Dome, Giotto's Bell-Tower and Arnolfo's Tower have been performed in order to define the seismic response of these monuments. In the case of the Brunelleschi's Dome, the elastic response of the structure was measured during the 2008 seismic sequences occurred in the Mugello area (30 km North from Firenze), with Magnitudes ranging between 4.2 and 2.8. Besides, more data acquisitions are in still in progress at the Uffizi and the Academia Gallery.

Preliminary data indicate that the above mentioned monuments have elastic response generally below 1 Hz while the ground shows amplification at frequencies of about 5 Hz. Frequency response of the geological setting is thus higher than the one measured for these monuments and indicating that earthquakes similar to the one in the past cannot induce the double resonance phenomena, which so dramatically can affect the integrity of these structures.

LEARNING FROM LOCAL SEISMIC CULTURES, AS A STRATEGY FOR REDUCING THE RISK OF CULTURAL HERITAGE

Letizia Dipasquale, Natalia Jorquera Silva
University of Florence, Italy

One of the latest lines of research about cultural heritage safeguarding, concerns its preservation in risks contexts. The more frequent problems associated with natural disasters, social and economical crisis, have adversely affected the preservation of cultural heritage, especially the ones that are already in a state of increased vulnerability, such as vernacular habitats.

Vernacular habitats are the result of a process of interaction and adaptation of the communities to the environment, and this interaction is reflected through the establishment of certain rituals and traditions, where the architecture is the technical response of the community to the need for room.

Among the different types of natural risks, one of the most devastating threats is the seismic one, due to the unexpected nature of the event and the great destruction that it can produce. Most of the time, the great destruction is due to the previous state of conservation of the building environment, where earthquake is the last step in a chain of deterioration.

In the contexts of high seismic activity, local communities have early developed strategies for managing such a risk, adapting all available resources for creating precise anti-seismic rules, shaping not just a particular building culture, but a complex local seismic culture: earthquake becomes part of the experience of the community and part of the collective identity of the group, that together join the effort to achieve the stability of the built environment.

Seismic risk stays on people's memory, and local community create a set of commonly adopted but unwritten rules about it, that are however readable in the constructive characteristics of the buildings, as well as in the general structure given to the territory. Local seismic cultures generate an immaterial heritage (local constructive knowledges and popular culture, transmitted from generation to generation through oral tradition) together with a material one (the anti-seismic constructive solutions, made with natural available resources, suitable for building material).

Codifying this not written traditional knowledge (material and immaterial heritage) of local seismic culture, could become a strategic for safeguarding the heritage at risk. To carry out a comprehensive inventory and multidisciplinary analysis of local construction and solutions, could generate local practice codes, in the same way that standards and quality controls, are use in the case of preventing any modern construction from seismic action.

AN INTERDISCIPLINARY APPROACH TO A CULTURAL AND ARCHITECTURAL HERITAGE: EARTHEN DOME ARCHITECTURE IN SYRIA

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University of Florence, Florence, Italy

As Vernacular Architecture is the result of this rich and complex process that begins with the formation of a particular social and cultural structure in close relation with the environment, and is reflected through the establishment of certain rituals and traditions, where the architecture is the technical response of the community to the need for spaces, the Earthen Dome Architecture of Syria represents a valuable example of vernacular architecture and a unique cultural landscape that is the result of a process of interaction and adaptation of communities to the environment with scarce natural resources over thousands of years.

A deep interdisciplinary method of analysis is required that includes the architecture as part of a system that has to be studied along with, and not detached from, its environment, a deep knowledge of the environmental and cultural context and all the factors that brought about the architecture being necessary.

The cognitive system that is behind vernacular architecture is part of a much more complex knowledge system, for which practices and representations are integrated and mutually dependent, including language, relationship with place, beliefs and world views, and so 'tacit local knowledge'.

An interdisciplinary approach

The project has been based on an interdisciplinary scientific research joining an in-depth study of local architecture, the representation of architectural knowledge and a theoretical and experimental scientific analysis and interpretation. Three geographic areas of northern Syria regions were studied at several investigation scales, in order to have a complete analysis.

The fieldwork produced a large set of data and qualitative and quantitative information, which has been the basis for the scientific analysis and interpretation, through the collaboration and integration of different scientific approaches to urban, architectural, technical, archaeometrical, structural, geographical and environmental dimensions.

Geomatic survey

The whole set of geomatic surveying methods has been used, from direct and topographical methods to sophisticated methods of acquisition such as photogrammetry, 'laser scanning' and digital photogrammetry for a 3D model and information on materials and surfaces.

Urban and Architectural analysis

The urban and architectural analysis of architectural forms and functions starts from the identification of the basic architectural elements, their technical, functional and morphological characteristics and of spatial and functional relations. In this way the modes of aggregation of individual cells that give shape to urban and housing units, are analysed and characterized.

This type of analysis is based on direct observations and documentation.

Mechanical Analysis

The structural or mechanical analysis is based on the direct surveying, the deep insight of building elements and their static schemes, identification and diagnosis structural pathologies, and an archaeotechnical interpretative analysis of the construction. The purpose of this analysis is the understanding and identifying of the structural characteristics of constructive culture, structural pathologies and failures.

Building Technical analysis

The analysis of the local tacit constructive knowledge system has been based on the direct observation and surveying of building elements, on the identification and characterization of materials, on building technique and construction process identification.

Archaeometric Analysis

The archaeometric analysis is based on sampling materials of the buildings for characterizing the mineralogical composition, determining particle size, the physical (plasticity index, porosity) and mechanical parameters, the origins of materials, the mixtures of soil and additives, the methods of mixture and characterizing the degradation process.

Mechanical Analysis

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Urban and Architectural analysis

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The **resource and environmental analysis**, as well as the **ethnographic** analysis has been developed in field by several interviews with people living in the villages and with building specialists, integrated with the scientific literature on people living in the selected regions of corbelled dome villages.

Tacit local knowledge representation

The new information and knowledge was consolidated in order to gain a complete perspective of the subject for each discipline, but at the same time, a systemic information that enabled the modelling of a detailed representation of the architectural knowledge, and so a codification of tacit local knowledge.

Conclusion

The tacit local architectural knowledge is the result of several factors, and to understand them and make them explicit and sharable, we need an interdisciplinary approach based on knowledge such as that outlined and applied in the project. As shown in Figure 1, the analysis and modelling of local knowledge systems is at the heart of the work of cognitive inquiry, as a result of an integration process of all the specific knowledge areas.

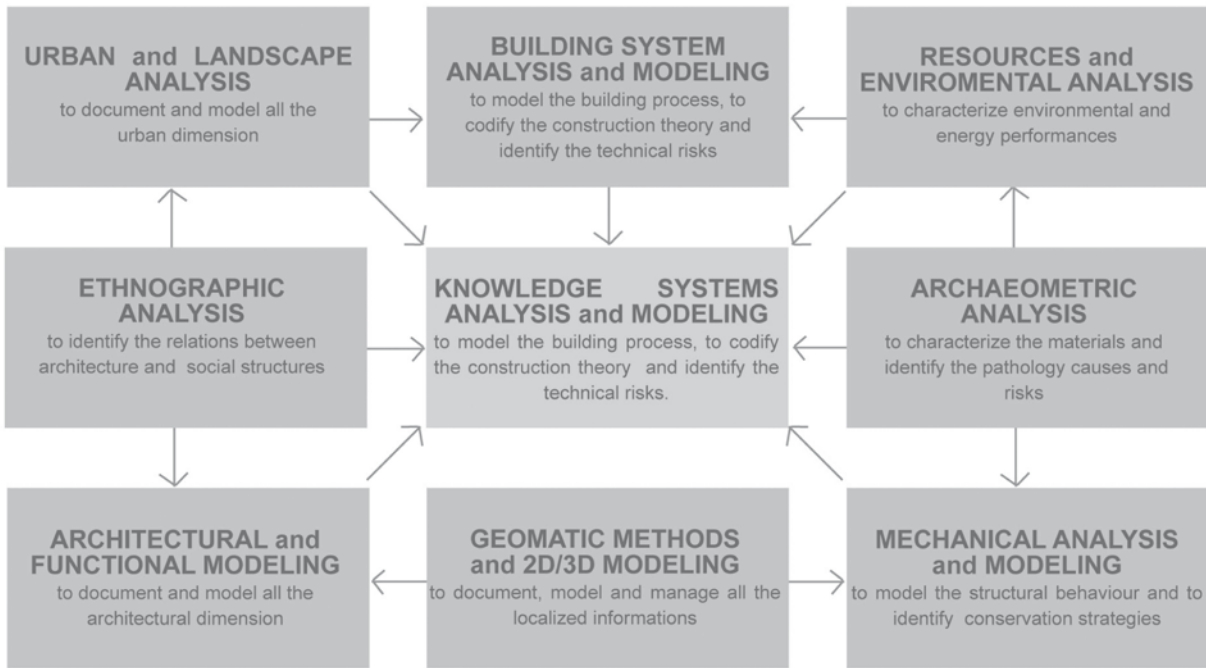| URBAN and LANDSCAPE ANALYSIS to document and model all the urban dimension	BUILDING SYSTEM ANALYSIS and MODELING to model the building process, to codify the construction theory and identify the technical risks	RESOURCES and ENVIROMENTAL ANALYSIS to characterize environmental and energy performances
ETHNOGRAPHIC ANALYSIS to identify the relations between architecture and social structures	KNOWLEDGE SYSTEMS ANALYSIS and MODELING to model the building process, to codify the construction theory and identify the technical risks.	ARCHAEOMETRIC ANALYSIS to characterize the materials and identify the pathology causes and risks
ARCHITECTURAL and FUNCTIONAL MODELING to document and model all the architectural dimension	GEOMATIC METHODS and 2D/3D MODELING to document, model and manage all the localized informations	MECHANICAL ANALYSIS and MODELING to model the structural behaviour and to identify conservation strategies

Figure 1: Conceptual scheme of analysis and modelling of a tacit local knowledge system

RISEM – SEISMIC RISK IN MOMUMENTAL STRUCTURES. THE SAN GIMIGNANO CASE

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Department of Construction and Restoration

THE SAFEGUARD OF CULTURAL HERITAGE

The RiSEM project is financed by PAR FAS REGIONE TOSCANA. The Civil Engineering and Environmental Department (project coordinator Gianni Bartoli), the Department of Electronics and Telecommunication of the University of Florence, the Department of Earth Sciences of the University of Siena and the Municipality of San Gimignano, all participate in the project. They have set as their objective investigating, analysing and diagnosing the techniques which would define (even in an expeditious way with non-contact techniques) the seismic risk to the monumental heritage, or even to the collective urban structures of historical interest.

The project phases will be:

Defining the seismic risk (evaluation of the local seismic response to events and the dynamic interaction between terrain and structure).

Acquiring information on the geometric characteristics, the historic evolution and the various interventions on the edifice.

Defining the mechanical and dynamic characteristics of the towers.

Defining the seismic vulnerability.

Defining the seismic risk.

San Gimignano was selected as a case study as it represents a unique case in the world panorama regarding the density of towers present in the various structures of the antique centre of town. The study proposes analyzing all the towers as they are the monuments most "at risk" in the case of seismic events and because of their potential vulnerability to such events.

The group made up of the Department of Construction and Restoration and including the Geomatics Laboratory for Conservation led by Grazia Tucci, have set as their objective the survey of the towers with direct investigation of the structures, supported by laser scanning techniques, photogrammetric and topographical survey. The geometrical survey will form the platform on which multiple aspects regarding anti-seismic diagnostics will be based. Among these, the interventions which occurred during various epochs, the mapping of the possible cracks in the towers, the possible overhanging structures, the variations in wall thickness at various levels and the use of chaining to support the structure will be investigated. Also under consideration will be the functioning of buttressing of the adjoining structures against the towers, something regularly found in San Gimignano. In this case it will be necessary to verify if hidden passages occur in the walls of the towers, which might weaken them dangerously, particularly at the lower levels where the main load is carried.

Numerical modeling of the behavior of the towers
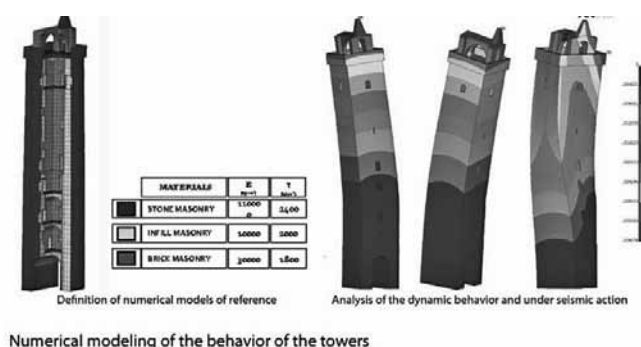
To be verified is the localized deformation due to thrust or to the curvature of the walls caused by vertical loading and not by a physical inclination of the towers which is often caused by subsidence of the foundations. The transformation will be able to shed light on the possible added storeys of the towers and the usual shifting in the levels of the floors occurring over a period of time (often with changes to the structure of the walking areas, vaults demolished to create wooden floors or vice versa).

Equally frequently we find changes to the dimensions and positioning of the openings. Another area requiring verification is the stair systems, which could be simple stairs in wood, stone stairs in the gallery, or cantilevered stairs supported by parietal arches, brackets or interior pillars. These aspects have a considerable relevance in terms of safety and structural behaviour of the towers and very often, a significant architectural value.

The existence of cellars or underground rooms below the towers, as well as in adjacent rooms, must be verified. Actually, if the rooms were excavated at a later stage, and exposed parts of the foundation, it could create a potentially dangerous situation. The foundation wall may be of poor quality and once without the thrust of the soil, it may give rise to phenomena of disintegration of the foundations. This aspect should induce great caution when archaeological excavations are carried out at the foot of the tower. This lack of homogeneity in the structures may highlight the incorporation of pre-existing towers, which may have influenced the subsequent construction choices. Their architectural context will anyhow be assessed, as it may have imposed some important choices in location, size and overall characteristics of the structure.

he investigation started in the towers of San Gimignano showed some early signs of great interest. In one of the two Ardinghelli towers the inner sides of the summit masonry of the structure were dismantled, in order to re-use the material to raise the height of the tower itself. It therefore appears to have been constructed with smooth and homogenous stone walls.

The Salvucci tower has extraordinarily thick walls in contrast with the limited internal space of less than one meter. Here also, as a result of amalgamation and gradual residential use of the lower levels, we find a consistent demolition of the wall mass, which almost transformed a massive continuous structure into a structure with nearly parallel bearing walls.

Luca Giorgi, Associate Professor of Architectural Restoration at the University of Florence. Architect. He used non-destructive diagnostics in his research on cultural heritage by IR reflectography on paintings, by termography on buildings and art objects. Author of publications founded on direct assessments on the most relevant Italian religious buildings (the complex of S.Maria del Fiore, S. Lorenzo Maggiore in Milan, S. Pietro in Rome, the Cathedral of Siena, S. Biagio in Montepulciano) and Jesuit churches. Promoter, National Delegate and vice-chairman of the COST-LUCE Group 'Urban Heritage – Building maintenance'.

Pietro Matracchi, Senior Researcher at the University of Florence. Professor of Architectural Restoration at the Faculty of Florence since 2002. Author of essays and monographs on various subjects, including the Museo Nazionale del Bargello in Florence, the Cathedrals of Florence and Perugia, the church of Santa Maria delle Grazie in Calcinaio in Cortona and Vasari's Santa Maria Nuova, the dome of the Cathedral of Siena. In his researches he paid special attention to the philological problems in the interpretation of significant structures, and thus of concrete architectural artefacts, in relation to archival documents.

SECURART. LARGE SCALE MANAGEMENT OF CULTURAL ASSETS

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Conservation and *enhancement* have been keywords in the Italian debate about of the cultural heritage for at least twenty years. Recently, since the emanation of the 2004 Cultural Heritage Code, they have gained further momentum. The integrated knowledge of a cultural asset, intended as a compound process of profiling, cataloguing and storing in shared databases, can act as the catalyst of a virtuous circle that starts from the strategic planning of specific interventions and ends up with the enhancement of the cultural asset, either in terms of its fruition and in terms of its preservation. These actions, in turn, will provide economic gains and savings that can be reinvested to feed the circle further.

The Cofely Cultural Asset Knowledge Cycle

The *Securart System*, developed by Cofely for the Italian Ministry of Cultural Heritage, is a first example of the application of these principles. From 2000 to 2010, Cofely has developed and managed the Securart DataBase, concerned with the cataloguing of the whole set of cultural interest sites, that are under direct control of the Italian Ministry of Cultural Heritage. The Securart data base involves more than 1100 sites (i.e. museums, archeological sites, archives and libraries, historical buildings, monuments and offices) spread across all the Italian regions, with a total surface of more than 2 millions of square meters. Securart, at present, contains more than one million of alphanumerical data, comprising registry and cadastral information, usage, morphological and geometrical data, security and fire prevention systems, service plants. Securart is also interfaced with a graphical GUI to a CAD archive, allowing the access to the set of drawings concerning each site, as well as to a satellite imaging system for the visualization of the aerial images of each site. The exploitation of the information pool contained in the Securart database is, at present an ongoing process, and involves both the asset performance and its management. For example, the risk analysis concerning burglary or fire is currently made possible by the integrated access to usage profiles, technical data and CAD drawings. Future developments foresee the integration of sensors networks in order to acquire relevant and contextualized information from the environment, and to implement adaptive dynamic behaviors of the asset so as to optimize its relationships with the surroundings.

Securart contains the data base of the cultural heritage of the Italian Ministry of Cultural heritage and is therefore a fundamental tool for the planning and monitoring of safeguard strategies

DESIGN WITH THE GLOBAL SOUTH: A MEDITERRANEAN PERSPECTIVE

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THE SAFEGUARD OF CULTURAL HERITAGE

As a definition for Southern and Northern countries far from judgments we can use Franco Cassano's definition which says that the idea of South is settled in the conviction that a different kind of richness is possible. In this model common goods are more important than private ones (Cassano, 2009).

From this point of view the South represents a reality that can teach instead of learning from the northern society because it is able to give a critical evaluation of the present and look forward to the future giving new advice (Cassano, 1996). There is not a systematic theory about this theme so far, especially considering it from a point of view of the debate between local and global development models.

Since the mid 60's, for the first time, the design and research started to question about the contribution they can give for the development of southern countries. This new attitude was connected to a general growing interest in social and political matters.

Nowadays, after years of poor attention to social implications, design started to adopt a more critical approach to the project by paying more attention to southern countries.

The argument is wide, with a special attention on big themes such as hunger, water, energy. Under this point of view the most important experience is the recent exposition of Cooper-Hewitt, National Design Museum, Design for the other 90% (Cooper-Hewitt, National Design Museum, 2007).

Also the attention upon the themes more strictly related to local development is growing. All of this in a view of a sustainability model, which comprehends not only environmental but also social and cultural aspects.

The interest comes also from an attempt to get creative power back from reality which has not yet been contaminated by globalization. Objects created for markets more sensitive to particular products, some of which are unique.

Forty years have passed from the works of Papanek, Bonsiepe and Bo Bardi, but the situation in Southern Countries in most cases has not changed, indeed the economic gap has increased.

Among the present contribution of design to international cooperation the more structured experience is surely the one promoted by the Eindhoven Design Academy. The Academy's master in Man and Humanity foresees three project areas, Global, Local and Personal.

It is in the Global section that projects which are more related to our considerations have been implemented. The projects have been realized in different local realities: *Design Solidario* (2001) which has been developed in Serrita a village in Pernambuco State and in São Paulo in the *Associação Comunitaria Monte Azul*; the project "Enjoy the difference" in Kenya (2002); in Peru with the collaboration of the NGO Alpa, placed in Lima; the project "Home" in India (2004) (Eindhoven Design Academy, 2002; Eindhoven Design Academy, 2004a; Eindhoven Design Academy, 2004b).

This kind of intervention, according to project publications, faces troubles that usually are present in this kind of projects: the difficulties of the first moment in front of an unknown reality; the problems that the local population is facing and the following emotional involvement; the role of women, who in spite of all the difficulties can be the true changing power; the risks that once again, the western point of view impose.

Also the Corso di Laurea in Disegno Industriale e Magistrale in Design of University of Florence has developed projects on these themes. For example the action done in collaboration with ADEDRA - *Association pour le developpement de la Valle du Drâa* – in the framework of the project *Valorizzazione ed innovazione della Produzione Artigianale legata alla palma nella Provincia di Zagora* – Morocco. The project was about encouraging the economic development of the Province of Zagora through the knowledge, valorization, development and innovation of the region's artisanal capital.

The professionalization of artisans has been one of the main aims - in particular of the associations of *femmes rurales* which work with palm and near sectors. All of this in a particular interesting context such as the oasi of Valle del Draa, where the desert is advancing inexorably (Lotti and Bedeschi, 2007). More recently, in the project *Sviluppo dei Saperi artigianali tradizionali e Integrazione dei sistemi produttivi in Italia e Marocco* the Corso has worked with the INBA, - *Institut National de Beaux Arts de Tetouan* – e le associazioni ADEO – *Association de developpement et protection de l'environment di Oued Laou* – di Ifrane Ali e Assaida al Horra di M'diq – Tetouan –. The two contexts have a really different production; the first has a highly traditional production, almost archaic, with extremely functional products. The second is featured by the production of ceramics which aesthetics features are not strictly related to the Moroccan tradition, and decorative elements are quite different from those featuring the local culture; also shapes are usually non-functional. The main objective of the workshop is to help women working on ceramics to produce objects which can be interesting for local and international markets through the valorization of local knowledge and tradition.

In order to make the project more operative the laboratory ARCO, Action Research for co-development of the PIN of Prato has been involved. The themes addressed in this paper are just a part of the typical problems of the design for the South of the world and the implication in terms of sustainability of the model of intervention, there are still many open questions to answer and debate:

Which innovation is necessary in a case of intervention?

Usually we are in front of highly traditional contexts with an ancient production the level of innovation introduced in the production needs to be attentively calibrated. It is fundamental, to have multi-disciplinary teams, involving economists and anthropologists, which are able to answer properly to the complexity of this theme.

How can we operate on shared, truly agreed upon projects without any risk of falling back to neocolonialism?

It is impossible to give an absolute answer to this question; despite this the experience shows that products made in this kind of projects have a strong sharing level between the designer and the artisan. Usually students are disappointed at the beginning, because the product does not correspond to their idea, but then, they understand the value, the formal contamination, the continuity with the tradition, the material concreteness, and in the end, they prefer the transformed product.

Which instruments should be used to describe the project, making it comprehensible to those enacting the project (for example how to describe forms, dimensions to artisans)?

The description of the project is never traditional (in a modern sense). Measures are given by hands; technical drawings are usually impossible to be understood while 3D is perceived as something already existing, and therefore, useless to copy; the comparison with objects is fundamental because it gives the possibility to work with similitude or difference.

Regarding the market, how can we guarantee concrete positive results to those working within the project safeguarding their rights?

The rules of fair trade seem a sure reference. But the complexity of local contexts and the distance from our reality require a special attention. For example, considering the case of the Dr. Valley's project and to the hypothesis of development of a big production with palm in a long time term can destroy an extremely fragile environment such as the one of the oasis.

Which can be the more adapt partner in order to obtain durable results in the area?

An important role is surely the one of local NGOs, while more difficult seems to be the work with the Italian ones less related to the territory. Local NGOs usually are more able to manage the complexity of relationships with local background

and to keep these relationships correct. The limit of local NGOs is that they have the difficulties to relate with a market that traditionally is not part of their core business.

Talking about the durable effects, it is relevant the role of local schools and universities which is expressed by the relationship with students, in the growing empathy, in the building of new, plural society, open to compromise

The contribution of women is also very important; through the consciousness of the importance of their work they can progressively acquire position into family and society.

Last but not the least, the role of Mediterranean area in this context. "For 'Mediterranean alternative' we can, therefore, mean the attempt to resist, using tradition and local values, to the universalistic and "monotheist" drift, which comes from the west, from the United States and that violently gets to the old world… The 'Mediterranean alternative'… would like to value the culture of limes, of the many Gods, of the many languages and civilizations, of the sea among the lands, which is alien to the monist, cosmopolitan and humanitarian dimension of oceanic powers" (Cassano and Zolo, 2007).

Mediterranean, therefore once again, as a sea in between, not only between hearth but between two models of development: the first commonly known as occidental, ours, which brought in average to economic well-being but lacks on environment sustainability, and creates disparities with realities featured by lower development level. This attitude if generalized all over the world would bring the planet to collapse; the second of the southern part, too slow, that risks to be subject to uncontrolled westernization even if it still expresses continuity with the territory, in relation with tradition and strong social connections.

All of this gives birth to a new design phenomenology which has lost any assertive temptation; it becomes an instrument of sharing and participation.

According to Canevacci Ribeiro (2007): "The relativist takes a position… it is not neutral anymore, as now it challenges the totalitarist theories… the new relativism is a method not a doctrine, it valorizes cultural differences against every universalism."

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Ilaria Serpente, designer and teaching assistant of "Design for Sustainability" at Università degli Studi di Firenze. Her professional activity focuses on the theme of Sustainable design - re-use design, sustainable development for rural and urban communities. She has been working on projects in Southern America – Amazon region and Sao Paulo Region – and in Marocco. In Italy she is coordinating the project "Laboratorio delle Alternative Possibili" about product made with re-used materials in partnership with the NGO Manitese.

LOCAL AND INDIGENOUS KNOWLEDGE SAFEGUARDING AND INNOVATING: THE INN-LINK-S RESEARCH CENTER

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Local and indigenous knowledge refer to the body of knowledge, skills, practices and representations that have been preserved and maintained by local communities through complex interactions with the natural environment. These "technological" cognitive systems are part of knowledge systems more complex for which knowledge, practices and representations are integrated and mutually dependent, and include language, the relationship with the place, beliefs and world views. This knowledge can be defined in different areas by specific terms such as Traditional Ecological Knowledge (TEK), ethnobiology, ethnobotany, ASPPA, ethnology, vernacular architecture, material knowledge, knowledge naturalists anthropology, anthropology museum.

Traditional techniques at the local, cultural, social organization and rituals of the populations highlight the close relationship that has existed over the centuries between human communities, technology and the natural environment. One of the most promising and interesting research line on cultural heritage is on local knowledge systems through the architectural and construction, ecosystems and cultural systems hardware analysis and .

The problem of immaterial heritage conservation is to integrate the different skills and capabilities horizontally in order to develop more effectively on field research activities

The main cultural heritage research field should be based on a holistic approach of local and indigenous knowledge in the fields of natural ecosystems and human, architecture and cultures as physical as themselves and strategic element in the process of local sustainable progress, able to improve the lives of people, giving them the means to a greater understanding and interpretation of the processes of interaction between man and his environment.

In terms of research methods, it could be effective to experiment a systemic approach geared towards an integration of methods and tools quantitative experimental scientific research, with methods and qualitative research tools and knowledge management.

The objective of european research in order to maintain a competitive advantage is to develop innovative systems for the conservation, development and management of local knowledge systems as an expression of cultural diversity in the relationship between nature and society and sustainable fashion natural resource management.

On the whole, the research could focus on developing activities:

- Location, identification, representation, modeling and coding of local and tacit knowledge.
- Classification, organization and communication of local and tacit knowledge systems;
- Design and evaluation of learning and communications systems;
- Design, testing and evaluation of sustainable innovations of local and tacit knowledge systems.

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ENERGETIC ISSUES FOR THE ARCHITECTURAL HERITAGE DOMAIN

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The challenge which the European cities and, in particular, of those owning an extensive Architectural Heritage (AH) must face concerns their reconversion in view of ambitious energetic savings targets.

Shortly relevant results deriving from a systemic action in the medium and long term, can address the following priorities:

• The opportunity to exploit the natural meso-microclimatic resources rather that undergo distortions caused by the specific urban and microclimatic conformation determined by urban and architectural development;

• To adjust the built stock (e.g. 30% reduction in primary energy demand in the short term and up to 80% in the long term);

• The need to produce relevant results with low or no cost measures (15% of the energy savings could derive from no-cost measures, another 15% from low cost measures);

• To implement systems for managing built heritage through innovative politics which correspond to participated organizational approaches (energetic management systems) for the energetic management of buildings and for on-going improvement implemented in order to reach the energetic savings targets: increased use of renewable resources and CO_2 emission reduction;

• To act on the behaviour (awareness and comprehension) of the final users through a combination of knowledge management instruments and ICT;

Relevant scope for the AH in the energetic domain is to *transform existing and scattered conservation strategies on architecture heritage into a more effective, structured and sustainable one*. This means not only defining integrated design strategies and providing suitable & sustainable technology of analysis and preservation, but also rediscovering ancient and traditional treatments, active low cost and passive strategies, tacit and explicit local knowledge and their way of working, in order to compare their results in different local contexts.

It means also *promotion of networks of partners and connecting them into a network* to behave as a flexible, virtual organisation in order to exchange and structure the collected data.

The energetic research stream in the AH comes with the intention of developing the theme of energy management and effectiveness of preservation measure of architectural heritage aiming at *integrating the preservation strategies with sustainable development concepts,* opening the evaluation not only to strictly physical or procedural parameters, but also to environmental, socio-cultural and local context considerations. In synthesis the research scope has to cope with:

- supporting the definition of an energetic refurbishment domain for the Architectural Heritage,
- taking into consideration both the technical problems (vulnerability of the monument, suitable energy policies in conservation actions and knowledge of the conservation technologies) and the opportunities run by the areas in their peculiar situation;
- offering tools and methods to better preserve the buildings and to 're-use' them.

The most generally accepted priorities of policies for conservation of heritage on which the energetic projects are based can be summarised as follows:

- specification of operational choices for restoration that maintain long term quality levels and are suitable for adoption on a wider scale;
- selection of techniques that respect tradition and traditional construction materials as well as the local environment;
- increased cultural awareness of conservation problems on the part of the local population and maturing of a more correct attitude on the part of visitors through study and knowledge of local history;
- development of knowledge, experience and culture of programming for ordinary and long term maintenance. This is one of the most effective means for prevention of new forms of decay or deterioration;
- shared growth and awareness of the similarities and diversities between individual historical experiences, and of the shared need to protect and exploit a historical-environmental heritage characterised by the presence in the area of a wide range of artefacts attributable to the various cultures that have alternated and influenced the subsequent ones.

The contribution of the energetic refurbishment of the Architectural Heritage can be estimated in relation to the problems affecting common AH policies:

Study of the effectiveness and sustainability of conservation measures

The application of the principles of the AH conservation – such as reversibility, effectiveness, compatibility and sustainability - can provide a picture of the options that make a research action acceptable or unacceptable. These options not only according to the historical-cultural context but also according to the social and environmental context, as the scientific world involved in protection of the heritage has recognised. The project aims to make further contributions to assessment of effectiveness of actions for the conservation of architectural heritage in different country. The research will make contributions in the field of knowledge of interactions between ancient and traditional materials, of synergies between different materials and of their life cycles, as well as of maintenance requirements.
Contribution to research on the physical system simulation and the study of appropriate test methods.
At present there are some studies on the simulation of energetic behaviour of buildings over time available to the scientific community but there is a perceived need to develop reliable testing methods. Further contributions through a programme of studies aimed at evaluation of energetic performances and to contribute to the definition of appropriate diagnostic methods and tools, above all those suitable for the on-site testing, are required.

Connection with sustainable development

The research actions address the various topics associated with conservation of Architectural Heritage, with attention to aspects associated with the concept of sustainable development. To make the concept of sustainability in the project more realistic, it is intended that local communities, should be strongly involved in the process of conservation of the assets studied – through recovery of traditional techniques and discussion on site. Moreover, unlike other

historical construction technologies, the energetic refurbishment has a very strong connotation of sustainability, both environmental and social, which makes it an interesting "appropriate" technology for the present and near future in all geographical areas.

Knowledge management

Management of knowledge in every discipline and of all the geographical areas involved in the research essential to prevent any hint of cultural colonisation in decisions on conservation actions, as well as for survival of the shared cultural heritage. Recovery and systemisation of all the knowledge that is or could be involved in conservation activities is one of the most important issue of the research scope. Multidisciplinarity and geographical transversality are key-aspects of the methodology of working put forward in the energetic refurbishment projects to achieve the objectives.

Strategic Impact: Preserving the cultural heritage and the environment while enhancing the energetic performances and actualising the potential of AH

The expected impact is to obtain integrated approaches to conservation of AH directed to set out an affordable and easy to use system supporting and improving the complex decision process oriented to conservation of architectural heritage by means of:

• the conservation of the geographical culture on architecture and its energy saving issues and measures because this is an important chapter in the architectural culture and geographical identity already reduced by time;

• historical actualised building technologies may have a very strong connotation of sustainability, both environmental and social, which makes it an interesting "appropriate" technology for the present and near future in the energetic field;

• knowledge is increasingly being recognised as a vital organisational resource that must provide every sustainable economic and social development programme;

• the valorisation of "tacit" (not formalized local and traditional building and conservation culture) knowledge is the core issue for a proactive behaviour of the final user.

• a process of construction a common and shared competence of methods and tools, respectful of different regional cultural characteristics,

• suitable and adequate design measures: the setting out and diffusion of available scientific and technical knowledge, facilitating the circulation of the best practice, as a necessary conditions allowing continuity and conservation of the AH.

• a valorisation of both the technical knowledge (explicit and mostly tacit) or common knowledge shared by technicians and users;

However, the main social objectives that the energetic research stream in the AH can help achieve are linked, to the reduction of important social costs and the gradual harmonisation of these costs.

CULTURAL PLASTICITY AND SUSTAINABILITY OF TRADITIONAL BUILDING CULTURES: EARTHEN ARCHITECTURE AS MODEL

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The chief scientific problem related to vernacular architectures, undervalued for the past century or so on account of the difficulty of managing them from a standardized industrial and commercial point of view, lies in the reconstruction of value chains, knowledge and local production.

Vernacular Architectural Heritage (VAH) is important for our own future because these architectures are characterized by:

a high level of technical variability and integration in geographical and cultural environments together with their traditionally ecological and effective energy performances, which is of the utmost relevance;

consistent levels of "tacit" and local knowledge, of technical and procedural competence and of information on local materials, resources and practices;

criticism, however, related to the durability (in the chemical and physical sense), to mechanical weakness and seismic vulnerability.

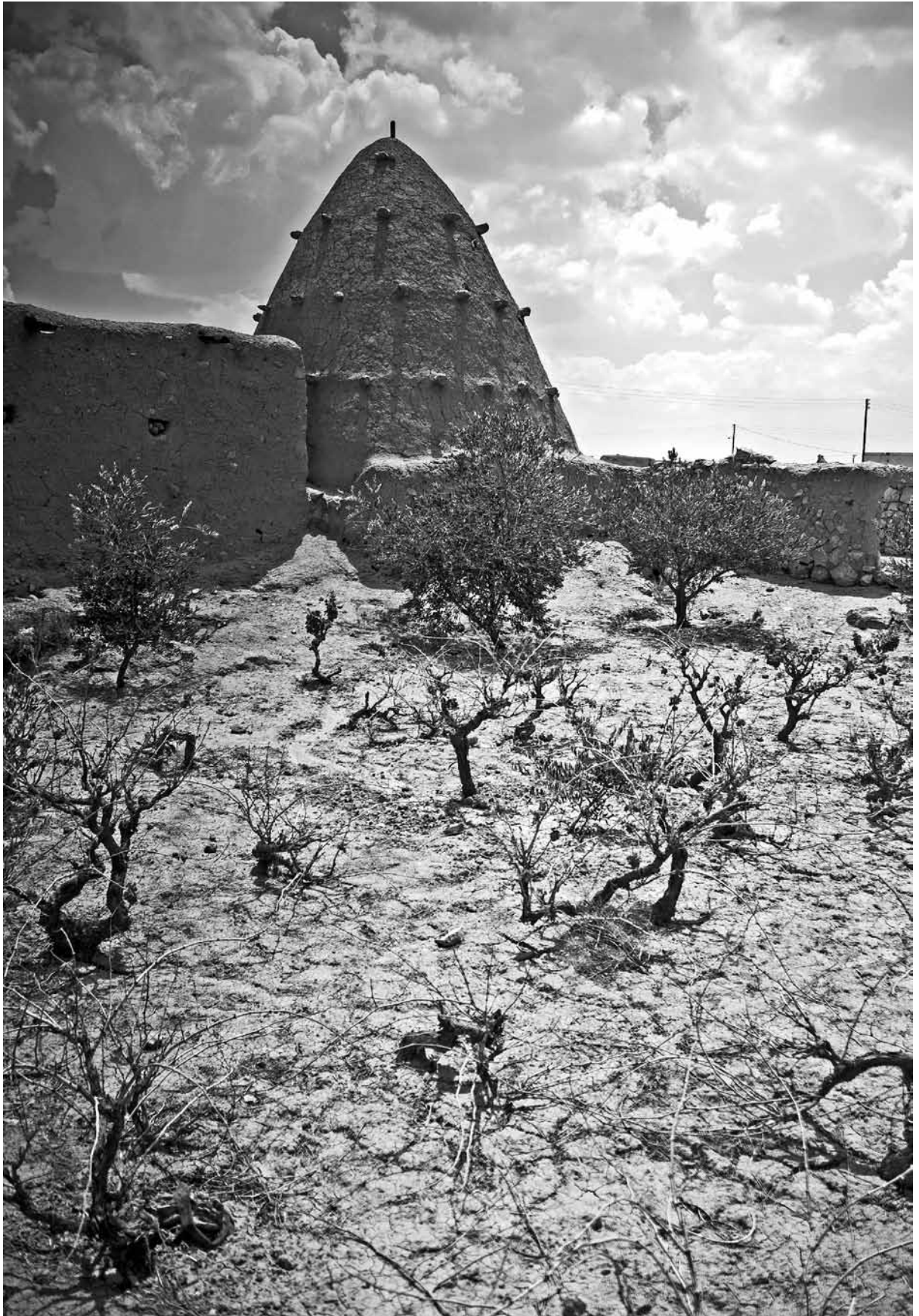### Cultural plasticity and sustainability of traditional building cultures

Earth is an essentially original and misunderstood raw material with great potential ranging from its positive environmental/energy ratio, to its admirable capacity to integrate other materials such as stone, wood, brick, lime and vegetable fibres, etc., capable also of constituting the sole material for whole buildings in climatically and geographically extreme situations.

In particular, in regions with a hot/dry climate it boasts the considerable advantages of quick manufacture and ease of drying, with good resistance to fire and, when properly protected, even to the elements. It also has the capacity to keep buildings cool in summer and warm in winter through thermal insulation and inertia.

With fresh attention to the environment, we can return to earth as a new technology of architecture for the twenty-first century. In the most vulnerable regions, earthen building is the most effective and sustainable technology with which to produce volumes of houses and buildings in the short-term, capable of encouraging the development of local resources, materials and craftsmanship, of increasing technical and professional competence, and of reducing the share of imported goods and technologies related to building activities.

In this era of globalization there is the definite need to enhance local cultures and earthen architecture, for which we should develop research and testing processes, and investment in the pursuit of knowledge, in order to explore and develop the significant strategic potential of the material, as was the case with reinforced concrete in the twentieth century.

If we identify Knowledge in the broad sense as the main resource that can be produced, reproduced and dissemina-

ted to trigger the processes of self-development and creativity, training of new paradigms, methods and the design tools of human settlements, research and experimentation should be the main fields of international co-operation among Mediterranean countries, being one of the most powerful tools to rebuild such a Mediterranean community that only in recent centuries has been dismantled.

We need investment in knowledge, in the rebuilding and development of constructional skills, combined with a common language and the sharing of scientific and technical culture regarding earthen construction, not only between technical and professional communities, but also between the peoples of the Mediterranean themselves.

The 'Coupoles et habitats' Culture 2000 project

The core goal of the 'Coupoles et habitats' project[1], was:

to document the unique historical landscape of traditional architecture, as earthen dome villages in northern Syria, that has continued to express the complex relationship between the environment, people and architecture over thousands of years;

to examine the common roots between different cultural regions of Europe and Mediterranean demonstrated by the astonishing diffusion of corbelled architectural and building culture all over Europe and the Mediterranean;

to experiment and test an interdisciplinary approach to the analysis and valorisation of knowledge systems that we call Vernacular Architectural Heritage.

Syrian earthen corbelled dome architecture expresses these characteristics at the highest level: the project offered to Syrian and international communities an analysis of its constructional system, based on a deep knowledge of local building culture, on local technical heritage and on experimental research into the its physical, energy-related and structural behaviour.

The conscious design of new architectures and heritage conservation requires a combination of specific scientific and experimental knowledge, along with both the local and tacit knowledge systems that are at present dispersed, unconnected and, in some respects, lacking.

Insufficient social value and a lack of knowledge is, in fact, at the base of the perceived poorness, inadequacy and unreliability of earthen technology, an 'old' material but, nevertheless, an indomitable expression of cultural diversity, variable in relation to the cultural and natural characters of places, capable of being a strategic material for the future of architecture and human settlements.

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[1] Culture 2000, Third Countries : Coupoles Et Habitats, Une tradition constructive entre Orient et Occident. Contract n.2007-1134/001-001 CTU COHANT

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WEB-BASED CODIFIED AND TACIT KNOWLEDGE MANAGEMENT AND CONSERVATION OF VERNACULAR ARCHITECTURE HERITAGE

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The scenario

The research in the field of conservation project is related to the more generic issue of the re-evaluation of the overall production process that is the field of vernacular architecture, undervalued for its difficulty to be managed through an industrial and a commercial point of view; the process of valorisation of pre-industrial technologies, that has been started for years and sustained by important international committee as UNESCO, is founded on the elicitation of constructive knowledge, in compliance with the original contexts, in order to use this knowledge through an evolutionary frame organized on the basis of social, economical, and technical expectations, in relation to the product and the process project.

The field of vernacular architecture conservation can be successful only if it allows the safeguard of the values of diffused quality in a widespread architectural heritage and if it enables to work with the current building procedures. In this sense, even the conservation issue has to be faced trough methodologies and tools concerning the design and the project organization.

The research should be located in the field of the organization and management of the conservation plans, through the definition of a Knowledge Management integrated approach, applied to the knowledge that is oriented to the decisions of the conservation actions and, therefore, to the definition of more critical decisional processes in relation to the aspects of greater vulnerability of vernacular constructive systems in specific national contexts.

Local and tacit knowledge heritage

The conscious planning of conservation, consolidation and restoration interventions requires specific scientific knowledge and experiences, and *local and tacit knowledge* that, at present, is dispersed, unconnected and, for some aspects, lacking.

Insufficient knowledge or in a wrong way managed knowledge is in fact at the base of the technical risk (planning and execution errors), of uncertainties in the activities of the architectonical heritage conservation and of perceived reliability of the vernacular (pre-industrial) technology between the possible customers. The uncertainty conditions are still more emphasized in the field of earthen constructions because they use a "poor" material from a mechanical point of view and above all they are characterized by extremely variable constructive techniques; therefore it is fundamental to develop a collaborative system of knowledge management, essential for the definition of the decisional processes to be placed at the base of the conservation activities, in order to reduce the risk of planning errors.

The pre-industrial constructive systems are based on a proper organization of the building process that must be rediscovered in each of the local declinations for understanding the effective possibilities of a rigorous operative way

(respecting its peculiarities). Today, rehabilitating this kind of heritage means, at first, to predispose instruments for the knowledge organization able to describe the object through a reflection about to the linked planning and building processes, identifying and interpreting the "decay" whose diagnosis is a complex operation as referred to a particular constructive case.

Moreover a systematic diagnostic process, enriched through the comparative analysis of several analogous cases, can supply precious indications about the technical "critic aspects" and the" vulnerability" of the object. In the cultural background that is essential to acquire for the success of the research target it is necessary, firstly, to possess the repertory of several constructive techniques, to recover the local technological heritage and to acquire, on scientific bases, the knowledge of the complex behaviour of building material and of the structural elements.

Main scientific references

The Knowledge Management approach

The current approach to Knowledge Management (KM) support in practice entails a combination of several Information Technologies. The process-centred view mainly understands KM as a social communication process which can be improved by various aspects of concurrent management support, by applying consolidated techniques for communication and cooperation. These techniques are important enabling technologies; they form a fundamental part of the necessary technical infrastructure for KM. A KM technique is to capture knowledge from various sources in social and scientific context and make it available for different tasks at hand.

The applications of Information Technology to Knowledge Management are specialized on computer based application, aiming at an efficient and flexible modelling of production processes and products, can be easily available and adapted to diagnostic process in the conservation of the Vernacular Architecture.

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MICROTREMOR: FROM THE CONTAINER TO THE CONTENTS

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We present results from a seismic vulnerability assessment study on the Basilica of the Holy Sepulchre in Jerusalem. The study was conducted, by the Centro di Ateneo per i Beni Culturali (CABEC) of the Università degli Studi di Firenze and the Prato Ricerche Foundation, on behalf of the Franciscan Custody of the Holy Land.

The monumental church, about 1700 years old, is formed by a series of architectural works built at different times, with different design solutions and heterogeneous materials.

The seismic vulnerability assessment of a such complex construction requires the knowledge of regional and local seismicity integrated by the study of geological and stratigraphical features in order to evaluate the local seismic response. This was investigated with instrumental, single-station seismic noise acquisition processed with HVSR approach, which allowed to obtain the natural frequency of oscillation of the foundation soils. This type of instrumental analysis has been extended to the whole building in order to assess the presence of double resonance phenomena of land / building and to obtain a modal instrumental support for subsequent engineering analysis. Finally, the same measurements were used to derive the longitudinal and transverse sections through the cathedral at points of particular archaeological interest allowing the reconstruction of seismic stratigraphy based on the different impedance of the buried layers.

It must be noted, however, that buildings of historical and cultural significance may contain artistic heritage of inestimable value, for which there is no assessment of their effective vulnerability related to how they are displayed or stored. Just consider the case of statues and ceramics placed on pedestals, not equipped with any insulation system capable of mitigating the oscillations induced by possible earthquakes.

Future development of this work will therefore go beyond the assessment of the structural vulnerability of the edifice, focusing instead on the effective vulnerability of the goods therein contained.

CRITERIA FOR THE USE OF COMPOSITE MATERIALS IN THE CONSOLIDATION OF HISTORICAL HERITAGE

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Safeguarding the world's historic buildings requires defining appropriate methodologies for their restoration and consolidation. In defining such methodologies, it is important to comply with two different demands:

1. the structural safety, including seismic hazard

2. the respect for the original construction, from both an aesthetic and a structural perspective.

With regard to the many issues associated with the maintenance and restoration of historic buildings, the interest of workers in this field has become increasingly devoted to the development of innovative materials and advanced technologies. The composite materials most often used in the fields of civil engineering and restoration are FRP (Fiber Reinforced Polymers).

FRP composites highlighted some deficiencies related to high temperature, humidity, brittle collapse mechanisms (with delamination) and to the loss of transpiration (that is an important requirement for all the historical buildings). We cannot renounce to such particular and innovative materials in restoration of ancient buildings, but we need to individuate the appropriate material for each intervention, because historical heritage shows a lot of different constructive techniques we have to refer to.

In our research we came across study cases with real peculiarities, as:

Medieval cathedral (XII century, S. Leo, Italy), made by stone and lime mortar

The Noh Gumbad mosque in Balkh (VIII century, Afghanistan), made by raw and baked bricks, and by a gypsum or mud mortar

Some remarkable earthen buildings, as the Syrian villages with their domed roofs, or the Morocco's sugar ancient refinery (XIV century)

All these buildings exhibit several weakness and need intervention focused to their specific structural identity. With this aim we studied different composite materials; they can be identified by the composition of the matrix and by the fiber reinforcement type. Matrix appropriate for ancient masonry buildings need to be compatible with old binders and aggregates, so cement, lime, gypsum, pozzolana, clay etc. made matrix can be taken into account. Since these new materials are offered also the reinforcement must be adapted to them and therefore the choice of nets is necessary, instead of strips, since only the nets have the possibility to establish a hookup with these matrices. Among nets types it will be possible to evaluate the use of nets in innovative materials such as carbon, glass, basalt, but also in humble materials (adjusted to buildings on earth, for example) such as coco, jute and plastic .

Thanks to the aforesaid reasons each of the above cases has required a specific solution (Fig.1):

1) for the medieval Cathedral in S. Leo, exposed to seismic actions, a special made cement matrix with carbon net was employed (a good flexibility of the reinforcement mesh was required too)

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2) for the Afghan mosque, where a big arches system needed to be consolidated, it is now subjected to a campaign of experimental tests a solution with gypsum matrix and glass fiber net suitable, perhaps, to be integrated with the gypsum binder;

3) for earthen buildings strengthening the only conceivable matrix material is the earth itself. Consequently an experimental campaign was carried out, on in-scale models, in order to verify the effectiveness of such matrix, associated with natural poor nets, made of coco or jute, appropriate to social and technological contexts where earth is employed.

Our final purpose is to define criteria in order to carry out consolidation strategies appropriate to historical heritage.
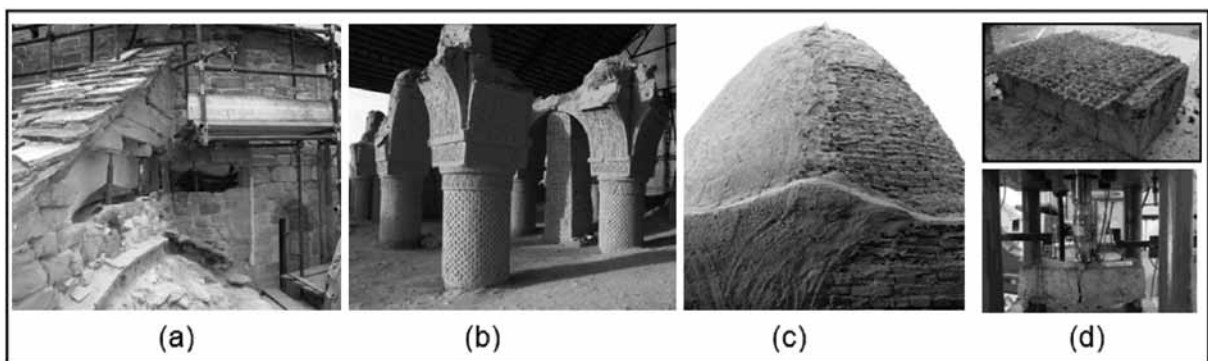

Fig. 1: (a) Cathedral of S.Leo; (b) Noh Gumbad mosque; (c) Syrian dome model; (d) Tests on natural net in earthen matrix.

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COMBINING ONTOLOGIES AND SOCIAL NETWORKING IN THE COLLECTION OF CULTURAL HERITAGE INFORMATION RESOURCES

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An ontology is a formal specification of some conceptual domain. This couples an intensional part made of abstract concepts and relationships with an extensional part made of concrete individuals. This provides a means to associate concrete individuals with an intended meaning that derives from that of the concepts that they realize.

The ontology abstraction has been largely investigated in different perspectives, including Philosophy, Logics, and Artificial Intelligence, as a way to characterize the semantics of a domain and make it amenable to automated reasoning. In particular, this provides a means to share an explicit and agreed interpretation on the meaning of a collection of information resources.

The results of the Semantic Web Initiative have now made available a full-fledged system of standards and components off-the-shelf that enable practical implementation of the principles of ontological representation and reasoning. This includes languages for the representation of ontologies (OWL/RDF) and rules (SWRL), languages for the expression of queries (SPARQL), a variety of (more or less) mature tools for automated reasoning (e.g. Pellet, Sesame, Mulgara).

Moreover, various Application Programming Interfaces (e.g. Jena) enable the integration of all these components into web applications combining representation and processing capabilities provided by ontologies and programming languages, respectively. This combination, that technically gives raise to a so-called Reflection architectural pattern, provides a number of relevant advantages with respect to web applications developed according to more conventional software architectures and based on relational archives. In particular, this opens the way to the construction of repositories where information resources can be effectively indexed, searched and displayed in a way that explicitly reflects their intended meaning.

Various applications have been reported exploiting this capability in repositories that collect information resources pertaining to cultural heritage. These have been used either to organize one or more existing collections of resources, or to drive the collection of new resources contributed by external participants.

As a common trait, most of these applications rely on predefined ontological models. This separates the role of a central administrator of the repository which manages the intensional layer, from the role of distributed participants which can contribute concrete individuals but cannot change or refine the abstract concepts used to index resources. While facilitating an ordered accumulation of information, this separation limits the applicability of the approach in the construction of distributed communities based on the emerging principles of social networking. In this case, a major requirement for the success of the social mechanism is that participants feel "in control" of the evolution of their own network. In particular, this means that the community shall be enabled to refine its own way of characterizing the semantics of the domain. This may possibly result in multiple different ontologies addressing different

aspects or areas of the cultural heritage domain, or even in multiple ontologies providing different conceptualizations for the same resources. By leveraging on native capabilities of ontologies, these indexing structures can then be composed and even reconciliated, or they can be put in competition in a complex game leading most popular or best fitting solutions to emerge.

In the presentation, we recall the basic principles of ontological modeling and briefly outline the existing technological platform that supports their actual practice. We then outline the way how this can be finalized to the construction of a variety of autonomous yet consistent repositories, and we discuss how this can become the linchpin for the aggregation of one or more communities applying social networking mechanisms in the construction of a repository of information resources. We finally discuss how this can specifically fit in the context of cultural heritage.

Enrico Vicario received the master degree in Electronics Engineering (cum laude) and the Ph.D. in Computer and Telecommunications Engineering at the University of Florence in 1990 and 1994. Since 2001, he is a Full Professor of computer engineering at the University of Florence. He is a member of the Dept. of Sistemi e Informatica and a member of the scientific committee of the Excellence Center for Media Integration and Communication of the University of Florence, and a member of the Inn-Link-S interdisciplinary center. His research focuses on Software Engineering, with two different main lines of activity on the theme of formal methods for correctness verification, quantitative evaluation of dependability and testing in concurrent real-time systems, and on the theme of development methods, design and software architectures. In the past, until 2000, he focused a large part of its scientific activity on visual languages and formalisms, content modelling and search by similarity in image archives.

THE ROLE OF GEOMATICS IN SAFEGUARDING CULTURAL HERITAGE

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Cultural Heritage is formed by all material and immaterial evidence of the cultural identity of a population. The safeguard of all "objects" of Cultural Heritage requires a structural digital recording that will enable - besides its transmission to the future - its utilization by the society and for scientific analysis. This can only be achieved through the development of a Cultural Heritage Management Information System [CHMIS] for Europe. Provided that the elements/ objects of material/tangible and immaterial/intangible Cultural Heritage are associated with a specific geographic location or area, it is indispensable to identify and establish this "object to space relationship" as a basic component of the CHMIS. The inherent spatial characteristics of the elements of the CH are not the only reason for the inclusion of spatial information in the development of such a system. The fact that the elements of CH have been influenced by the geographic environment they were developed in, is an additional reason why space should be the overarching characteristic of the CHMIS.

Until recently the trend has been to record individually monuments and other objects of CH. It is now the right time to make a step forward with the development of the integrated CHMIS. In order to justify the reasoning behind such a proposal there is a need to elaborate on the basic ways of utilization of the CHMIS by both the laymen and the scientists. Nowadays the average citizen uses a cellular phone or computing device that is equipped with both positioning and wireless communication capabilities. These two basic characteristics will enable people to utilize the CHMIS to get any kind/form of information concerning the CH of an area utilizing context aware environments that are already available in the market or as "virtual visitors" through the Internet. For the researcher, the CHMIS will offer a wealth of spatial and non-spatial information that will contribute to the analysis of the role of the environment, the landscape, the geographic distribution of the population at a specific point in time and the other factors in the creation of the cultural characteristics of a specific area, how they were developed in the course of the time, why some of them prevailed and others did not, which were the interdependencies and interactions among the objects of CH and their inherent characteristics etc.

Geographic Information Science and the tools (H/W & S/W) associated with it along with Information Technology offer a multitude of solutions for both the digital recording of CH objects and their subsequent inclusion in the CHMIS. The approaches for the digital recording and organization of tangible and intangible CH elements and their spatial and social influences and relationships throughout the ages are different and they depend on the nature and the scale of each element. It is necessary to identify here the general categories of CH elements that must be included in the CHMIS: two–dimensional and three-dimensional monuments, early maps, globes and atlases, literature, music, social and financial information etc. Each one of them requires a specific methodology for its digital recording (geometry and semantics) paving the way for the utilization of all the fields constituting Geographic Information Science: Cartography, Photogrammetry, Remote Sensing, Satellite and Terrestrial Geodesy, Analytical Geography along with the other disciplines associated with the field.

It must be emphasized that the problem is not only the individual approaches/techniques, which will be utilized for the digital recording of the CH objects but the need for the creation of an interoperable environment in the framework of the CHMIS. Interoperability cannot be achieved without the adoption of international standards covering all the processes involved in the recording and organization of the CH objects within the CHMIS. However, there are no clear standards for those wishing to perform the documentation of tangible or intangible CH objects. This lack of complete standards and guidelines should be remedied in a way or another, mainly by pan European and international agreements. Some individual initiatives like the international standard (ISO 21127:2006) for the controlled exchange of cultural heritage information have been recorded so far, but with no wide acceptance. The European Union - EU can play an important role at the European level in that it can set as a pre-condition for funding CH projects that international standards must be met. Theoretically, it can initiate, implement and also provide an infrastructure in this area as well as set an example for monitoring the quality of the results. Examples here are the ongoing EU Networks of Excellence in CH. These programs run only for a specific period of time and some of the results remain within the consortiums. It would be possible with the adoption and implementation of international standards that results from these projects would be available everywhere at anytime though the Web. UNESCO can also offer a great contribution in this area. It can cooperate with the EU for the adoption of the standards and have them implemented in all member countries in the area of CH. It will be then possible to conceptualize a world data base, which is an indispensable part of the CHMIS, having a uniform format/data structure and guidelines for the documentation of different CH objects/monuments/sites. With this initiative a world CH website can be created "using a common albeit technological language" accessible by the universal public.

For the geographical data the EU has adopted the INSPIRE directive (INSPIRE, 2007) in order to standardize their collection, storage and dissemination through the creation of the Spatial Data Infrastructure. This will enable the sharing of environmental spatial information among organizations horizontally and vertically and better facilitate public access to spatial information across the EU. It is time that the EU adopt a similar directive for the CH heritage. This will enable the digital recording of the CH objects in a consistent and interoperable way and the incorporation of the recorded elements into the dynamic environment of the CHMIS. The implementation of the CHMIS will not only safeguard CH at a European level but it act as the reference for new and emerging areas of Geographic Information Science such as "Spiritual Geoinformatics" (Georgopoulos et al., 2008), "Literary Geography" (Piatti et al., 2008), "Phycho Geography" and "Affective Cartography" (Iturrioz Aguirre, et al., 2009).

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SAFEGUARDING THE SIGNIFICANCE AND INTEGRITY OF ARCHITECTURAL HERITAGE: THE ROLE OF RECORDING, DOCUMENTATION AND INFORMATION SYSTEMS

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A holistic approach in understanding the significance is essential for safeguarding cultural Heritage properties; equally important is the appropriate assessment of their "state of conservation taking into consideration the potential degree of vulnerability to cumulative and/or drastic risk/threats to their integrity. As evidenced in the most recent events, heritage places are constantly threated by environmental calamities (earthquakes, tsunamis, inundations, etc), and indiscriminative development of infrastructure. As well as, armed conflicts, weathering, and pure vandalism.

This paper will provide an overview of concepts and practice of recording, documentation and information management tools in compiling "baseline records" that contain information aimed at the protection, management and monitoring of change (threats/hazards) in heritage places.

Introduction

According to Clark, "Understanding the physical fabric of a site is an important first step in finding the right conservation strategy, and documentation is the first step in understanding."[1] Documentation can serve multiple challenges in the study and protection of cultural heritage, such as the creation of a permanent record, which is passed on from generation to generation and can be available in case of destruction and/or alterations in the heritage's significance and integrity.

Furthermore, a record can be used for promotion leading to participation, increasing the knowledge about a heritage place. It can be a tool for promoting the participation of society in its conservation, a tool for 'cultural tourism and regional development'[2].

Moreover, increasing the knowledge of the relevant heritage places in a region can lead to its inclusion in inventories and other legal instruments that can eventually prevent its destruction and helps in combating 'the theft of and illicit in cultural property on a global scale'[2].

In this context, the ICOMOS International Scientific Committee on Heritage documentation (CIPA) has endeavored over 40 years to organize venues for reflection, exchange and dissemination of research and projects in the field of documentation of cultural heritage. The contribution to the field has been substantial and can be consulted on http://cipa.icomos.org (last accessed 20/05/2011).

Making "Baseline records" for conservation

A "baseline record" is the product of any recording and documenting project when studying heritage places. The structure, specification (metadata), quality and extend of this 'record' should follow international recognize standards and should provide relevant, timely and sufficient information to protect it.

This presentation illustrates the preparation of "baseline records" using two first hand case studies developed at the R. Lemaire International Centre for Conservation (University of Leuven) in collaboration with UNESCO at the World heritage properties of Baalbek (Lebanon) and Petra (Jordan).

In the case of Baalbek, the most sophisticated surveying techniques have been used in order to correctly captures the "geometric configuration" of architectural heritage's fabric. This can effectively serve as a "base line record" for the detection of changes over time that potentially threat the heritage integrity addressed by the "Outstanding Universal Criteria(s)" for which this important site has been recognize by UNESCO's World Heritage Committee. While in Petra "rapid-assessment" techniques have been used for understanding threats to the core zone of the property. In both cases "Risk Preparedness" approach has been developed.

Closing remarks

Information is required to be timely, relevant and precise. It should provide a "clear understanding" of the fabric's condition and materials, as well as, the property's chronology of modifications and alternations over its extended lifespan. Therefore, documenting and recording these issues, along with assessing the degree and type of "risks" is an essential part of the property's understanding, conservation and management.

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. With these new opportunities, there are also conflicts, and an intense effort to build digital media into the education of conservation professionals.

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DIGITAL 3D RECORDING FOR HERITAGE DOCUMENTATION AND PRESERVATION – LATEST DEVELOPMENTS AND PERSPECTIVES

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Introduction

The 3D recording and creation of digital models of visual heritage and archaeological objects or sites requires a powerful methodology able to capture and digitally model the fine geometric and appearance details of such sites. The importance of landscape and heritage 3D recording and documentation with optical remote sensing sensors is well recognized at international level. Digital surveying, documentation and preservation are demanded as our heritages (natural, cultural or mixed) suffer from on-going attritions and wars, natural disasters, climate changes and human negligence. In particular the built environment and natural heritage have received a lot of attention and benefits from the recent advances of range sensors and imaging devices. Nowadays 3D data are a critical component to permanently record the form of important objects and sites so that, in digital form at least, they might be passed down to future generations. This has generated in the last decade a large number of projects, mainly lead by research groups, which have realized very good quality and complete digital models (Levoy *et al.*, 2000; Gruen *et al.*, 2004; El-Hakim *et al.*, 2008; Guidi *et al.*, 2009). Indeed remote sensing technologies and methodologies for Cultural Heritage 3D documentation and modelling (Remondino, 2011) allow the generation of very realistic 3D results (in terms of geometric and radiometric accuracy) that can be used for many purposes, such as historical documentation, digital preservation and conservation, cross-comparisons, monitoring of shape and colours, simulation of aging and deterioration, virtual reality/computer graphics applications, 3D repositories and catalogues, web-based geographic systems, computer-aided restoration, multimedia museum exhibitions, visualization and so on. But despite all these potential applications and the constant pressure of international heritage organizations, a systematic and targeted use of 3D surveying and modelling in the Cultural Heritage field is still not yet employed as a default approach. And when a 3D model is generated, it is often subsampled or reduced to a 2D drawing due to a lack of software or knowledge in handling properly 3D data by non-expert. However, the availability and use of 3D data open a wide spectrum of further applications and allow new analyses, studies, interpretations, conservation policies or digital restoration. Thus 3D virtual heritages should be more frequently used due to the great advantages that remote sensing technologies and the third dimension offer to the heritage world but also to recognize the digital documentation and preservation needs stated in numerous international charters and resolutions. But there are still some difficulties of communications between the geomatics/surveying people and the heritage community. New technologies and new hardware are increasing the quality of the produced 3D models with the purpose of attracting new people into the 3D world. Many companies entered inside this market developing and employing software and survey systems with good potentialities and often very impressive results. Thus if from one hand the number of 3D products and software is huge and the cost of these technologies is slowly reducing, on the other hand it's difficult, in particular for non-specialists,

to select the right product due to a lack of standard terminologies, specifications and performance benchmarking. Thus the communication with the experts is still very fundamental.

Optical active and passive sensors and data processing methodologies

3D recording can be performed with active or passive sensors. The acquired unstructured 3D information ('point clouds') must be then converted into structured data through geometric and appearance modeling. Geometric modeling deals with the data registration and processing (editing, cleaning, meshing), while appearance modeling deals with texturing, blending, rendering simplification and LOD.

Optical range sensors like pulsed (Time-of-Flight), phase-shift and triangulation-based (light sheet or pattern projection) active instruments (Vosselman and Maas, 2010) have received in the last years a great attention, also from non-experts, for 3D surveying and modeling purposes. Range sensors directly record the 3D geometry of surfaces, producing quantitative 3D digital representations (point clouds or range maps) in a given field of view with a defined measurement uncertainty. Range sensors are nowadays quite common in the surveying community and heritage field, despite their high costs, weight and the usual lack of good texture. There is often a misused of such sensors simply because they deliver immediately 3D point clouds neglecting the huge amount of work to be done in post-processing for the creation of a geometrically detailed and textured 3D polygonal model.

On the other hand, passive optical sensors (like digital cameras) provide for image data which require a mathematical formulation to transform the 2D image features into 3D information. At least two images are generally required and 3D data can be derived using perspective or projective geometry formulations. Image-based modeling techniques, mainly photogrammetry and computer vision, are generally preferred in case of lost objects, simple monuments or architectures with regular geometric shapes, small objects with free-form shape, point-based deformation analyses, low budget terrestrial projects, good experience of the working team and time or location constraints for the data acquisition. The latest development in automated 3D recording from images are promising (Hirschmuller, 2008; Vu *et al.*, 2009; Furukawa and Ponce, 2010; Pierrot-Deseilligny *et al.*, 2011) but still this kind of approach requires large experience and knowledge if compared to range sensors methodologies.

Despite all the available 3D recording technologies and potentialities, the 3D modeling pipeline has still some problems and challenges in:

(i) selecting the appropriate methodology (sensor, hardware, software) and data processing procedure;

(ii) designing the proper production workflow, guaranteeing that the final result is in accordance with all the given technical specifications;

(iii) speeding up the data processing time with as much automation as possible but always with metrics and accuracy as primary goals;

(iv) being able to fluently display and interact with the achieved 3D model.

Perspectives and conclusions

The article briefly reviewed the actual optical 3D measurements sensors and techniques used for reality-based heritage documentation and 3D modeling. The last years of applications made clear that reality-based 3D models are very useful in many fields but the related processing pipeline is still far from being optimal, with possible improvements and open research issues in many steps. At present different research solution and commercial packages have turned towards semi-automated (interactive) approaches, where the human capacity in data interpretation is paired with the speed and precision of computer algorithms. Indeed the success of fully automation in image un-

derstanding or 3D point clouds processing depends on many factors and is still a hot topic of research. The progresses in automation are promising but the acceptance of fully automated procedures, judged in terms of handled datasets and accuracy of the final 3D results, depends on the quality specifications of the user and final use of the produced 3D data. A good level of automation would make also possible the development of new tools for non-expert users. Beside data processing, data collection finds its best solution in the sensor fusion approach which experimentally demonstrated to be useful for collecting as many features as possible, allowing the exploitation of each range sensing technology capability. Currently available packages allows the creation of different geometric levels of detail (LoD) at model level (i.e. at the end of the modeling pipeline), while this should be performed also at data-level with the development of novel packages capable to deal simultaneously with different sensors and data. Such novel feature should allow also to include new sensors and 3D data in the processing pipeline taking into account their metrological characteristics.
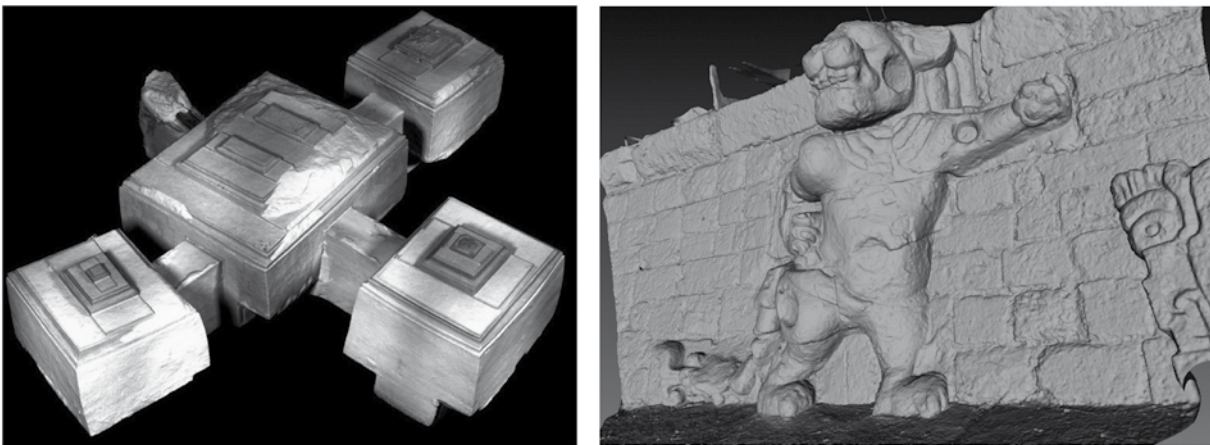

Fig. 1: Examples of reality-based image- and range-based 3D models of heritage sites.

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MULTIMEDIA TECHNOLOGIES FOR CULTURAL HERITAGE

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Digital cultural heritage is growing rapidly in importance. Digital collections have becoming available for use from interested amateurs to collection administrators, from university researchers to cultural entrepreneurs. New methods and techniques for using the digital sources and for presenting them are now possible thanks to the advancements of research in Information Technology and particulaly in Multimedia. Interoperability of large-scale and distributed sources, community-based solutions for data integration and data enrichment, automatic annotation of digital media for accessing large digital libraries, visualisation and simulation, natural interactivity … are just some of the most recent and important ones.

Research in social-economic history, historical inguistics, art history and archaeology.. is based more and more on large, internationally accessible, unlocked data collections. Progress in *pattern recognition* and *information retrieval* promises to relieve professionals of the effort of semantic annotation of digital media and provide users with more effective retrieval facilities in music, image and video databases by exploiting content similarity. Invisible layers of heritage objects can be made visible with new possibilities for observation and analysis. And new multimodal interactions with the objects will be allowed to visitors spawning new experiences and enhanced affective appraisals.

Under the influence of such social and technological changes, cultural institutions find themselves confronted with an environment in which the current work methods, collaboration possibilities and organisational forms no longer provide satisfactory answers. Testing the usability of the research results in this outline is therefore becoming one of the primary challenges of the present days.

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MARE NOSTRUM: A HERITAGE TRAIL ALONG THE PHOENICIAN MARITIME ROUTES AND HISTORIC PORT-CITIES OF THE MEDITERRANEAN SEA

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

Introduction

Six Mediterranean countries are participating in the "Mare Nostrum" project: "A Heritage Trail along the Phoenician maritime routes and through the historic port cities"[1]; the goal of this project is to valorize the cultural heritage of the sites involved by promoting and supporting sustainable tourism. WP4 concentrates on the port cities of Tyre and Tartous, chosen as pilot sites. The on site research was conducted in accordance with the WP4 objectives: on the one hand a survey campaign was set up to acquire metric and qualitative data on the structures chosen as samples; on the other hand an enormous amount of photographic and video documentation was collected for the 3D models that were produced in the first phase. The paper will describe how the disciplines involved in Geomatics can provide important contributions to all four phases of the Heritage and Development framework.

The Contribution of Geomatics

The contribution of geomatics does not only consist in the application of the latest information technology procedures but creates a new methodological behavior within the data acquisition and management process. Geomatic techniques can play a central role because they provide innovative and more complete ways of describing reality which, in their turn, allow approaches at different levels:

1. Geomatic techniques can manage enormous quantities of data relating to a single geographic location but generated at different times;

2. Extra features can be added to the representation field during the research phase using processing to reconstruct modifications that have taken place over time;

3. Georeferencing of data makes possible to lin the existing relationship between cultural heritage objects;

4. The knowledge acquired can be widely disseminated on-line;

5. The information can also be transferred to external databases and web sites.

To sum up, the research for this project uses geomatic techniques to propose innovative ways of using case studies, allowing diverse analogous elements (the port cities linked to each other in the Phoenician commercial maritime routes system) to be considered simultaneously. In this sense it is possible to propose hypotheses for valorizing these heritage objects which take into account a series of conditions such as accessibility, current transformations within the area, relations between the more important monuments which profoundly effect their use.

On the one hand the acquisition and manipulation of data for studying and conserving sites: preparing geometric

and thematic surveys, setting up maintenance programmes and simulating models for predicting the impact of the tourist flow. On the other a powerful tool for communication. To provide the cultural heritage with such a powerful system for learning, enriched by information technologies, is certainly a first step towards a better understanding of the sites and an essential step towards their appropriate valorization.

Goals and Methodological Choices

The on site research was conducted in accordance with the WP4 objectives: on the one hand a survey campaign was set up to acquire metric and qualitative data on the structures chosen as samples; this provided the necessary information for the systematic analysis (chronological phases, construction techniques, state of preservation) required for preparing conservation guidelines; on the other hand an enormous amount of photographic and video documentation was collected for the 3D models that were produced in the first phase; this documentation is being used for multimedia popularization and communication of the most interesting sites: architectural heritage, landscape and archaeological sites. (Guarnieri *et al.*, 2004)

In particular: integrated topographic and laser scanning techniques were used to provide a metric survey of the part of Tartous and Tyre; the most interesting parts of Tartous and Tyre was photographed for modelling for communication projects (virtual tours, integrated video and multimedia products). (Fig. 1).

Fig.1: 2D image of the total points model of the Knights' Chapel in the old city of Tartous, Syria
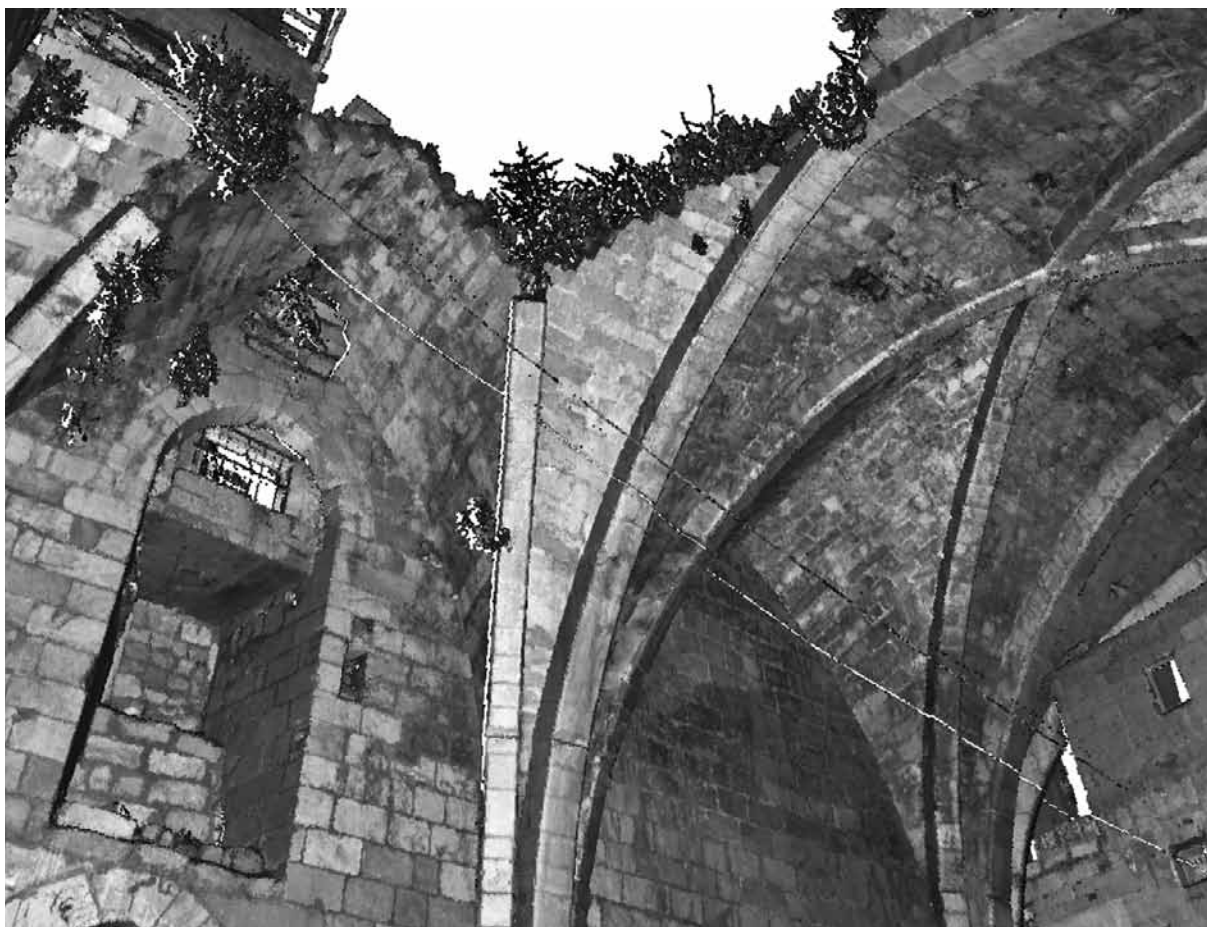
Results

The total points model is an extremely versatile 3D database as it allows graphic output to be modified to meet specific requirements. The following information can be obtained from the range maps: plans, elevations and vertical sections; 2D images of the range map; 3D static and dynamic digital models. Further information can be obtained from the photographic archive: spherical panoramas; high resolution image mosaics; digital stereo images. (Houtarib, 2004)

Repeated elaboration of the data collected makes it possible to extract a wide range of graphic output whose complexity and articulation depends on the goal desired and to experiment ways of representing this output that have enormous communication potential: 3D digital modelling as a method for checking the historical reconstruction; 3D and kinetic digital modelling as a tool for understanding and for education and communication; 3D digital modelling for representing morphological transformations.

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EXPERIENCES OF NATURAL HERITAGE 3D SURVEYING AND PHYSICAL REPRODUCTION

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3D scanning for art work

The collaboration between computerized three-dimensional survey technologies and art heritage is now well established in cataloging, preservation and dissemination applications. In this field, GeCo Laboratory has gained significant experience working with many academic institutions and museums.

The three-dimensional scanning techniques are also used in the field of artistic production and sculpture in particular. The most traditional form of this contribution is to support the transition from a maquette, modelled manually, to the finished sculpture. Other artists test instead the creative potential of the new technologies elaborating elements drawn from real world (Ganis 2007).

The last works by the sculptor Fabio Anfossi seek for this way too. After his previous projects, based on the serial reproduction of cast of skulls of endangered animals, preserved in the collection of the Museum of Natural History "La Specola" of the University of Florence, the artist turned to GeCo Laboratory to develop the BlowUpSkulls project. He sought to create accurate large scale skull replicas, starting from the skull of a young *Panthera Pardus*, so GeCo Laboratory designed a 3D model that could allow to get a magnified physical reproduction. Using a triangulation 3D scanner, cranium and mandible was scanned separately, to get complete scans, and toghether, to keep the correct position and kinematics. The point-cloud (with more than 904.000 points) was processed getting a high resolution surface model useful for enlargement. In this case, the interest of the survey was focused more on geometry than on texture, as the model was designed for reproduction with non-realistic materials and finishings.

These urban-scale sculptures, as the author says, are "*able to attract and enthral people's consciousness to nature*".

3D recording of natural history collections

From the perspective of the GeCo Laboratory, this experience is part of a new line of research on the survey of cultural assets of natural origin. About this kind of objects too, 3D images are acknowledged by museum specialists for opening up new technological possibilities both for scholars' research and for exhibition display and education (Lyons *et al.* 2000, Bates *et al.* 2010). In addition to the skulls, there are ongoing projects about the surveys of meteorites and minerals: the findings show a remarkable variety of materials and shapes, and deliver different problems from those faced dealing with artifacts, even if they require high definition and accuracy as well (Smith *et al.* 2005).

Further collaborations are currently being finalized with the Museum of Natural History in Florence in order to apply 3D digitizing systems to some of the important collections hosted by the Museum. Besides natural history collections, the Museum is renowned for its collections of anatomic models, the moulage masterworks by Gaetano Giulio Zumbo and the later works created between XVII and XIX centuries by Clemente Susini and his disciples. Those wax
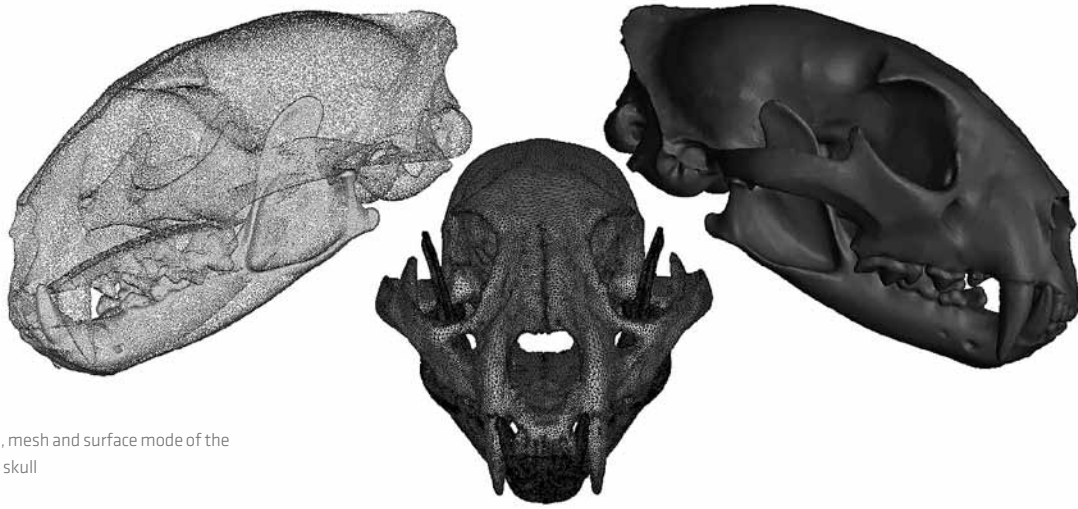
Fig.1: Point cloud, mesh and surface mode of the *Panthera Pardus* skull

models are our legacy of historical three-dimensional realistic representation of natural specimens. Their digitization, on-going in other Museums too (Petronilli 2010), fulfils both the scientific popularization purposes and the acknowledgement of their artistic and cultural relevance. The goal is to maximize the communication and dissemination potential of 3D models, making them accessible online, on-site or through physical replicas.

The need to prepare digital three-dimensional models which might be materialized in large sizes and with various technologies and materials, as with additive reproduction or multi-axis milling procedure, has also called for in-depth research on physical models manufacturing techniques.

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THE 3D DIGITAL CONTENT PRODUCTION FOR VIRTUAL ARCHAEOLOGY: MODELS FOR CONSERVATION ARCHIVES AND MODELS FOR INTERACTIVE EXHIBITIONS

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

Introduction

In the archaeological field, three-dimensional models of findings and of sites are currently employed for several study and communication phases: for descriptive classification, morpho-typological comparative analyses, conservation, hypothetical reconstructions, and for scientific popularization through virtual museums and tours.

Yet, it's still rare to find large assemblages of reliable digital models of medium-small size heritage artifacts for scholars' research and for didactic visualization on interactive interfaces. The issue is to find adequate systems to undertake and achieve this target at reasonable costs and as per standard procedures.

GeCo Lab, within the MUS.INT. project "An interactive museum system design: The virtual museum of the Aegean and Cypriot antiquities collections in Tuscany"[1], during the past year has been testing and fixing workflow guidelines for accurate 3D data acquisition through laser scanner and subsequent processing, based on the vast content implementation of the first exhibition to be planned (Tucci *et al.*, 2011).

This pilot display is indeed focused on the virtual connection of unknown local archaeological collections of findings coming from Eastern Mediterranean and Aegean sites, first of all the one held by the National Archaeological Museum in Florence, which, in spite of their distinguished value in terms of quality and assortment of the repertoire, are usually excluded from physical museographic events.

The 3D digital reproduction process is partially differentiated according to the two main expected applications:

polygonal models for further archaeological research activity maintain the highest resolution, ensuring sub-millimetric accuracy, and, where the laser scanner couldn't measure, the limited but unavoidable missing parts are not complemented with similar interpretative polygonal surfaces;

to be easily and promptly viewed on the virtual display, either on the Web or on multimedial devices, generated models are geometrically simplified, blind spots are compensated with imitative volumetric reintegration and texture "impainting", and photographic texture is edited to remove reflections and mitigate tone variations if produced.

Acquisition and post-processing work-flow

The model reproduction process we tested on the archaeological sets and then defined in detailed guidelines for future applications, can be summarized in the following basic pipeline (Bernardini and Rushmeier, 2002; Guidi *et al.,* 2010; Vrubel *et al.,* 2009): *Survey planning; Data acquisition; Alignment and mesh fusion; Polygonal mesh/texture editing; Mesh simplification; Export in storage formats.*

As well known, the acquisition stage is very short compared to the time necessitated for elaboration of raw data.

Even if it can't be quantified, given so many variables as the type of specific features of the object, the number of views, the expertise of the operator and the hardware potential he's working with, the two main phases are generally in a ratio of 1 to 10 / 15.

Data acquisition

One at a time the selected museums artifacts have been temporarily removed from their glass display cases or the museum storerooms to be placed on the turning base and scanned. To cover the whole object average 20 scans have been captured in approx two hours: half of this time extent is needed to study

and prepare the placing of the artifact in the right perspective and to check every time the scanner's field of view in relation to the rotation of the platform.

Alignment and mesh fusion

All range maps must go through a first screening to remove portions of the rotection materials and of the support on which the object was leaning or standing, and occurrent outliers (Guidi *et al.,* 2010).

Critical is the development of the operator's skills in performing the screening of the raw data through a reasoned trimming action in order to reduce overlapping of single range maps and to choose the best geometric information and RGB color texture available among the data produced automatically by the instrument. This is surely one of the longest and crucial operations of the entire processing procedure and requires persisting testing and comparing vision.

Editing of polygonal mesh and of texture

Volumetric and chromatic reintegration compensating for unavoidable missing parts, yet limited, has not been performed in the highly detailed copy that will be used for scientific purposes. Before being archived, though, the number of triangles of the original mesh may have been partially reduced. A complete mimetic reconstruction has been carried out, instead, for the model which will be viewed in the virtual exhibit applications, in order to give unity and formal adherence to the real object (outside and visible parts of the inside. Fig. 1).

Fig.1: The model of a small greek alabastron, before and after volume and color editing

Mesh simplification

Within the MUS.INT. project, models are being simplified: the version intended to implement the database for archaeology professionals and scholars, which varies from about 1.000.000 polygons the artifact; the versions designed for Web applications will be decimated up to 95% resulting 10.000/5.000 polygons in the end.

Export in storage formats

When the models are ready, files are converted into OBJ and 3DS formats, which define and file geometry and also texture information and are supported by most applications, but likewise could be saved in many other output data configurations.

All fundamental steps of the processing work-flow are recorded and sorted in the project's data archive and backed on hard drive for permanent storage.

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3D SURVEY FOR THE KNOWLEDGE AND CONSERVATION OF THE PRATOLINO PARK

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

Introduction

In 1568 the Grand Duke Francesco I de' Medici started to project the Pratolino Park on the hills near Florence. The Park resulted to be a joint effort between the Grand Duke and the architect and engineer Bernardo Buontalenti, which co-operated with all the most important artists working in Florence in the last part of the XVI century. During fifteen years, they built the Villa, the Park and all the other buildings enclosed in the site: the bizarre inventions as water tricks, sculptures, grottoes and fountains, made the park renowned all over the world.

All those elements were only the visible part of a wide network of waterworks. When those garden ornaments became outdated, the underground water system quickly ruined and sank into oblivion.

In 1981 the Province of Florence bought the Park, badly damaged and where only few original elements survived, and started supporting studies and restorations still in progress. The Park now spreads over more than 1,5 sq km and stands out as a wildlife park, as well as for its history and heritage.

Being open to the public for many recreational and cultural activities too, its preservation and maintenance request a careful management.

The surveys

Recently, thanks to an agreement between the Department of Conservation and Restoration (University of Florence) and the Province of Florence, the Geomatics and Communication Laboratory (GeCo) carries out a project to improve the knowledge of surviving parts as a requirement for their conservation. The project concerns a 3D survey of the main buildings, based on laser scanning and on photogrammetry, spread to surrounding land and environment. Surveys are done with multi-resolution and multi-sensor techniques and are geo-referenced by GNSS.

First studies concerned the Chapel by Buontalenti and the Paggeria (this two buildings were also subject of the workshop that Ge.Co. held during the First Postgraduate Course in "Geomatics for Cultural Heritage Conservation"), the Fountain of Jupiter and the giant statue of the Appennino by Jean de Boulogne. These first case-studies show the wide range of artifacts present in the Park; each one of them requests appropriate techniques for surveying and representation.

The Chapel and the Paggeria are real buildings, even if with really different size and geometry. The plain fronts of the Paggeria could be suitably surveyed by image rectification, but to draw the whole Chapel (a central-plan church covered by a domical vault) was more appropriate to extract two-dimensional drawings from 3D point clouds generated by laser scanner.
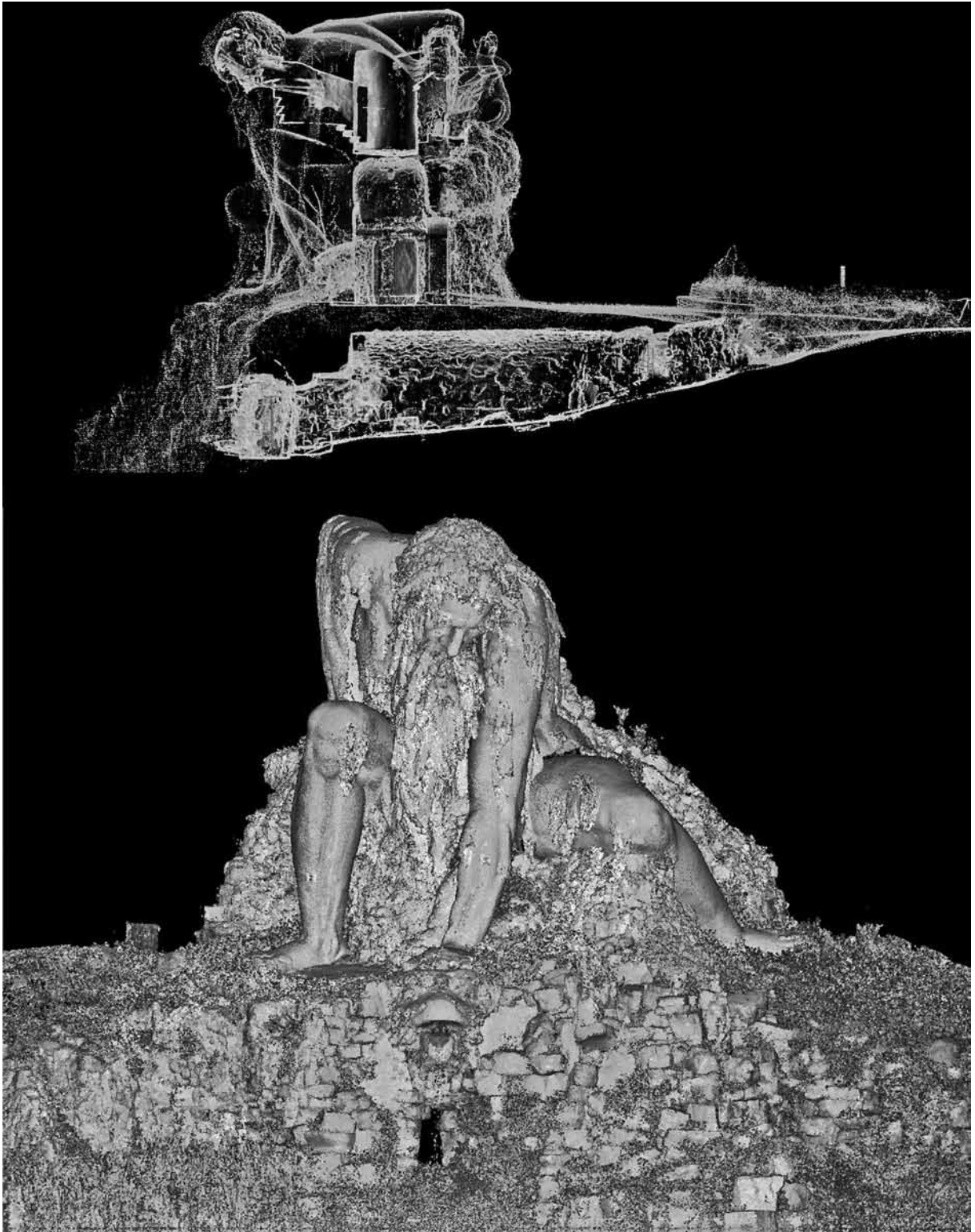
Fig.1: Two views of the point cloud of the Appennino giant statue.

On the other hand, the Fountain of Jupiter and the Appennino statue are complicated artworks made up of natural and artificial elements. Laser scanning was used in these cases too, but 3D modeling was more apt to describe their organic and irregular shapes. In the same time the uneven spaces and rooms into the Appennino statue can be described by two-dimensional plans and sections.

Further developments

Metric data set a database to draw up digital 2D drawings and 3D models. Furthermore, they can outline an overall informative system to relate buildings' geometry with the results coming from previous multi-disciplinary researches on the history of Park and its lost buildings and water plants, as like as on its vegetation, fauna and so on. This can be the framework to connect knowledge and divulgation requirements as well as management to improve the preservation of the Park.

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3D GIS MODELING FOR SAFEGUARD OF CULTURAL HERITAGE

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Several applications in 3D imaging and modeling require the definition of conceptual models, implying knowledge of 3D topologies.

Object modeling allows the widest possible representation of bodies and shapes for further study and analysis. The relations between characteristic elements (points, lines, surfaces and 3D bodies) determine modeling validity: object modeling is an innovative and technologically advanced instrument in order to study spatial phenomena and temporal dynamics. Unfortunately, the use of this instrument is still rare, as it remarkably increases complexity of realization and management of informative systems.

Every object can be described as a conceptual entity, easily defined by means of its data and situation context. The situation context includes a set of operations and methods, valid on the object itself. Its state assumes the values of local variables. Every single object belongs to a class, which defines object type. Thus, spatially referenced objects are identified and described by means of geometric and thematic features. The first formal requirement, in order to construct a formal data structure, is:

every object must be associated to an identifier (name or number);

every identifier must have a link to the attributes of an object.

Further developments in a formal structure for a complex object introduce two types of topological relations:

the former is expressed by graph structure

the latter presents the linkage between geometric elements and thematic ones

Finally, in case of 3D bodies modeling, it is necessary to establish a cross - connection table between edges and faces (or characteristic lines and surfaces), so that a topological linkage between primary graphs and dual graphs is present. In fact, while this linkage is directly defined by the edges in the planar graphs, primary and dual spatial graphs are completely separated.

Structure of vector data in a 3D space can be represented with linear approximation using the polyhedrons, polygon, segments and points. Therefore, topologic relations between elements in a 3D space show:

a point with a relation "*one – n*" with segments, polygons and polyhedrons

a segment with a relation "*one – two*" with points, and "*one – n*" with polygons and polyhedrons

a polygon with a relation "*one – n*" with points and segments, "*one – two*" with polyhedrons

a polyhedron with relation "*one – n*" with points, segments and polygons

In fact, a polyhedron is close to a surface made by polygons, delimitated by segments, each of them with a start and an end in a point. A polygon is delimitated by segments, but it only has one polyhedron on the right and only one on the left. A segment can be common to lots of polygons (and lots of polyhedrons), but it has its start and its end in a

point. A point could belong to the surfaces of different polyhedrons, or be the common node to different polygons and different segments.

Using the graph theory, the concept of nodes and arcs can be used and directly connected to points and segments. In other way, using the concept of duality, it is possible to connect polyhedrons to nodes (dual) and polygons to arcs (dual). Cross – connection table shows the *m-n* relations among the segments and polygons, providing: the set of segments, which delimited a polygon, and the set of polygons, which have the segment in common. Indeed, each polygon builds the faces of a diedric angle with same common segment.

Using this object-oriented approach, geometric structures with different complexity can be described by objects belonging to suitable classes of features. Complete complex objects have mutual relations within space, where they are located.

Study on topological and geometric relations among primary elements and groups of symmetries shows curious identities between number of found relations and cardinality of symmetry groups. In fact, as 7 are the topological relations in one dimension, as many are the elements of the group of liner symmetries, which have one single translation direction. The same analogy is evident in two dimensions where, in correspondence to 17 topological relations, an identical number of elements forms the group of symmetries in the plan, considering two translation directions. Again, to the 32 topological relations in three dimensions, correspond the elements of the group of symmetries in 3D space, considering three translation directions and crystallographic restriction.

Furthermore, considering the main geometric relations:

10 (number of elements in the monodimensional case) corresponds to the elements number in the group of plan symmetries, considering the crystallographic restriction

32 (number of elements in the bidimensional case) corresponds to the elements number in the group of 3D space symmetries, again considering the crystallographic restriction

230 (number of elements in the three-dimensional case) corresponds to the elements number in the group of 3D space symmetries, without any restriction

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The present paper constitutes an extended version of: Mussio, L. & Poli, D. & Pozzoli, A. 2005, *Symmetries and Topology for the Definition of Conceptual Models* (In: *3D Digital Imaging and Modeling Applications of: Heritage, Industry, Medicine & Land*, A. Vettore (Ed), AGRIPOLIS, Padua, S1_8 p. 8), where a real example is added to the proposed methodologies and procedures.

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THE SPHERICAL PHOTOGRAMMETRY FOR CULTURAL HERITAGE

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It is well known that the Cultural heritage are high risk they disappear at a higher rate than that with which they can be documented. The Multi-image Spherical Photogrammetry is a photogrammetric technique set up by the A. and particularly suitable for close-range surveys and cultural heritage, using as imagery the so-called spherical panorama, obtained by stitching several images taken from the same point. This technique is normally used to produce quick time movies that are already very useful for the documentation of cultural heritage. One panorama can replace many normal photographic takings. It is a kind of ideal (pseudo)image: very large resolution, FOV up to 360°, no distortion, being estimated and corrected by the stitching software. Ease, rapidity, low cost, and completeness of the documentation are the main advantages of this technique. Few distances are sufficient to get the correct size of the model. Several examples of survey confirmed the quality of the technique. The restitution can be combined with non-metric images such as archive photographs. The only limitation derives from the lack of stereoscopy. We experimented the back-projection of the oriented panoramas over the rough model to edit, improve, correct the model up to the best fitting with the projected panoramas. The panoramas produced with narrow lens have large resolution but geometrical instability, whilst wide angle lens panorama have low resolution, but good geometric stability, ease to be oriented; to take advantage of both types of panoramas, it is convenient from the same point to take both of types.

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THE SURVEY OF THE DOME OF THE BASILICA OF SAN VITALE IN RAVENNA

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Introduction

The aim of this research is to study in depth the geometry of the Basilica of San Vitale in Ravenna to obtain more information for a conservative project of this monument, which is one of the most representative buildings of the VI Century AD and whose mosaics are inscribed on the UNESCO list.

The dome: description of constructive elements

The dome covering the central octagon of the Basilica of San Vitale in Ravenna, built, according to historians, by Justinian I in Ravenna in 547/548, is sustained by eight internal piers and is bonded with the octagonal drum by semicircular niches as pendentives.

The drum is assembled, except for the upper fifty centimeters probably built in the XVIII Cent., with the same brick work of the walls of all main vertical structures of the basilica, and with brick and mortar joints with the same thickness (almost 4 cm) (Mirabella Roberti *et al.,* 1995, Deichmann, 1969) .

The dome structure is built with clay tubes, arranged in concentric rings sloping down towards the top where there is an hole of almost 15 cm of diameter.

The clay tubes are shaped as syringes and have a rough surface. Their dimensions, as was surveyed, are, approximately: length 14 cm and 6 cm of appendix, with a diameter of 5 cm. (Baronio *et al.,* 1997, Lombardini, 1997)

Recent surveys

Topographic survey

The dome has been the subject of a topographic survey carried out in 1993/94 by the Polythecnic of Milan (Eng. Guzzetti). Measurements on the intrados surface were taken from a network vertex located in the center of the basilica, while for the extrados measurements were taken from 5 vertices in the attic. Since some areas were not accessible, the survey of the external surface of the dome is not complete.

3D scanning survey

The present study wants to investigate the actual dome thickness with its complete survey, which can offer more details on the structure and explain the constructive system employed for building the circular plant of the dome on the octagonal plant of the church and its features to support historical research.

The work here presented meets the need to coordinate in a unified system all spatial information on the dome. The choice of using 3D scanning systems is related to their ability to make a higher sampling of the space than traditional topographic instruments, so this technique offers the possibility to deepen the studies already undertaken. The choice of this technique has made possible to display a full 3D model, which can be explored in portions.
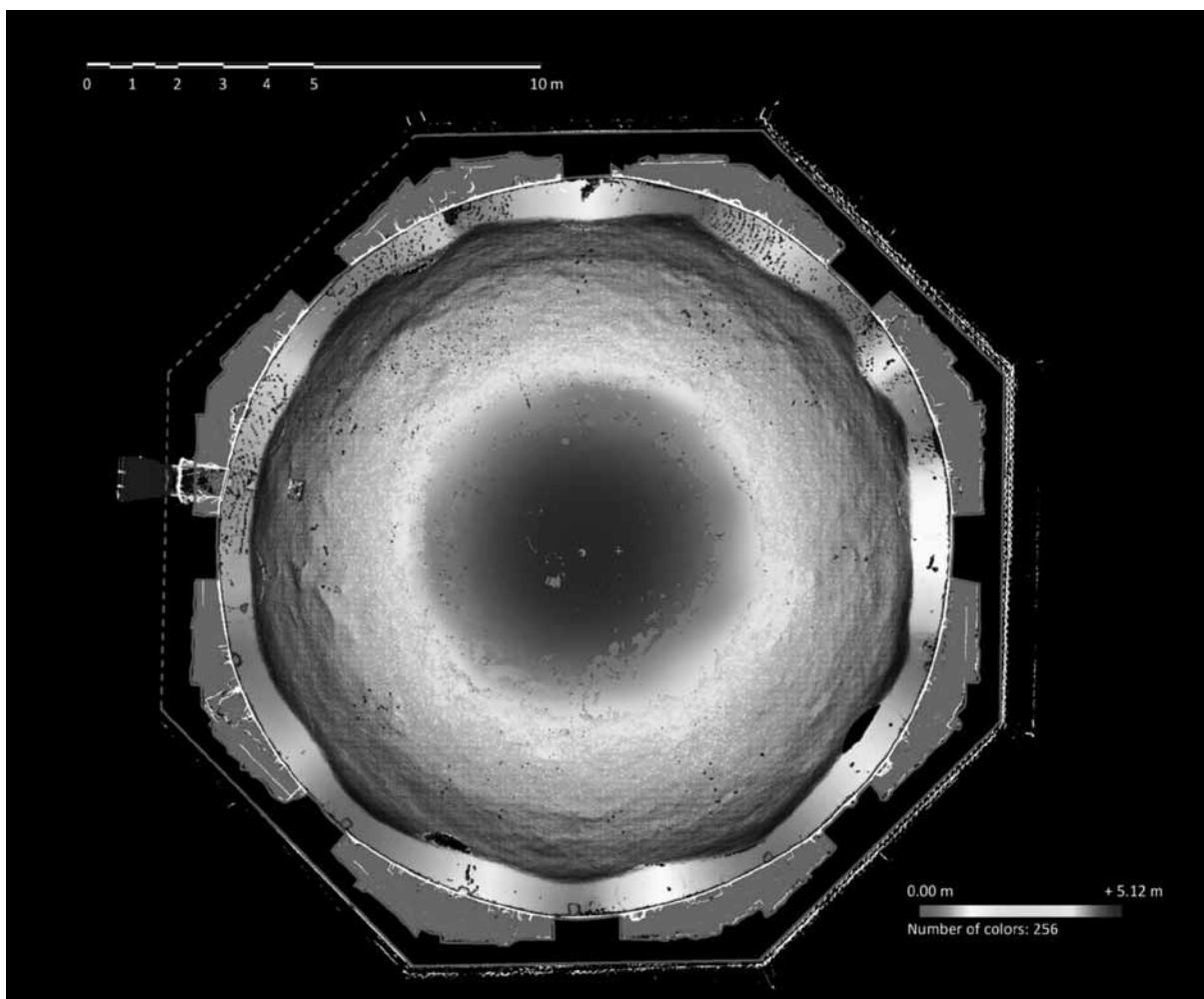
Fig. 1: Plan of the dome extrados. To make the representation more comprehensible, all data relating to the roofing has been left out. Full spectral progression of the image's colors is referred to the elevation above the level of the impost of the vault (red closer, blue farther)

The first step was the measurement of a net with GPS techniques to refer the whole set of data to a single geo-referenced system. Starting from vertexes with a known position in UTM-WGS84 were done some detail measurements to align scans.

Topographic measurements connecting indoors and outdoors were incorporated in the main network. For given conditions and constraints this operation was very delicate: only thanks to the topographic measurements which connected inside and outside of the attic it was possible to effectively link the top surface of the dome and the abutments with the characteristic hollows and the underlying architecture.

Conclusions

Evaluation of geometric and dimensional features of the dome

The technical choices, as well as the final outputs, bring about observations on the examined structure's features with a level of detail never achieved before thanks to data with complete, three-dimensional and high resolution characterization.

The analysis of the dome's curvature has been made on a surface model triangulated on the base of the collected data. Comparing the model and the surface of the sphere that best matches its configuration, it appears that the curvature of the dome corresponds to a sphere with a diameter equivalent to that of the drum (about 16 m) up to an angle of 21°. The sphere that best describes the radius of curvature of the dome above this level has a greater diameter (about 17 m) and a lowered center. Therefore, the dome appears to have two centers of curvature.

The dimensional features derived from previous surveys are substantially confirmed (diameter of about 16 m), except for the thickness of the dome which is slightly higher on the top. For the moment it's difficult to justify this thickening of the keystone because now it's impossible to see the elements composing the top point.

The employed surveying techniques allow to measure only visible surfaces and do not offer the possibility to investigate the internal structures. Further investigation, if deemed necessary even destructive, would give more results.

This survey of the dome reveals a lot of details before unknown even thanks to the advanced techniques employed. This represents an excellent opportunity to initiate new and different studies more in-depth with the aim to provide answers and to confirm the many assumptions on the constructive technique.

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GeCo - Geomatics for Conservation and Communication of Cultural Heritage Laboratory (Scientific Coordinator: Prof. Grazia Tucci). The research activity is applied to the following sectors: architecture, civil engineering, land and environment engineering and protection, and Cultural Heritage study and preservation. The Lab's mission is to develop modern methodologies of integrated survey, testing new hardware and software tools in relevant application fields. It is also considered important to transfer the research experiences to the teaching activities, even if opportunely simplified. Theoretical classes are sustained on practical demonstrations and training: direct testing arouses the interest of the students and motivates them to acquire knowledge and proficiency in the Geomatics field. Lastly, the Lab enhances spillovers within the professional world of the activities which have been conducted in the academic circle: the high request for consulting service by public and private organisms proves the efficiency and competitiveness, also in terms of costs, of the submitted assignments.

2D – 3D CH IMAGES FOR ICT SYSTEMS

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In the Project "Digital Excellence Archive for Polo Museale Fiorentino", developed by MICC – University of Florence, Hitachi Ltd. and Centrica S.r.l. for Polo Museale Fiorentino (Superintendent Cristina Acidini) very advanced technologies were developed for several goals:

• to perform very high quality digital acquisition of paintings (in particular of Uffizi Gallery), having very high space resolution, colour calibration;

• correction and geometrical distorsion elimination;

• to use a special software "XL-image", developed by Centrica S.r.l., which permits to "access" in fast way all details of the painting ("zooming") and to "navigate" easily in the content;

• to develop, in particular by MICC-University of Florence in cooperation with Tuscany Region and GARR, efficient telematics systems, with special reference to video-conferences using very high quality digital images; important experiments were developed between Florence (Tuscany Region, Headquarters) and Tokyo (Istituto Italiano di Cultura) with Superintendent Cristina Acidini describing the digital image content;

• to protect the digital CH content through "cryptography" and in particular "digital marking" identifying the Owner and giving archiving identification.

New researches have been also started regarding 3D Objects digital acquisition and data protection in a new Laboratory in the INCUBATORE CsaVRI of University of Florence (Campus) in Sesto Fiorentino. In particular a new Spin-off Project, INN-3D, was started with the goal of protecting 3D data ("mesh models", "vector models") against "unauthorized copies" through 3D digital marking (in addition to more conventional cryptography). Real 3D art-works have been acquired in Bargello Museum, with coordination of Polo Museale Fiorentino.

New research lines are also developed in INCUBATORE and CsaVRI with the goal of defining, experimenting and realizing very advanced Video-Teleconference Systems, in particular for CH applications, having "immersive 3D characteristics" (giving more fidelity to reality for remote users and providing interactive multimedia 2D-3D content).

IRT-PHOTOGRAMMETRIC PROCEDURE FOR 3D RENDERING

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THE SAFEGUARD OF CULTURAL HERITAGE

Introduction

The combination of terrestrial laser scanner survey, photogrammetric imagery and IRT allows the generation of 3D multispectral models useful for localization, visualization, and analysis of anomalies in buildings. The proposal of research focuses on the emerging need of more effective images for gathering the thermal anomalies where the geometry of the object strongly affects the thermal behaviour. Such conditions can be due to reflecting materials, non planar surfaces, geometrical pattern of surface decoration and finishing, partial shadows, reflection effects due to fixed objects close to the surface which are under investigation, and places where movement is restricted for data acquisition.

Scientific literature refers to studies in progress to define the best capture conditions depending on the kind of defects, orientation, and building characteristics (Grinzato et al. 2010).

As the state of the art comprehends some basic techniques for mapping IRT imagery on 3D models, many developments are required to increase the automation and reliability of testing procedures to localize/quantify specific defects on finishing materials (Grinzato et al. 2009). This application of IRT has often been required for the maintenance of facades: the integration of IRT, NIR and visual photogrammetry is much more convenient for the localization, detection, measuring, of defects and, in the meantime, producing the digital documentation to support the project and maintenance steps (texture 3D models, vector rasters maps of facades, sections, elevations, technical details) (Alba et al. 2011).

Expected results are the improvements of diagnostics and survey as well as shortening the time from data analysis to preliminary restoration design. Moreover, the availability of results in the preliminary phase allow to address the executive projects since the beginning, avoiding expensive changes of orientation in the further steps of the study/projects.

Another result is the possibility of applying the method for monitoring the damage in the preservation plan and to prioritize the interventions in a full scale economy (e.g. the preservation of an entire historical centre/villages, sites).

Integration of IRT and photogrammetric/laser scanning surveying

IRT are usually acquired with relatively small format digital sensors, which rarely are larger than 640x480 pixels. These allow a detail investigation of local anomalies, but they need to be integrated in a mosaic made up of many images. Different levels of products featuring diverse accuracies can be obtained. If the final IRT mosaic has the aim to give only a visual impact of the thermal behaviour of the façade, images can be empirically rectified on a planar reference surface, irrespective of the actual surface of the building. Example of this approach is depicted in Fig. 1a. Whilst the aesthetic result might be good owing to the continuity in the mosaic, no correspondence with the surface holds, except in case of flat facades.

A more rigorous approach to obtain a 3D rendering of a complex building is based on the use of photogrammetric or-tho-projection. This requires a 3D model of the surface to be mapped and a coverage of the images to be projectec. Different kinds of data can be used to this purpose with different results (RGB, IRT, near-infrared images). 3D models can be obtained from different sources: existing drawings and projects, photogrammetric or terrestrial laser scan-ning surveying (see Alba et al. 2011). On the other hand, disregarding the specific technologies that are applied, all da-ta need to be geo-referenced into the same 3D reference system to enable rendering of the 3D model. When working with low-format and poor resolution IRT images, two main problems arise. First, the orientation of such images is quite a complex and time-consuming task. This requires a qualified expertise in the photogrammetric adjustment of image blocks, as reported in Barazzetti et al. (2011). An alternative procedure based on the use of a 'bi-camera' sy-stem integrating an RGB and an IRT camera is proposed in Alba et al. (2011). This exploits the possibility of using the RGB images for easier registration. At the current state-of-art, no solution seems to show an overwhelming poten-tials, but the best option has to be sought for each practical case. However, good results can be obtained by using the-se approaches in the case of buildings showing not too much complex surfaces, as the one reported in Fig. 1b.

The third example shown in Fig. 1c is representative of the second important problem in IRT 3D rendering. When the building's facades are rich of details and decorations and when the capturing conditions are restricted by obstacles and other limitations, the final result might be of poor quality. Ongoing research are focused to overcome these pro-blems with automated and accurate procedures.

A main application of the IR thermography concerns the analysis of performances and state of health of buildings. Thermal scanning of a construction provides information regarding technological elements, shape, physical charac-teristics of materials, and state of decay. Different kinds of defects affecting building structures can be detected by the analysis of surface temperature, submitted at particular boundary conditions.

Because the infrared thermography (IRT) is mostly used as preliminary investigation tool, a direct survey of the shape, materials and their damages is necessary to know the real state of the surface to analyze. Moreover, planning the ac-quisition of IR images suffers from the approximation depending on the accuracy of the preliminary reconnaissance. The integration between IRT and Photogrammetry/laser scanning has the advantage to overcome the lack of relia-ble survey and assessment, joining both steps in one and reducing time and cost of inspection. In the case of ancient buildings, the walls to investigate are usually not regular. Indeed, thickness, structure and number of layers may be different even in the same part of the construction. Therefore, the metric location of thermal anomalies that should be further investigated with destructive tests is crucial for reducing as much as possible the size and number of sam-ples to withdraw. The inspection of building envelopes by IRT is based on the effects of heat flow across the structu-re. The surface temperature is a function of heat flow crossing the wall and local boundary conditions. This parameter may give information regarding the interior layers of the structure. The heat is transferred more quickly throughout the most cohesive materials or/and materials with greater thermal effusivity. Any detachment of the finishing layer strongly reduces the heat transfer and adds its signal to that given by the structure.

In the examples presented in this paper, thermal scanning was accomplished during the cooling phase (in a time win-dow of about 80 minutes) after the solar irradiation. The targets of the investigation were thermal anomalies due to finishing detachment, thermal loss of the structure, and damages of the concrete finishing. The IRT shooting was aimed to test the procedure for image capture, calibration, and superimposition to the visual 3D model. Therefore, in this phase of the research, the authors did not acquire a sequence of multi-temporal thermal images to obtain the heating diffusion in the materials under investigation along time (as shown in Radaelli et al., 2011).

30 image pairs composed by RGB/IR images were taken. In addition, a few complementary images were captured to

strengthen the photogrammetric block. The environmental conditions were: RH 50-65%; T ranging between 31 and 25°C, wind's speed lower than 3.5 m/s; the interior conditions were RH 45%; T 24°C.
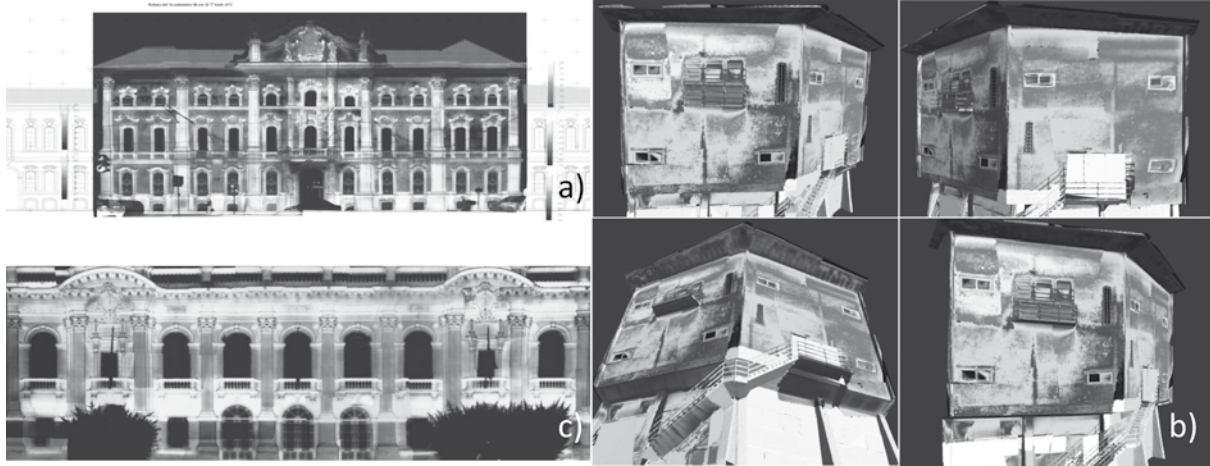
Fig. 1: a) Litta Palace, Milan, mosaic of photograms and superimposition on the measured drawings (geometrical survey); b) Politecnico di Milano, "Trifoglio" building, IRT 3D rendering of simple facades; c) Politecnico di Milano, main campus, Rector Building, IRT 3D rendering of articulated facades and restricted capturing conditions

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THE MADONNA OF PIETRANICO: A TESTBED FOR ADVANCING COMPUTER-AIDED RESTORATION METHODOLOGIES

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This paper describes the restoration of the Madonna of Pietranico, a terra-cotta statue severely damaged in the 2009 earthquake. The statue, fragmented in many pieces, has undergone a complex restoration. The restoration and re-assembly of the statue was performed under two constraints: first, the willingness to bring back as much as possible the artwork to his original status, with the aim to be recognizable as a devotional object and to return it to the original community of provenance; second, since several travels of the restored statue were planned (temporary exposi-tions at the Italian American Museum in New York, USA; and then in Pescara, Italy; after those, the Madonna will move back to her small village of origin, Pietranico), it was very critical to ensure stability, solidity and easiness of disas-sembling-reassembling in a few pieces to simplify shipping.

Therefore, the restoration was planned by setting up a multidisciplinary working group. The contribution of innova-tive digital technologies was planned from the very beginning, resulting into an innovative way to manage a reas-sembly and restoration process. A first important contribution was the study of the recombination hypothesis of the fragments that was performed on digitized 3D replicas of the latter, with the aim of reducing fragments manipula-tion, preventing further

damages and increasing the capabilities to rehearse and evaluate different reassembly options. Then, the digital 3D models of the fragments were also used to design and produce an innovative supporting structure, constructed with a rapid prototyping device (3D printing). This solution allowed us to prevent the use of a metallic support structure, that would have been much complex to disassemble/reassemble for the travels, and also made it much more easy to fill up and hide the fractures among the several broken pieces.

Finally, another important contribution concerned the study and virtual restoration of the polychrome decoration of the statue; first attempts were done to reproduce and restore in the virtual 3D domain the very complex polychrome decoration from the very few remaining traces. A side effect of this activity was to get insight into the limitations of the current technologies for reproducing pictorial decorations over digital 3D models and the need for further impro-vements.

BUILDING THE VIRTUAL MEMORY OF THE HOLY SEPULCHRE IN JERUSALEM: METRIC SURVEY AND 3D MODELING

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The Basilica of the Holy Sepulchre in the Old City of Jerusalem is an architectural complex consisting of several different structures mainly built between the first Century and the age of the Crusaders. In the past two centuries a fire and an earthquake damaged the Church. These events and the restoration work consequently undertaken define the current state of the building. In the Basilica, visited by a large number of pilgrims, various religious communities still coexist. For the CABeC (University Centre for Cultural Heritage, at that time directed by Prof. P.G. Malesani) of the University of Florence, the need to assess the effects of further seismic action has been an opportunity to undertake a major project aimed to understand and preserve the Basilica.

Instruments and survey methods for the 3D survey

The integration of different methods and measurement techniques made it possible to produce the info-graphical representations required for the structural study. The database is the starting point from which it is possible to extract different kinds of information required for documenting the Basilica: raster (rectified images and orthophotos), vectorial representations and three-dimensional models. The integration of topographical, photogrammetric and scanning techniques enables geometrical and photographic information to also be integrated: the geometrical information was obtained from the detailed topographical survey and 3D scans, the photographic information was obtained by projecting high resolution photographic images onto the 3D model.

The accuracy and completeness of the acquisitions and the methodological approach followed throughout the survey make it possible to process the data for seismic risk evaluation, and to subsequently integrate the data and process them for other purposes.

Graphical output for structural analysis

The first objective of the integrated metric survey carried out on the Basilica of the Holy Sepulchre was to obtain the metric and qualitative information necessary to define the models used in structural studies.

The study of seismic vulnerability required, first of all, a geometric description of the entire architectural complex. The most innovative element is the contemporaneousness of these stages of study: a flexible investigative tool is available once the *in situ* data acquisition has been completed. Starting from the model, all the sections required can be quickly extracted, without the constraints imposed by a traditional approach.

The results of the analysis are generally reassuring. As the study has been carried out after having divided it into constructive macro elements, a vulnerability value has been assigned to each of them. Through the detection of the most risky areas, we can define intervention priorities.
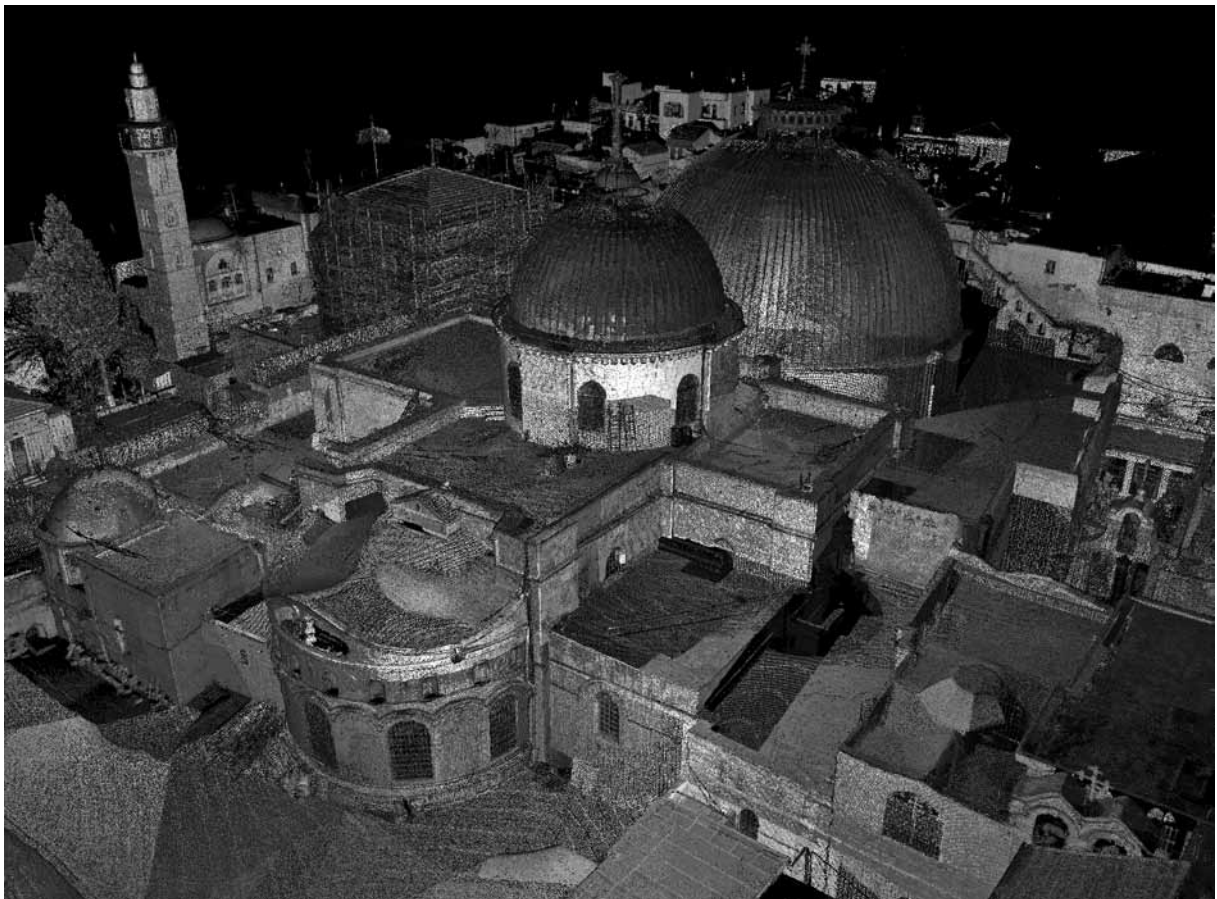
At the end of the last survey campaign the whole block was surveyed. An aerial view of the whole 3D point model

3D Modelling

The modelling of the current conditions of the basilica is in progress. In this case too, we decided to start working on the most important symbolic element (the Aedicule of the Holy Sepulchre,) to extend the study to the Anastasis and finally to the rest of the building.

The choice of the most suitable modelling technique is based on the geometric complexity of the part to be modelled and on its importance compared to the whole model. These two parameters can be summed up in the "level of detail" that you want to reach for the different elements of the model.

Diachronic analysis of the structures

Through 3D digital representations we want to sum up the results of an in-depth bibliographic research: scholars from all around the world often focused their attention on the complex events that caused the several transformations that the basilica underwent during the centuries. The analysis of masonry structures is in progress in order to date the different parts of the existing building and to allow its diachronic reconstruction.

The main representation tool is represented by 3d models, which can be used by the scientific community and to integrate the digital material useful for general projects.

Communication project

The huge quantity of data collected during the first phases of the project allows defining a coordinated project involving communication, promotion and enhancement of this Place.

The various activities proposed address to differentiated targets through the shooting of videos *in situ* and information panels for pilgrims and tourists, to give them brief information on the building they are about to visit. As regards "virtual visitors" looking for alternative interpretations and for an instrument capable of linking the specific infor-

mation on the Basilica to the information concerning other holy places, the traditions and the life in the Holy Land, a website will be created, together with an online video.

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THE BASILICA DELLA MADONNA DELL'UMILTÀ IN PISTOIA: 3D SURVEY AND STUDY OF GEOMETRY AND STRUCTURE OF THE DOME

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Introduction

The present work aims to show the first results of the profitable cooperation between University research institutes, ecclesiastical institutions, banking foundations and the Ministry for Cultural Heritage and Cultural Activities in the definition and realization of a complex conservation intervention.

Our studies, aimed at the definition of a 3D data base in support of the project of the restoration and consolidation of the Basilica dell'Umiltà of Pistoia, have been conducted with well-established surveying techniques, such as topography and photogrammetry, united with more innovative techniques like threedimensional scanning systems. The agreement with the Superintendence was that we would extract classic two-dimensional elaborations, plans and sections (18 tables in a year. Fig. 1), starting from an unstructured 3D database, which today is difficult to manage due to the large dimensions of the files and the absence of coded guidelines to follow for graphic restitution.

The Basilica

The Basilica della Madonna dell'Umiltà is the most important example of monumental Renaissance architecture in Pistoia.

The building of the temple was decided upon in order to celebrate the occurrence of a miraculous event which took place on 17 July 1490 in the small parish church of Santa Maria Forisportae, the place of the present Basilica (Cipriani, 1992).The change of the name and the definitive metamorphosis of Santa Maria Forisportae into the Basilica dell'Umiltà were ratified by the Bull of Pope Leo X in 1515.

The conception of the geometrical structure of the church was made by Giuliano da Sangallo, the architect of Lorenzo the Magnificent, assisted by his brother Antonio, and by Francione and Pollaiolo; but the instigator of the construction was the Pistoian architect Ventura Vitoni; and later, in the mid-15th century, Giorgio Vasari was responsible for the design and realization of the majestic dome (Belluzzi, 2002; Quinterio, 1997).

The earliest structural problems of the dome became apparent only a few years after the dome was completed. Since then there have been a series of observations and studies which have attempted a geometric-structural analysis of the dome; such analysis, although accompanied by uncertainty, inevitable when dealing with such complex organisms, can constitute a reliable base for diagnosing the problems of the dome.
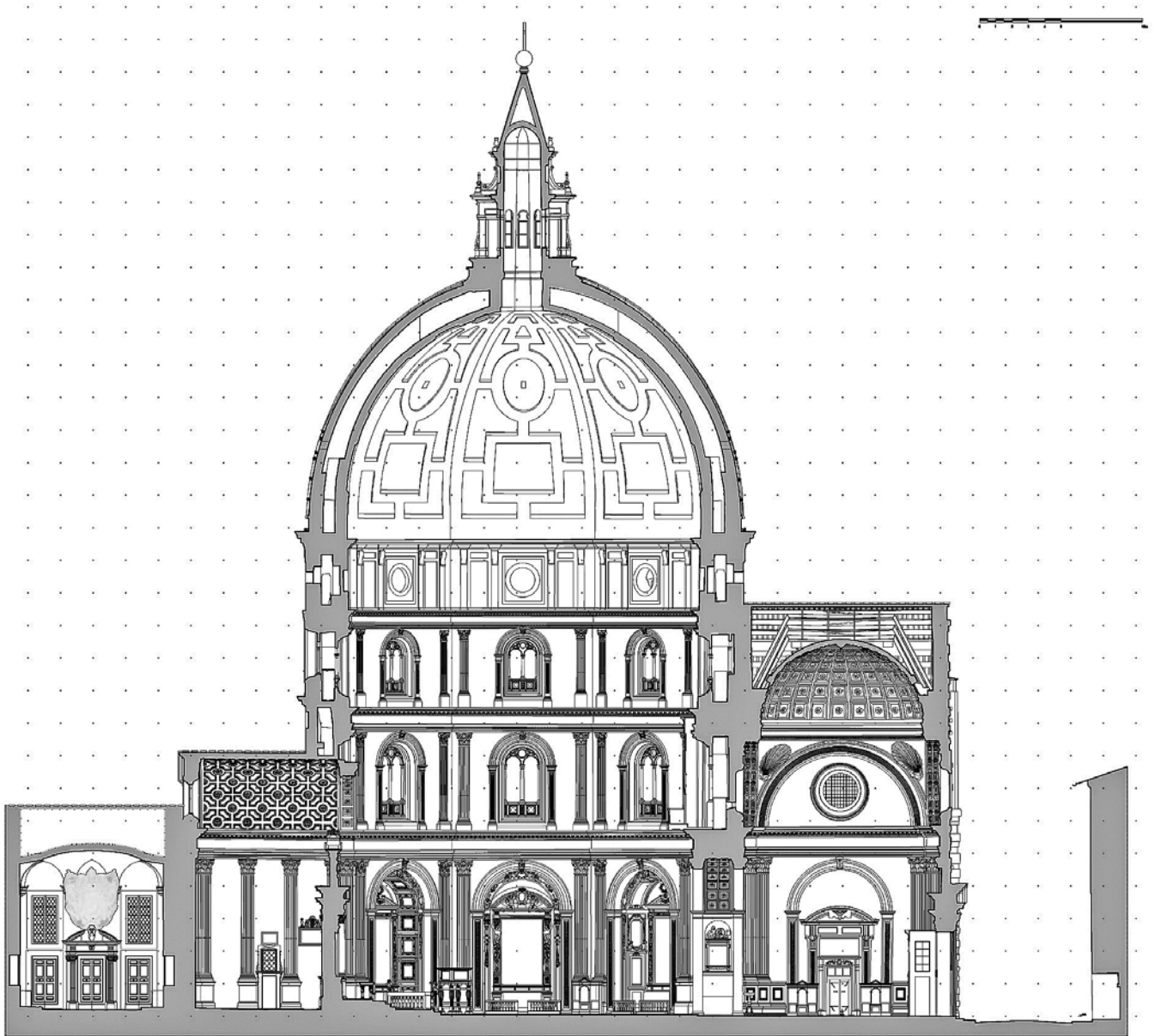
Fig.1: Longitudinal section of the Basilica. Original in scale 1:50

3D digital survey

The planning phase of the survey represents a fundamental part of the whole acquisition process. In the specific case of the Basilica, given the large dimensions of the construction and the complexity of the space, due to both the spatial articulation and the decorative richness, the acquisition process has involved a careful survey and the drawing up of a programmed register of the survey. The major difficulties faced during the acquisition phase are related to the need to reach some restricted spaces of the structure; to the need to document the high level of detail in some decorative elements; to the importance of defining the thickness of the masonry so as to reveal the external parameter. The in situ work has been carried out in five measurement campaigns.

A topographic net, including the internal and external vertexes of the Basilica, has been created. The measurement operations have been conducted with both a total station and geodetic GPS receivers. The maximum planimetric range of the network, which is presented elongated in the parallel direction of via Madonna, is equal to circa 480 m x 170 m, while the proportional development ranges from 0 to circa 47 m.

The scans resolution has been planned each time for the formal and dimensional characteristics of the investigated spaces. The most problematic parts found are the arrangement of the reference frame in order to ensure the correct-

ness of the operations of roto-translation of the points obtained from the different stations; the acquisition of the space between the two calottes.

Results

The three-dimensional survey of the Basilica dalla Madonna dell'Umiltà has highlighted and made it possible to quantify, for the octagonal hall and the dome, the number of ribs (eight angular, eight central and sixteen median), their correct placing, form and dimension; the exact placing and dimension of the internal and external chains; the actual thickness of the two calottes; the building materials and techniques; the consolidation of the interventions; the internal connections, both horizontal and vertical; the cracks present on both calottes, highlighting the most damaged awnings; the links between the geometry, the structure and the deformations shown over time (Tucci *et al.*, 2011).

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HOW CAN GEOMATICS HELP?

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THE
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Fig.1: GeCo Lab. made the 3D survey of the whole balisica. Graphic elaborations embrace both 2D vectorial drawings to help conservation project and tests on surface models (see the detail in picture)

Metric documentation of Cultural Heritage consists in circumstantial understanding and careful observation of the site, suitable graphic restitution of the collected data as well as dimensional quantification using appropriate instruments.

Documentation projects are particularly important in those cases where the heritage is, for whatever reason, in a precarious state. It is, therefore, important to collect documentation as thoroughly as possible: geomatic methods can be applied to generate permanent records from which information can be extracted.

Recording is a key activity in the conservation management of Cultural Heritage. Conservation-related information is usually obtained from multi-disciplinary research activities. In team with multi-disciplinary expertise geomatic techniques are used to build a reference base which enables all members to meaningfully participate in both investigative procedures and project development and application.

The management of spatial data often requires specialist skills making it difficult for experts in other fields to use raw data. So Geomatics not only plays a vital role in the data acquisition phase but it is also important for data management and interpretation, acting as a 'filter' between raw data and graphical information (i.e. the transition from the points model to distinctive sections) that has to be structured in such a way that experts in different fields with a basic or mid-level knowledge of CAD, image processing, and new technologies can use it autonomously.

Recording spatial data requires, in the first instance, the collection of available materials, on the basis of which preliminary observations are made and further operations are planned. So there is an initial off-site activity, followed by on-site verification and integration:

- Off-site: existing sources are generally available for smaller scale documentation: small scale topographic maps, satellite images, aerial photos and sometimes, architectural sketch drawings.

- On-site: photos and instrumental survey: GPS, total station, photogrammetry, laser scanning, direct measurements.

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CULTURAL HERITAGE BETWEEN 3D DIGITIZATION AND 3D REPRODUCTION

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Geomatics for Conservation and Communication of Cultural Heritage Lab.

The documentation and 3D modelling of Cultural Heritage are now mainly based on digital techniques to produce complete, detailed and photorealistic three-dimensional surveys. The integration of various technologies and sensors is the best solution to obtain results with these characteristics.

According to the reproduction scale, you need to change the characteristics of the instruments used during acquisition. Some objects can be reproduced in full scale, such as for example archaeological finds, sculptures, decorative elements and so on... Generally, acquisitions are carried out with triangulation or pattern projection systems, which have a limited operating range and provide an accuracy of 0.1 mm.

During scanning we try documenting the whole surface; some parts are not detected: this is due to the operating limitations of the instruments used.

In architectural scale, reproduction is carried out on a reduced scale and acquisition can be limited to the portions we are interested in and/or integrated during the following stages. Generally, the instruments used include distance scanners, which provide centimetric accuracy. In this case the lack of data can be due also to the presence of furniture or other encumbrance on the scene.

The growing rapidity of the acquisition phase - enabled by the technological evolution of scanners, which are quicker and quicker, and by the spreading of image based techniques - allows increasing documentation, as well as what is immediately necessary. This way we create a database of metric information from which we can draw all the necessary data for graphic representation. A point model as complete as possible is useful to meet documentation needs that have not been planned at the very beginning, saving a huge amount of money.

In both cases the quantity of the 3D data available and their level of detail provide solid reproductions using rapid prototyping techniques.

Reduced or real scale solid models are an effective support for projects involving communication and divulgation: they can be understood without the intermediation of data processing systems, therefore increasing the potential users.

Models too can be divided into "real scale and real aspect models" (models of objects, statues, etc.) and "reduced scale models" (models of buildings, archaeological excavations, etc.).

For the "reduced scale models" we have to consider the ratio between the level of detail and the reproduction scale. 2D digital representations refer to an equivalent graphic scale, reminding the concept of graphism error. Unfortunately, this concept is not significant for 3D models, both real and unreal. In this case fruition methods become the discriminating factor.

Rapid Protoyping (RP) is an expression indicative of technologies used to fabricate physical objects directly from CAD data sources; they are also called three-dimensional printing, solid freeform fabrication or layered manufacturing.
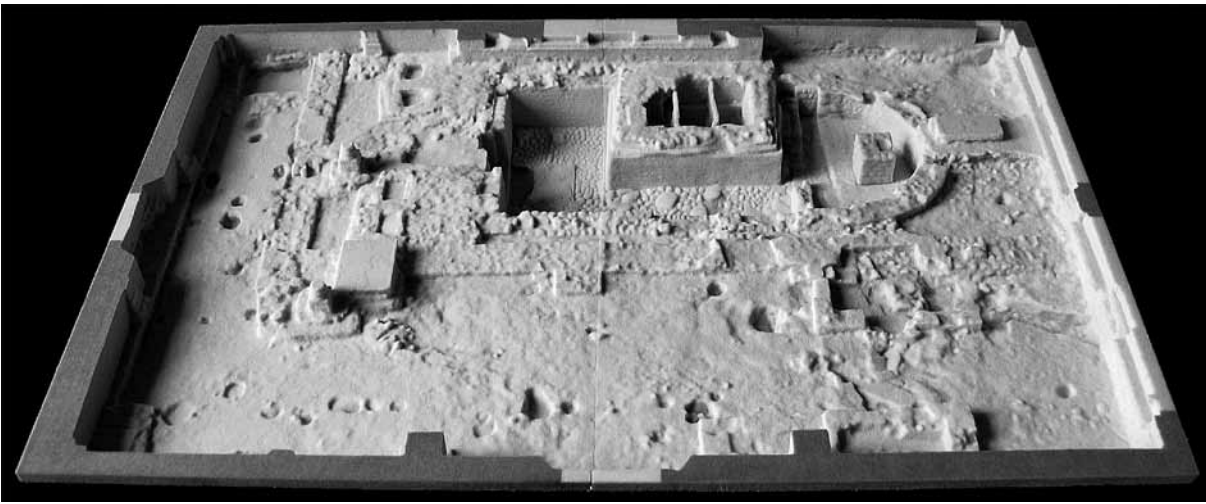
A view of the solid model of the archaeological excavation of the church of Santa Maria del Lavello at Lecco

Following, only factors related to the processing that involves the superficial aspect of the solid model are analyzed. Some important aspects useful in other applications, e.g. mechanical behaviour of the used material or the method to realize the internal structure or possible supports of the model, are neglected.

- Stereolithography (SLA): it was the first generation of machines for RP; it builds plastic parts or objects a layer at a time by tracing a laser beam on the surface of a vat of liquid photopolymer.

- Selective Laser Sintering (SLS): it is based on bonding powders.

- Laminated Object Manufacturing (LOM): a laser cutter or a knife which cuts profiles of object cross sections from paper or plastic.

- Three dimensional printing: a jetting which deposits a liquid adhesive compound onto the top layer of a bed of powder object material.

- Fused Deposition Modeling (FDM): It works by extrusion of thermoplastic materials.

- CNC machines make solid models by removing material from a stock shape of material.

According to the purposes of the solid model to build, it is important to evaluate these aspects in advance:

Working precision, according to the level of detail required;

Surface aspect: colour, roughness, and so on;

Mechanical strength, thermal strength, etc., if the model needs to have functional features;

Possibility of applying finishing;

Weight of the finished model.

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GeCo - Geomatics for Conservation and Communication of Cultural Heritage Laboratory (Scientific Coordinator: Prof. Grazia Tucci). The research activity is applied to the following sectors: architecture, civil engineering, land and environment engineering and protection, and Cultural Heritage study and preservation. The Lab's mission is to develop modern methodologies of integrated survey, testing new hardware and software tools in relevant application fields. It is also considered important to transfer the research experiences to the teaching activities, even if opportunely simplified. Theoretical classes are sustained on practical emonstrations and training: direct testing arouses the interest of the students and motivates them to acquire knowledge and proficiency in the Geomatics field. Lastly, the Lab enhances spillovers within the professional world of the activities which have been conducted in the academic circle: the high request for consulting service by public and private organisms proves the efficiency and competitiveness, also in terms of costs, of the submitted assignments.

AN OBSERVATORY ON INNOVATIVE TECHNIQUES FOR MOISTURE DETECTION IN HISTORICAL MASONRY

Elisabetta Rosina
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The research has two main aims: the comparison of effectiveness of the different methods and techniques for localizing and measuring the water, both at the micro and macro scale, and the establishment of an observatory on the research developments in the field of moisture diffusion in historical structure. At present, the research line involves many techniques those have been developed in laboratories of three universities and four Centers of the National Research Council (CNR).

Infrared Thermogaphy (IRT)

Infrared Thermogaphy (IRT) is successfully applied to obtain a map of moisture distribution, to locate areas with abnormal water content and determinate particular microclimatic conditions. IRT is not invasive as it is a passive imaging technique. Shooting can be repeated periodically to monitor cyclical or developing phenomena as infiltrations or capillar rise of water. A new method uses the active approach (AEFT): it allows to build the map of evaporation on the surface under investigation.

REF.: N.Ludwig, M.Gargano, Università degli Studi di Milano, Dip.Fisica; E.Grinzato, P.Bison, CNR-ITC, Padova

Evanescent Field Dielectrometry (EFD)

Through the dielettric properties is able to measure the sub-superficial content of water and the presence (in the same volume) of soluble salts. EFD measures the absolute water content (MC) of the layers underneath the surface and the presence of soluble salts (the volume is a half sphere of about 2 cm of radius). EFD measures MC on plaster or similar materials, between 0 and approxi- matively 20%; the technique allows to quantify the presence of soluble salts by the "Salts Index" (SI), an index of the salts concentration.

REF.: R.Olmi, CNR-IFA, Sesto Fiorentino; S.Priori, CNR-ICVBC Sesto Fiorentino (FI)

Unilateral Nuclear Magnetic Resonance (NMR)

Unilateral NMR is a recently developed portable Magnetic Resonance technology which allows measurements to be performed in situ and in a completely non invasive way. The measurement of water content in the first centimeter beneath the surface. The probe is a small magnet, its magnetic field is disperded towards outside. The magnet and the radiofrequencemeter are applied on the same side of the wall.

REF.: D.Capitani, N.Proietti, CNR-IMC, Laboratorio di Risonanza Magnetica, Roma

Holographic Radar

The technique is a high resolution imaging. The working principle is close to the microwave reflectomety: a continuous wave trasmitter produces a reference signal that interfers with the received signals reflected by the materials. The difference of phase between these two signals produces a contrast in the obtained images by scanning the surface.

REF.: L.Capineri, P.Falorni, Università degli studi di Firenze, Dip. di Elettronica e Telecomunicazioni

The gravimetric tests

They give the measure of the water content of the sample, by measuring the sample twice, before and after its drying. The test is standardized and it has been used as reference of the innovative techniques.

REF.: M. Valentini, Politecnico di Milano, Dip.di Energia; L. Soroldoni, Accademia di Belle Arti "Aldo Galli", Como

Fixed Point Measures (FPM)

The technique allows monitoring water content also deep inside the masonry. The procedure consists in the insection of dried small terracotta cylinders in the wall. After having inserted the probes, the hole is sealed. The probes reach the balance with the masonry in about one month. After that time, the probe can be removed and the water content is obtained as for the gravimetric test.

REF.: M. Valentini, Politecnico di Milano, Dip. di Energia; L. Soroldoni, Accademia di Belle Arti "Aldo Galli", Como

The above techniques were applied to an ancient oratory located in Cornaredo, a small town in the neighbourhood of Milan, in particular on a very degraded fresco painting, with the main objective of quantifying the rising dampness. As a result, moisture and salinity images of the wall were obtained by EFD and uNMR, determining the moisture distribution from a depth of 0.5 cm up to 2 cm inside the wall, and the distribution of soluble salts in the sub-superficial layer. Furthermore, the presence of detachments and material "anomalies" were detected by means of the HR survey and IRT. The application on the study case allowed the researchers to compare the results of the techniques according to the feasibility, working methods and costs (Rosina, 2011).

The results of the water content measurements are in a good agreement in the surface of masonry. On the contrary, data coming from the inner layers of the masonry have higher variability, because of the diffusion of water inside the material and the lack of established techniques "measuring" deep inside the material.

The comparisons highlight the feasibility and reliability of the techniques in their application on the site, and the required conditions of work and costs.

The further development of the research line is to establish a permanent observatory for the innovative techniques in Italy and abroad, with the aim to constitute a common net for the exchange of procedures and the advancements of the researches.

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Elisabetta Rosina is an architect, researcher at the Experimental laboratory, Politecnico di Milano, BEST dept., responsible for the "mobile Laboratory" unit. Currently he is assistant professor at Politecnico di Milano, she teaches "Conservation" at the MS Architectural Engineering. She is competent in surveys and building assessment, in design, planning and execution of non destructive investigations for preservation and maintenance. Co-chair of the MOdiHMa International Committee on the innovative techniques for the detection of Moisture in Historical Masonry. She is author of more than 150 among books, articles and papers, she presented more than 80 papers at national and international conferences, serving also as chairperson. She organized and taught in international seminars, in collaboration with Universities of USA, China, Turkey, Spain, since 2001

THE MAIN SPIRE OF MILAN'S CATHEDRAL SURVEY, MODELLING AND THINKING IN 3D

Francesco Fassi, Carlo Monti
Politecnico di Milano

THE SAFEGUARD OF CULTURAL HERITAGE

The Main Spire was built in 1765 by Benedetto Croce, four centuries after building started on the Cathedral. The term "Main Spire" identifies the unitary block overtopping the main vault of the Cathedral. The total height of the spire, including the statue, is about 43 meters and it rises towards the sky reaching about 108.50 meters above the floor of the Duomo (Fassi, Achille, Fregonese & Monti 2010).

Everything is in Candoglia marble and this is the key aspect of the whole work (Dalaibi, 2004; Godin 2001). It has different parts: the octagonal base, 9 meters high, rests directly on the lantern and is connected by eight flying buttresses to the side walls, rising from the lantern; the octagonal prismatic pipe, 19.40 meters high, surrounded by eight columns; the spiral staircase leading to the last landing terrace called "Belvedere" rotating between these columns and the central pipe; the finely decorated terminal pyramid 9.77 meters high; the Madonna statue, made of gilded copper (about 5 meters high) universally known as the "Madonnina". It is a really complex object rich in decorations, statues, terraces, narrow places, columns, arcs and flying buttresses. At present, the spire is caged in huge scaffolding designed ad hoc to be able to proceed with restoration.

This job wanted to create a detailed 3D model of the spire, to be used for professional purposes both to plan the restoration and for routine works on site. In this context the 3D model needed to be "accurate", "complete" "easy to manage" and "final".

The word accurate means it should be a "real based model" sufficiently accurate for extraction of metrical information on a scale of 1:20 - 1:50. Some parts were also modeled supporting the real scale 1:1.

It should be "simple to manage". The 3D model should be available for different kinds of operators to use and modify in different ways and for different purposes (design, planning, storing information, visualization…). All these operators are not normally proficient in using 3D software which is typically complex and requires skilled operators. In this context the "working software" choice should fall on an application that allows us to reconstruct the object's geometry from different kinds of surveys with the desired accuracy and should be relatively simple to use and learn. The digital model will be very complex too and should be structured and segmented to be easily and quickly visualized and inspected. It should be "final" meaning that the model should not only be the "real, exact geometric image" of the object, but also the robust base on which it is possible to study and simulate future modifications. For this reason, it must be easily upgradeable to store and report later structural and geometrical changes. Damage and deterioration will not be modeled: the survey purpose is the structure's geometric shape (damage information will be added separately in another way).

The main goals were: i) to extract all kind of 2D information such as classical sections, plans and vertical profiles; ii) to extract 3D information, like volumes, weights, that can be useful and usable during renovation, iii) to create a kind of
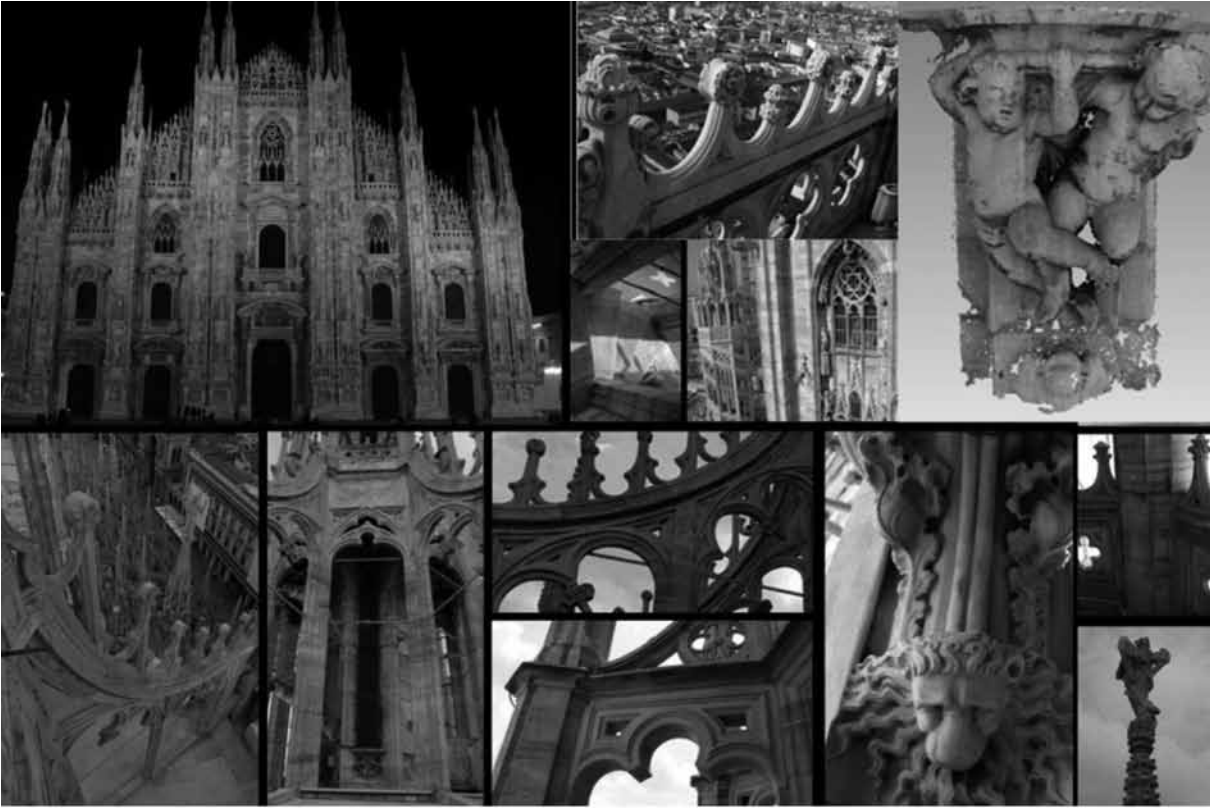
Fig. 1 Some pictures of survey moments on the spire. The image shows work conditions and the environment to be measured. At the end of the modeling phase the global model is made up of six macro-blocks subdivided into micro-bocks corresponding to the clearly identifiable and/or decorative building parts. One point cloud examples extracted by image matching.
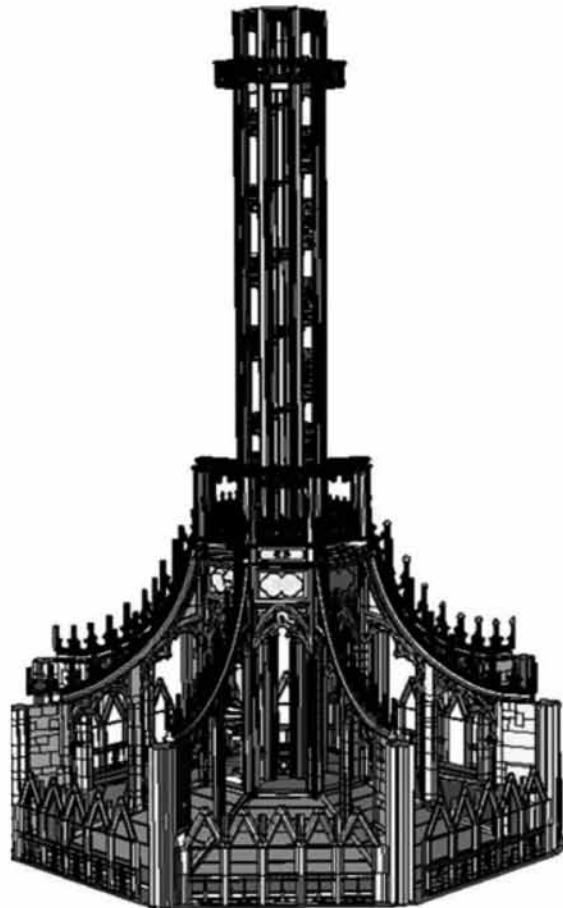
3D catalogue of all marble blocks, to be visualized, measured and tabulated with all necessary additional information also during yard operations and iv) to build detailed 3D models of the ornaments for a sort of reverse engineering of the artistic parts. The explanation gives us the opportunity to suggest a way to survey and model complex architecture integrating different methodologies. In particular, presenting problems and possible solutions found during the job both for operating difficulties inside a very intricate environment and for experimentation and integration of different new methodologies in a complex test field like this (Fassi 2009).

An interesting aspect is that technologies and methodologies have changed and been upgraded enormously. So there was the chance to experiment and test the different steps of this development in survey and data processing methods.

The aim is to turn upside-down the classical architectonical "2D thinking" that is bonded to work only with 2D logic, beginning from the survey phase until the last stage of elaboration. Since all of us were trained in the 2D surveying and engineering world this can be easily understood, but this kind of thinking is definitely holding back the overall adoption and benefits of 3D Laser Scanning and in general modeling capabilities. "We all need to think in 3D" (Roe 2010).

Acknowledgements

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TRAINING AND RESEARCH. THE STUDY FOR PROTECTING THE ARCHAEOLOGICAL AREA OF THE SANCTUARY OF DIANA BESIDE THE NEMI LAKE

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THE SAFEGUARD OF CULTURAL HERITAGE

Introduction

Italian Universities offer specific training on the methods and on the instruments useful for the practice of conservation of Cultural Heritage (CH).

Accurate documentation is indispensable support to safeguard CH (priorities indicated by the Ministry for Cultural Heritage and Activities in the 2010-2012[1]). Methods and instruments are chosen in relation to the peculiarities of the object to be studied and to the need for detail required. The training and the research here presented concern the geometrical survey and the material characterization of the ruins of the Sanctuary of Diana at Nemi. Purpose of the work is to design a protection structure for the area. The project must avoid changes in temperature and humidity that can be harmful for the conservation of archaeology site. The geometric survey, conducted with topographical instruments, photogrammetric methodology, and completed by using the laser scanner, it is necessary as a support for the organization of data concerning the characteristics of the material in order to their degradation. All of this information, combined with the historical ones, are the fundamental support for the project of the protection of the ruins. In fact, the protection project of archaeological sites is often left to improvisation in the belief that the system is temporary. The protection must, however, ensure that the heritage does not decay. For all this, the aim of the workshop is to offer to the students the opportunity to implement a complete analysis and knowledge process for the project of the protection structures.

The survey in the Cultural Heritage (CH) field: the experience of summer school

A modern architectural and archaeological survey must be 'expeditious', detailed, not too expensive and repeatable [3,4], also if the generation of processed data is not simple. A survey with these characteristics must be carried out by an operator with specific technical skills [5]. The purpose of the summer school organized by Politecnico di Milano was to offer to the students a real case study situation represented by an extended archaeological type. The on-site survey was done in the latin Sanctuary of Diana at Nemi, near Roma, almost in the centre of the Colli Albani on the homonymous volcanic lake.

Through the use of the instruments and the experimentation of the methods for surveying the geometric dimension and for analyzing the material and the constructive system, the students have to project the protection structures of the archaeological site also for its valorization.

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[1] Conservation and protection of cultural and landscape heritage; promoting knowledge and fruition of heritage and cultural activities and modernizing and rationalizing operating structures [1]
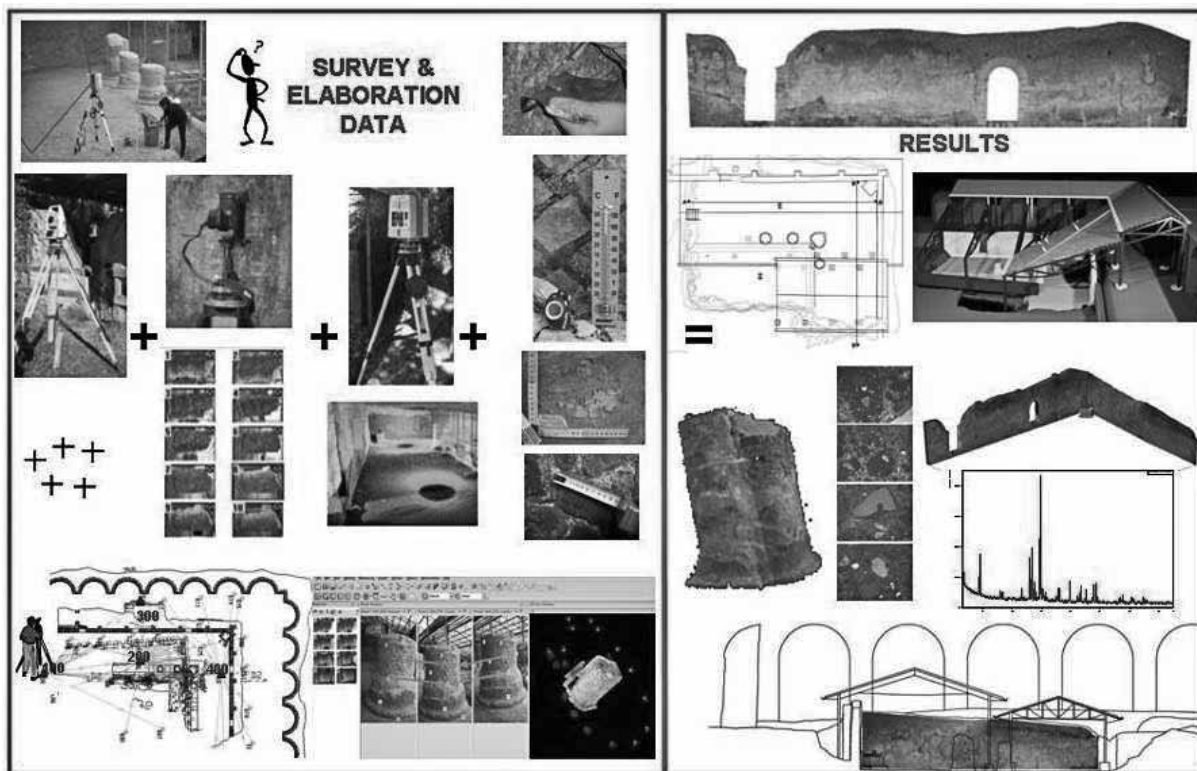
Fig. 1: Sanctuary of Diana at Nemi. The image shows the workflow

The process of survey: acquisition and elaboration data

The summer school objective is to transmit the 'modus operandi' through a direct study of a real case. The students are involved in the entire survey process: inspection, planning the type of instrumental survey, time-management, measurement activities, checking data acquired, processing, producing results. The following stages are adopted for improving the experience of students on: topographic survey; close range photogrammetry survey; laser scanner survey; material survey.

Topographic survey

The students do a topographic placement network useful for georeferencing the data needed both to draw maps and sections and to compare them with those extracted from the laser scanner data. The survey and precision with which on site operations are carried out was coherent with the final rendering scale fixed at 1:50 (1:20 for details).

Close range photogrammetry survey

Considering the growing interest in the field of three-dimensional construction and the resulting technological evolution (also in order to the possibility of doing expeditious and economical survey with common digital camera) a this is one of most interesting subjects in the CH conservation analyzed during the course. [10]

The students faced with problems relating to: i) on site calibration; ii) image acquisition (common camera and mobile phone camera); iii) data elaboration (image orientation with manual, automatic and semi-automatic techniques; 3D model generation); iiii) generation of rectified images and orthophotos.

Laser scanner survey

3D scanner is a device that analyzed a real-world object to collect data on its shape. The collected data can be used to construct digital 3D models. The problem is managing processing of the 'point clouds' (millions of points). So it is important to establish how and to what extent data must be thinned out and filtered, related to the end product required. This type of instrument offers the great advantage of being able to acquire 'everything' and put data extraction off to a second stage.

The students are training in: i) survey plan; ii) acquisition of point clouds; iii) acquisition of panoramic images for to texture point clouds; iv) to georeference scans; v) extraction of plans, sections and vertical profiles; vi) link material data sheet to the 3D model.

The survey of the technical construction, the materials and their decay

The survey of the technical and material construction are made. The observation of all the aspect of the object, is important for the conservation project. The archaeological site was restored (1996) according a project by the Soprintendenza archeologica del Lazio and was protected by a structure that, because provisional, nowadays reveals some weak points which induces new decay phenomena. The students are guided in the use of instruments and methods accepted by the scientific community but that required a careful training.

Conclusions

Heritage and cultural activities linked to it are legitimately considered a productive sector; first of all, for citizens who can gain knowledge of their history and cultural identity from it; secondly, for the financial aspects linked to related activities (conservation, maintenance, management use). One of the training objectives is to change the way of thinking and behaving to promote long-term prevention and care strategies, to contrast just immediate benefits. For that, the summer school experience represented a real moment in which students could face the problems come up against, at all levels, in the CH sector.

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Cristiana Achille was born in Lecco in 1972. She then earned a degree in Architecture and the Ph. D. degree in Geodetic and Topographic Sciences (XV cycle) from Politecnico di Milano University. She is the author (or coauthor) of more than 60 scientific publications in Survey, GIS, Photogrammetry, laser scanner measurement. On December 1, 2007 was awarded the position of researcher by the DIIAR Politecnico di Milano – Faculty of Architecture and Society (Disciplinary Scientific Sector ICAR/06).

Francesco Fassi was born in Bergamo in 1975. He received the M.S. (Laurea) degree in environmental engineering and the Ph.D. degree in geodesy and geomatics (summa cum laude) from the Politecnico di Milano University, Milano, Italy, in 2001 and 2009, respectively. His main research interests are Photogrammetry, Topography and 3Dsurvey for the three - dimensional modelling of objects in particular focused on architectural and archeological cultural heritage. He is the author (or coauthor) of more than 25 scientific publications in Survey, Photogrammetry, laser scanner measurement. Still temporary researcher at the Politecnico of Milan.

THE NECESSITY OF KNOWING THE DIFFERENT STRATEGIES OF CONSERVATION FOR THE INSPIRATION OF CULTURAL PROGRESS

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In this paper cultural progress is the ability to be dealing immediately with the diversity with which culture manifests itself in different parts of the World, the same diversity with which it manifests itself, again, through the idea of conservation of cultural heritage. The act of preserving cultural heritage is in fact an expression of these differences and its respect and its understanding are an expression of progress.

The Icomos Venice Charter of 1964 for the protection of international cultural heritage refers: "*People are becoming more and more conscious of the unity of human values and regard ancient monuments as a common heritage. The common responsibility to safeguard them for future generations is recognized. It is our duty to hand them on in the full richness of their authenticity.*"

The Venice Charter has as an object of interest the monument and its material. The same document imposes paradigmatic requirements that are useful to limit the restoration like an imitative reconstruction.

Thirty years later, in the Nara Document (1994) on Authenticity it is possible to read: "*Conservation of cultural heritage in all forms and historical periods is rooted in the values attributed to the heritage. Our ability to understand these values depends, in part, on the degree to which information sources about these values may be understood as credible or truthful. Knowledge and understanding of these sources of information in relation to original and subsequent characteristics of the cultural heritage, and their meaning, is a requisite basis for assessing all aspects of authenticity.*" Any judgments on the peculiarities heritage is inseparable from understanding the cultural context from which that heritage is derived: "*All judgments about values attributed to cultural properties as well as the credibility of related information sources may differ from culture to culture, and even the same within cultures. Thus it is not possible to base values of judgments and authenticity within fixed criteria. On the contrary the respect due to all cultures requires that heritage properties must considered and judged within the cultural contexts to which they belong.*"

It is necessary to understand the "sense" of authenticity in different Countries involves the exigency of coordinating an international experience between students becoming from different Countries.

The experience, just finished, of training students from Polytechnic of Milan, Italy, and Technical University of Kharkov, Ukraine, offers the opportunity of having the possibility of training students with different culture from, especially, historic point of view.

This had been the occasion of comparing the "Italian conservation" with the "Ukrainian reconstruction". The differences between the state of conservation of the monuments in the two Countries and the differences that characterized as the history of the monuments after their construction, as the mean of the conservation.

Heritage conservation means knowing in deep or for conserving the historic values of material or for trying to understand and rebuild, also from an abstract point of view.

We are obliged to make reference to different cultural and historical situations to ensure the formulation of the opinion expressed on conservation in each Country.

1) The recognition of the limits that the historical or aesthetic judgments can reveal whether out of context, makes it necessary to take on the relativity of value attributable to the same opinion expressed on the conservative action, which can be hardly universally applied.

2) The opinions expressed on heritage unrelated to human cultural sphere, however, change over time and space, because change the historical, social and ideological conditions from which these judgment derive.

The activity of the heritage protection of a Country has an ethics value in that it is a right action, once again strongly contextualized within it and that cannot be judged if you take into account the same context. All this regardless from aesthetic reviews.

3) The historical (social, political, economic) contextualization leads to a different way of understanding, on the one hand the protection and on the other hand preservation of artifacts, because the different historical contingencies of the Countries may suggest the stylistic reconstruction or the new construction, or conservation. Only in this perspective we can understand the reconstruction of Warsaw's Old Town, destroyed the Nazi ideology; the reconstruction of Orthodox religious sites in Ukraine, destroyed by Stalin ideology; the new construction (not reconstruction) on the bombed sites in Berlin.

4) Understanding the history of other countries, understanding it as if it were their own history, is necessary for guarantee the comprehension of the complexity of the modern societies.

5) The comprehension of the complexity of the modern societies arise from the direct comparison of cultures, encouraging the communication. This is true, also, for the protection of cultural heritage.

About the international collaboration for the protection, the restoration and the conservation of ancient buildings

The results of the restoration of ancient buildings are based on specific historical conditions and aesthetic identity-making beliefs.

A global training program can help: the adoption of common knowledge tools, the use of common working methods, the understanding of the cultural reasons at the base of the conservation project.

The training program must address global mainly to the younger generation to which it is necessary to provide to work together on common themes that are the expression of different civilizations.

Then, we must encourage and support: cultural exchange programs that will help students to work together, teachers motivated and prepared to guide students, the maturation of the cultural background necessary to understand and deal with different cultures, depth knowledge of the methods of protection implemented in different countries around the world.

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SOCIETAL FUNCTION OF CULTURAL HERITAGE

Reporter *Magda Antonioli, Fiorenza Belussi, Fernando Alberti*

THE
SAFEGUARD
OF CULTURAL
HERITAGE

In the Subsession on **Conservation, enhancement of heritage and cultural tourism** emerges the compatibility and interdependency between the conservation of cultural heritage and its economic enhancement. The assumption that cultural heritage is 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" is the main point of departure. 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 market good valuation techniques but rather on simulations of "real-world transactions" capable of revealing individual preferences for both direct consumption and passive use values (Herrero).

- the analysis of the behaviour of consumers of cultural heritage along the three questions "Who? Why? and How?" (Colbert). Under-explored 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" (Greffe and Cominelli), and whose reproduction entails the transmission and enrichment of tacit, informal capabilities.

- the sustainability of cultural tourism. On one side, tourism economically supports the safeguard of cultural assets and sustains the vitality of the cultural sector, but it may also pose excessive physical pressure on sites, infrastructure and endanger the social texture of the destination, e.g. by displacing residents due to the "tourismification" of historical centres (Antonioli).

Consequently, public interventions for the allocation of public resources to the cultural sector should be based both on the evaluation of the expected social benefits of alternative projects and of the economic efficiency of institutions. Policies for the safeguard of intangible cultural heritage should build on a detailed comprehension of the dynamics of knowledge renewal, as a basis for the establishment of institutions aiming "to successfully transfer and employ these skills and their techniques in other sectors combining tradition and creativity", alongside with schemes of collective intellectual property. A deeper knowledge of consumer and tourist behaviour should, moreover, translate respectively into a better market positioning for cultural institutions – which Colbert sees as a "solution for good

marketing strategy" aimed at increased and improved fruition – and into efforts to "educating" visitors "to get into a deep contact with the destination, its culture and its residents and to preserve its peculiarities"

In this context, the challenge that Europe needs to concern mostly:

- harmonizing the quality of cultural services and tourist experiences whilst maintaining and enhancing the creative variety of approaches to cultural and economic development.

- ensuring coordinated management and marketing, promoting European heritage as one clearly recognizable entity whilst enhancing the diverse identities of specific areas. The use of ICTs, the availability to act jointly on the sides of culture and education, as well as for using tourism as a factor of sustainable development at local level, represent further useful policy tools.

The sub-session on **Creativity and innovation for industry** deals with how cultural heritage may contribute to creating competitive advantages and innovation in Europe. Fostering creativity opens up a space for rejuvenating historical industrial districts and low-tech sectors, through new applications of science and research activities to old low-tech firms, localized in historical systems, and also the introduction of innovative business models in traditional sectors. Among these, the virtualization of distribution, outsourcing/off-shoring choices, the valorization of the design function, and the establishment of linkages with the cultural local heritage may be emphasized in this regard.

These developments can also be connected to a new green creative model, characterized by the emergence of complex, resilient adaptive systems (Cooke). Design and digital tools, or products, are cross-sector platform technologies, capable of enabling cross-fertilization, knowledge spillover, and revitalizing old industries. In linking cultural heritage with traditional sectors in order to activate knowledge spillover, an important role can be played by the local civic communities.

Therefore, the promotion of activities must be based on a kind of platform of places (De Propris). 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 usage. The generation of new ideas (Belussi) is based on the variation-selection-retention mechanism wherein culture, cultural heritages, historical contexts, art cities, and universities are the knowledge repository for the activation of creative processes. Creativity is context-dependent (no space boundary but integration of various actors in various places: virtual places and crowd sourcing of new knowledge). Continuous process of recombination of ideas, complementary capabilities, and external sources occur (no time-boundary, complexity, speciation, pre-adaptation, exaptation and chaos).

Cities are becoming places globally interconnected, where we find altogether a high density of knowledge, density of skill workers, and density in the use of new information technologies (Trullèn). Experience goods and leisure activities represent today an increasing part of the consumption pattern. The increasing focus on non-material goods is related to the aesthetization of our everyday life. Thus, art, culture, design, and cultural heritage become important elements of our identity, both as consumers and citizens (Lorentzen).

Because of its widely acknowledged context-dependency, the issue of cultural heritage ought to be seen within a context of active policies for the promotion of local development, integrating the investment for the safeguarding of the historical areas of specialization (historical industrial districts), with new forms of cultural tourism, with the maintenance of cultural places, the creation of cultural objects, the safeguarding of cultural traditions, and the sponsorship of business-related and cultural events.

The Subsession on **Bridging culture, society and creative spaces** pinpoints the role of the human factor, and its interaction with space, as the main protagonist of the knowledge economy's development. The cultural milieu represents the balance between nature and artifices, the old (heritage) and the new (creativity), the artefacts and the practices, the stocks and the flows, the material and the immaterial, and so on. In particular, panellists' presentations and discussion touched the following dimensions;

Culture, considered as a set of heritage, practices, experiences, cultural productions, cultural consumptions.. Research and policies focus on culture-based production systems (i.e. local cultural productions and consumptions, utilizing cultural capital);on the creation of 'creative core' districts (i.e. historic buildings to host creative activities: individuals, small businesses, events); on the promotion and formation of culture/creativity managers (i.e. institutions able to build networks in the fields of creativity, culture and knowledge industries for the construction of creative industry clusters)

Space. Cities (or metropolitan areas) 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 (i.e. large scale iconic architectural forms; old industrial facilities refurbished for creative industry and consumers, etc.).. There is a process of homogenization of the urban landscape connected with economic and cultural globalization and gentrification, which makes it important to recreate authenticity. Policy failures occur at the governance level (institutions of collective management and coordination of metropolitan areas and city/regions) and calls for the challenge of designing a new local governance following the rationale of localized clusters.

Society , wherein a new division of labor is emerging (i.e. new class of cognitariats, symbolic workers, knowledge workers, creative class; new servile class etc.). In this case, the main challenges entail: mapping social transformations, expectations, 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.
Some places (city regions, metropolitan areas, clusters) are more conducive to entrepreneurial activities and innovative behavior in the cultural industries than others thanks to agglomeration effects. In this case, the challenge is to complement geographical proximity with other forms of proximity capable of enabling creativity and innovation, e.g. cognitive, organizational, institutional, social proximities.

MEASURING ECONOMIC VALUE AND SOCIAL VIABILITY OF CULTURAL HERITAGE AND INSTITUTIONS

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Hypotheses

Cultural heritage (CH) is not merely a group of objects inherited from the past, but lies at the basis of people's identity as well as providing a source of inspiration for their creativity. This is one of the reasons why today there is a growing interest in its preservation and valorisation. A society's cultural background is also felt to shape its creative specialization and to offer new comparative advantages.

From an arts perspective, CH represents a synthesis of intellectual endeavour and aesthetic emotion. Yet, from the economic standpoint, it may be considered as an asset, a good, and a productive resource. CH is not only produced and managed through scarce (material or intangible) resources, thus involving opportunity costs and price, but it also satisfies human needs, concerning which people are able to express preferences. From such a standpoint, it is appropriate to appraise both the value allocated to CH by individuals and the behaviour of institutions in their efforts to preserve it.

Cultural heritage is also a productive resource, since it contributes to a society's economic flow and is a measure of its socio-economic progress. CH needs to be viewed as an asset yielding rent in the form of goods and services, which may lose value if not properly cared for, or accrue further value when made target of investment. Conceived as a form of capital, CH evidences alternative uses, and is substitutive in nature with other options or resources, being therefore subject to collective evaluation and choice.

This argument poses three analytical challenges: first, assessing the scope and valuation of cultural capital, taking into account its specificity in relation to other productive factors; second, calculating its contribution to economic growth; third, estimating the short and long-term economic impact models of CH on different areas.

The concept of CH has been shifting in recent years and, besides encompassing monuments, archaeological sites and historical buildings, has broadened its definition to embrace other domains (ethnography, craftsmanship, industrial archaeology, natural landscapes etc.), as well as intangibles (rites, cultural and religious celebrations, ways of life, language, etc.) and institutions (museums, archives, libraries). Yet, any attempt to define heritage must reach beyond recognition of its historical or artistic value to embrace the notion of utility, which proves interesting to economic analysis, based on three arguments: (1) CH encompasses symbolic or aesthetic elements capable of determining preferences and behaviour, (2) it can and must be managed efficiently, and (3) its economic and social impacts affect urban planning.

Economic valuation of cultural heritage

When allocating value to cultural heritage, we need to distinguish between two concepts: cultural value and economic value. The former may at most be measured in order of preferences, as it is qualitative in nature. Moreover, there are no fixed value relationships in the domain of personal choices, since subjects' allocation of cultural value depends on

their individual tastes, human capital or previous cultural experiences. As regards collective choices, they are often implemented through public regulation, identifying goods of major cultural interest and devising appropriate protection strategies.

The measurement of economic value is complicated since most elements of CH are public goods (non-exclusive and non-rival), such that market-lead provision proves difficult. Moreover, not only does the utility emerging from direct consumption (*direct use value*) need to be considered, but also the people's willingness to pay for the possibility of consuming it at another time (*option value*), the desire to ensure that it may be consumed by future generations (*bequest value*), or simply the wish for the good to exist, irrespective of whether it is used or not (*existence value*). Such *passive use values* do not tend to be reflected in market transactions and are therefore not adequately expressed through prices.

In an effort to resolve the problem of allocating value to CH, various non-market good valuation techniques have emerged, based on either indirect (travel cost, hedonic prices) or hypothetical markets (contingent valuation, choice experiments) that simulate "real world" transactions estimating changes in individuals' welfare. This allows to elicit a hierarchy of individual preferences, which may offer a guideline to social decisions and a benchmark to alternative investments. The efficiency of the applications and the utility of the results considerably depend on the rigour of the scientific procedure and methodology. Yet, they may prove an extremely useful tool for public authorities, as they may provide consistent guidelines for allocating funds or for assessing the effect of regulatory action.

Further research lines:

Applying non-market valuation techniques both to single elements of CH (monuments, archaeological sites) and ensembles (historical cities, cultural districts) that include elements of the natural environment, cultural activities (performing arts, festivals) or intangible elements (customs, skills, language). Although such techniques have been applied to culture for many years now, the spectrum of comparative studies can be expanded and deeper insights into valuation and transfer of findings are to be gained.

Improvements in methodological aspects, particularly as regards the handling of valuation biases, the reliability of results over time, and standard protocols for gathering databases.

Integration of results into other analysis processes, e.g. the evaluation of cultural project feasibility. Estimations obtained from subjects' willingness to pay might yield an overall picture of the social benefits emerging from CH, which in turn may be incorporated into cost-benefit analysis.

Research into the implications for economic and cultural policy**:** shadow pricing estimations, patronage effects, typifying demand, implications for management of cultural bodies, and so on.

Evaluating the efficiency of cultural institutions

Managing and maintaining CH is an example of the allocation of public goods, yet to date has received less attention than areas like health, education, and so on. Notably, the study of cultural institutions from the economic standpoint provides a wide range of possibilities for allocation studies, given that most of these use inputs (capital, work and artefacts) to produce outputs, often of intangible or non-commercial nature, e.g. exhibitions, research, education and conservation.

A production function may then be defined, which may be valued in terms of productivity and efficiency through econometric estimation of cost functions, or through mathematical frontier methods (DEA etc). Such techniques allow thus to identify efficiency ranges, efficient units and causes of management inefficiency.

These results may prove an invaluable management tool, allowing to convert efficiency gains and ranges into guidelines for good practice, thus helping to establish rational criteria for fund allocation.

Further research lines:

Applying evaluation techniques to measure cultural institution efficiency, broadening the spectrum of analyzed institutions beyond that of museums.

Methodological progress, e.g. the use of non-radial distances in optimization models and the analysis of allocative efficiency, which involves attributing costs to a cultural institution's tasks.

Scope and economic impact of heritage

Cultural activities are experiencing growth and increasing ties with ICTs, thus offering enormous opportunities for creativity, innovation and productivity improvements. CH, along with cultural and creative industries, thus represents a new domain for development that may impact the comparative advantages of areas and regions.

Nevertheless, the relation between economic growth and culture must be viewed from a twin perspective: first, how much and in what way the latter contributes to urban and regional development; second, how economic growth affects the transformation of the cultural sector in cities and regions. As regards the second question, economic development may influence the extent to which citizens become involved in cultural activities as well as the conditions under which cultural goods are provided. It is therefore important to understand the spatial distribution and location of cultural and creative activities, as well as their impact on local/regional economic development.

Further research lines:

Studying the scope of CH and estimating its contribution to economic growth.

Studying the short and medium term economic impact of CH: comparative studies, methodological improvement, progress in the study of multipliers.

Studying the long-term economic and social impact: estimating externalities, cost benefit analysis of investment projects.

Studying the spatial logic of cultural activities: cultural clusters/districts, knowledge spillovers, etc.

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WHY AND HOW SHOULD INTANGIBLE HERITAGE BE SAFEGUARDED?

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Why should Intangible Heritage be safeguarded?

Cultural heritage is not limited to material manifestations; indeed it also includes intangible, living and fragile expressions, such as oral traditions, performing arts, festive events, or the knowledge and skills necessary to produce traditional crafts. Safeguarding skills and other types of intangible heritage poses a serious challenge to societies today: it gives a concrete meaning to human rights, promotes development and creates employment.

Even before we assert that skills can contribute to economic development, it should be pointed out that they also define and express the identity of an individual or a group and generate respect for it. Calling attention to skills and practices means acknowledging that history, knowledge and skills are the foundation of a person's identity and dignity. Even better, by linking these elements to a particular region and community, it is possible to enhance their image and prevent actions leading to their marginalization or exclusion. Undoubtedly, reference to the past does not necessarily guarantee the future but, by accentuating achievements and assets, it is possible to make everybody participate – even in varying circumstances – in the promotion of culture and development.

It should be remembered that one of the main characteristics of globalization is the elimination of boundaries between respect and scorn and between wealth and poverty, not only between countries but also between communities, individuals and regions within the same country. By stressing the fact that these communities, regions and individuals are equally worthy of respect because they possess knowledge and skills, even if limited and ill-defined, it is possible to restore their confidence and hopes for the future. Undoubtedly, it is not enough to assert this principle and it is very necessary to give them the opportunity to express themselves. The knowledge economy assigns a determining role to intangible elements when defining the production of new goods, which distinguishes cultural skills on two counts: firstly, as a source of heritage that is being continuously renewed, they support creativity; secondly, they put at the disposal of all economic sectors, ranging from arts and crafts to the automobile industry including fashion and furniture designing, a large number of references in the form of signs, shapes, colours and symbols. While encouraging creative processes, they propose innovative procedures that can be used by other sectors. The global economy provides greater opportunities for diversity by offering wider markets for specialized products. In addition, countries finding it difficult to face cost-based competition can find new markets by producing high quality goods because aesthetics now play a larger role.

In the specific area of skills and artistic professions, there are numerous reports underscoring the importance of the jobs in question and the ripple effect on other jobs. Though these jobs are important, they are not very stable. A recent study has shown that companies utilizing these skills to produce "cultural goods" are constantly exposed to a double risk (Greffe & Simmonet, 2008). Firstly, the product will sell only if it is known to be of good quality. Secondly,

companies utilizing these skills are often compelled to change from one product to another and thus incur extra expenditure for reorganizing and restructuring their activities. Further, the rate of default is often higher in the case of companies using traditional skills and craftsmanship than in the rest of the economy, especially after a period of three years.

How can Intangible Cultural Heritage be conserved?

The changes in attitude are quite drastic when you move from tangible to intangible cultural heritage. In the case of tangible heritage, mechanisms for its protection generally relate to expenditure for the conservation and maintenance of tangible elements. As for intangible heritage, the debate changes according to its nature and concentrates on the ability to transmit existing skills for the benefit of future generations; on intellectual property protection; and on economic sustainability.

The problem of transmission is evidently central to the safeguarding of intangible heritage and hence of traditional skills. As early as the 18th century, while preparing the Encyclopedia, Diderot came up against the difficulty of persuading craftsmen to describe the singular features of their trade and also their reluctance to reveal its secrets. After the French Revolution and the subsequent abolition of guilds, it was found necessary to create a mechanism for transmitting knowledge useful for various arts and crafts as well as industrial development. The need for education and training led to the establishment of remarkable institutions like the *Ecoles des arts et métiers* (engineering colleges) as well as an attempt to formalize this knowledge by the publication of technical text books.

Despite these tremendous efforts at formalization, a part of the knowledge on which skills are based continues to be tacit and accessible only through informal means to members of the family, the enterprise, the apprenticeship system, the workshop and "on the job". This informal training consists of several phases and different methods are used to transmit not only the technical aspects of the craft but also passion, sensitivity, culture and the tradition behind it. This training involves the transmission of knowledge about the structure of enterprises within which skills are put to use. In France as well as in Italy, there are numerous and varied official training programmes for imparting knowledge related to artistic crafts. Nevertheless, the quality of these training systems is going down: there are fewer students wanting to join schools of applied art because the courses have become longer and it is now possible to study the arts and also technical subjects in universities. At he other extreme, more ambitious mechanism are the *Master of Art* designation, inspired by the National Living Treasures of Japan: by bestowing a great deal of prestige on the position and assisting them to train one or more successors through adequate funding, they hope to be able to preserve cultural heritage over the years. This system, which seeks to ensure transmission of cultural heritage by turning a person into a much sought-after brand, is often criticized. It ensures the transmission of a skill rather than an activity. It takes for granted that there are people willing to be trained although salaries are not very attractive. It could bestow advantages and a privileged position on the selected person which, over the years, could crush competition. There are hardly new measures to protect the intellectual property rights of those who create products using these skills; they can only resort to indirect mechanisms such as patents and copyright. The international organizations concerned (WTO & WIPO) generally refuse to entertain cases related to the protection of intangible heritage, usually by advancing two arguments: what is the exact state of the skill and who holds the title to the skill in question? It therefore appears that the producers themselves must take measures to protect their products by adopting a label or a brand by enlisting those who will benefit from such recognition. It is to be regretted that UNESCO has not openly challenged the World Trade Organization, because losing this battle means lack of protection for these skills and turning one's back on the very idea of safeguarding intangible cultural heritage. As a matter of fact, "insiders" can take

advantage of the attention lavished on certain activities to enter the field and benefit by the low production costs, thus transforming what was conceived as a project to safeguard heritage into a project for producing kitsch!

There is nothing to show that public subsidies suffice to solve the problems of economic sustainability. The study mentioned earlier (Greffe & Simonnet, 2008) has in fact drawn attention to a paradox regarding funding: the response from banks is positive to the extent that they know how to judge the quality of projects and select those that are likely to have a higher survival rate, but taking a bank loan reduces the probability of their survival because they have to pay interest on the loan. It would therefore be advisable to establish a partnership between the private and public sectors by giving the private sector a major role in the analysis of projects, but bring in public funding to boost their sustainability.

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The challenge here is to ensure that these policies fit into the complex framework of the global economy in order to successfully transfer and employ these skills and their techniques in other sectors combining tradition and creativity. From this viewpoint, one can draw attention to some remarkable instances like the employment of techniques commonly used by basket-weavers and rope-makers in water-sports and fiber optics. Further, ceramists' skills have been used for manufacturing components for the aeronautical industry.

It is evident that the elements highlighted above constitute numerous work-sites and that the measures listed in this abstract should be able to provide solutions. But these measures will not be practically effective as long as the idea persists that elements of intangible cultural heritage need to be preserved in order to remain faithful to a nostalgic and marginalized view of the past, whereas they represent knowledge, skills and practices that should be transmitted to future generations because they promote creativity and development.

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THE MARKETING OF CULTURAL HERITAGE: SOME TOPICS TO BE EXPLORED

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Among the challenges Cultural Heritage is facing, and apart from the preservation of fragile artefacts, an important one is the fact that the marketing science knows very little on the behaviors of the cultural consumers; compared to the general marketing, the advanced of knowledge in the cultural sector is at its infancy. This presentation aims at discussing some of the topics deciders could benefit from more in depth knowledge from marketing.

When talking about consumer behaviors, scholars are interested by three fundamental dimensions that one can express by asking three questions: Who? Why? And How? The first question has been researched thoroughly over the last 40 years. We know now that cultural consumers can be divided along a continuum from popular culture to high culture, and that those at the extreme of high culture (contemporary arts for example) are very educated while those located on the other extreme are bearing the general characteristics of the population at large. We also know that this phenomenon is identical in every industrialized country and did not change despite all the efforts made by governments throughout the world. We also are aware that the percentage of the population interested by high art is the same everywhere.

Moreover, the case of cultural heritage is slightly different even if the general pattern is similar. Visitors of cultural heritage are either locals or tourists. Those two segments are different. Locally, families are very present on heritage sites. International tourists have culture among their top priorities when they travel far away. Knowing those factors is interesting but it does not help the manager to decide on the focus to put in the advertising campaigns or does not help to understand how decisions are made by consumers when deciding of a destination.

Since the pioneering works of Holbrook (1982), we know that cultural products can be classified as experiential products. Going to a venue or to a heritage site has no utility in the traditional sense. It is not food for the body, it is not a means of transportation, and there are no tangible benefits that one can observe. The contact with the past through objects gives pleasure, learning, feelings, but those are all intangible benefits. This relates to the "Why" question; in marketing we can distinguish two components to this question, the way consumers feel about the contact with the work of genius from the past, and the reasons why somebody would enjoy this type of experience.

Some researchers have conducted works using the semiotics methods to understand the meanings for visitors when they visit heritage sites. Others have explored the esthetic experience people get from their visits. Still others questioned the role of social ties in the choice of an outing (Assassi and al., 2010).

All those knowledge need to be refined and push further because we are only in the beginning of this exploration. The same can be said on the motivators for consumption. Researchers know very little on the reasons why some people enjoy this or that type of cultural events, or why some citizens have no interest in acquiring more knowledge on the past of human being. If the level of education is correlated to visiting heritage sites, it does not say anything on the

why those more educated show interest while those less educated are staying far from this kind of human experience. We are aware that tastes and preferences are formed when people are young. But, this being said, it does not say more on the mechanics that leads to the appreciation of art works of cultural heritage.

Apart from the question "Why?", the other important question is the "How?" people are making their decisions. But again, this relationship to price of entry is only one aspect of the steps potential consumers follow when trying to make a decision. We know little for example on the decision process among family members of a person, with his or her friends. Little has been published in the arts management literature on the dimensions that are taken into account in the process. Neither do we know about the effectiveness of diverse forms of advertising and the best arguments to use.

In conclusion, academic research in the marketing of cultural heritage is at its beginning. It constitutes a challenging field for academics. Every piece of information we can get on this matter will help managers and public authorities to improve the marketing of cultural heritage. Those pieces of knowledge are important in our contemporary world where supply of cultural products is well above demand, and where tourist's destinations are fighting for the travelers' attention. A well thought positioning is the solution for good marketing strategy (Colbert, 2009). Trying to come up with a sound positioning means marketers know not only who the potential consumer is, but why this consumer would choose this attraction over the other, or what are the elements he takes into account in its decision process.

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SUSTAINABLE CULTURAL TOURISM IN EUROPEAN URBAN SYSTEMS – STATE OF RESEARCH AND POLICY RECOMMENDATIONS

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THE SAFEGUARD OF CULTURAL HERITAGE

Cities have always represented a focus of attraction for travellers and pilgrims. More recently, urban tourism has become an important phenomenon at a global level, also due to the development of low-cost air connections, the segmentation of leisure time and the growth of city breaks. At the same time, the role of urban tourism as a driver of the economic development of European cities has emerged and its fundamental contribution to the revitalization of urban economies has been confirmed in famous cases of regeneration of post-industrial cities[1]. Cultural heritage and creative industries have represented a fundamental axis of intervention in successful urban planning strategies, wherein the preservation and management of cultural sites and artifacts, as well as the staging of involving experiences for visitors through enriched marketing and events, have taken an increasing priority.

Consistently with these phenomena, urban cultural tourism has acquired a stable position in the research agenda, with a number of studies and surveys focusing on the demand side (Ashworth and Turnbridge, 1990; McKercher, 2002; Poria *et al.*, 2003; ETC, 2005). In particular, a widely acknowledged evidence is that several segments of cultural tourists exist, each characterized by different intensity and centrality of cultural motivations in the visit experience[2]. These findings have also provided insights into the tourist offering of cities, wherein tangible cultural heritage (monuments, museums) can be represented as the core of the urban tourism experience, whereas the intangible cultural elements (contemporary and performing arts, fashion, music, design, gastronomy etc.) form its "outer circle". According to this view, the two aspects appear as complementary and converging in many places (ETC, 2005)[3]. Over the last few decades, urban tourism has attracted the attention and efforts of national and international institutions, which have developed inter-sector cooperative projects aimed at the economic enhancement of culture through tourism (such as the European Capital of Culture programme).

Increasing efforts have been also put in identifying and measuring the effects of tourism development and related policies on urban economies and societies, by applying the Tourism Satellite Account methodology and in-depth case studies (Palmer and Richards, 2007).

Economic and social benefits stemming from the tourism enhancement of culture within urban systems can be classified as follows:

- revitalization of urban economies through increased financial returns and employment in tourism, culture and in the industries belonging to the tourism value chain (Antonioli, 1995);

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[1] Emblematic cases of urban regeneration those of Barcelona, Glasgow and Bilbao.

[2] For instance, McKercher (2002) differentiated between five segments (serendipitous; purposeful; incidental; casual and sightseeing cultural tourists) on the basis of the depth of visit experience and of the importance attributed to culture.

[3] Accordingly, the ETC has classified European urban tourism destinations on the basis of their endowment of cultural heritage and creative industries (big cities, such as Berlin, Istanbul, London, Paris and Rome, occupy the first rank).

- improvement of city image and of its attractiveness as a location for high-value-added and knowledge-intensive industries;

- positive spillovers on other tourism segments, such as MICE (Antonioli and Gallo, 1998; Hankinson 2005);

- increased financial support (through direct transfers, partnerships, sponsorships etc.) for the safeguard of cultural heritage, in addition to the transfer of managerial capabilities;

- increased mobility of economic and social actors, leading to an overall enrichment of the city's range of capabilities;

- stimulus for public planners towards improving the city's network.

Alongside with this wide range of benefits, though, a series of negative spillovers of urban tourism have gradually manifested:

- increasing physical pressure on heritage sites due to exceeding of their carrying capacity;

- pressure on transportation infrastructure and points of access in some places;

- impoverishment of the visit experience of heritage attractions due to congestion and reduced length of stay;

- a tendency –in a context of asymmetrical information between producers and consumers– towards the decrease of the quality of tourist goods and services due to the rent-seeking behaviour of several tourism operators and to the difficulty in building a quality reputation capital (Caserta and Russo, 2003).

All of these themes imply relevant research and policy priorities.

As regards *research*, "there is still a considerable way to go in terms of developing a coherent corpus of work, pursuing and carrying out comparable studies" (Pearce, 2001). Studies on tourist behaviour at heritage sites and cities should provide us with accurate information about tourists' contribution to shaping and even altering the spatial patterns of the visited areas: to this purpose, the assessment of the effects of physical pressure needs can rely on the emerging application of geo-referentiation studies (see, for instance, Shoval and Raveh, 2004).

Moreover, comparative studies focusing not only on cities, but also on individual urban districts are welcome to increase our knowledge of the processes of integration or separation between urban areas (Pearce, 2001).

Another level of analysis sets tourist cities within a larger economic context, considering them as parts or nodes of a super-regional network (Pearce, 2001), wherein each city can represent the point of access for a region or country and can be inserted in a wider travel circuit (as in organized international travel). In particular, the tourism demand originated by emerging countries (BRICs) perceives Europe as one entity[4]: as such, the relationships between different urban destinations both from a tourist behaviour and a marketing/distribution point of view should be further investigated.

The most promising field of study, though, is related to tourism governance in urban systems, which should provide more insights into the involvement and role of different stakeholders in formulating and implementing tourism policies at city level. To this purpose, comparative case studies investigating how, within different urban contexts: power and persuasion patterns influence tourism policies leading to specific planning and marketing strategies[5] (Marzano and Scott, 2009); how tourism policy networks at both a local and trans-local level develop and grow in time (D'Angella and Go, 2009; Baggio *et al.*, 2010); how policies are evaluated in terms of both economical benefits and social spillovers (Antonioli, 2000b; UNWTO, 2004a), are welcome.

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[4] This is one of the findings of a study on Chinese tourists in Italy (Antonioli, in press), underlining the necessity to promote Europe as an umbrella brand towards the Chinese market. A contribution to the coherence (within diversity) of the promotion of the cultural heritage at the European level can be represented by the European Heritage Label, that will be awarded by the Commission to sites which symbolise European history and values.

[5] A related field of research appears the internal marketing and branding of urban destinations, that is the destination managers' persuasion and communication efforts to mobilize internal stakeholders towards the destination brand, so that they can support the brand message towards the outside in a cooperative perspective (Snaith and Haley, 1999).

In general, the functional and socio-economic complexity of urban systems calls for a more multi-disciplinary approach based on a closer collaboration between economists, management scholars, sociologists and economic geographers.

As regards *policy* guidelines on urban cultural tourism both at local, national and international level, many fields of intervention seem to exist –and have, in some cases, already been activated– in order to foster the sustainable economic and social development of art cities.

First, the need for constantly collecting and processing both quantitative and qualitative data on tourists' motivations, patterns of visit, satisfaction and expenditure cannot be overstressed. In particular, the next step in the development of urban tourism observatories (Antonioli, 2000a) is the enhancement of the tracking and evaluation of the economic and social spill-over arising from tourism, including the levels of physical stress placed by visitors on the urban infrastructure and environment[6]. The availability of an adequately rich and deep cognitive basis is, in fact, a fundamental requirement for effective planning and regulation including limitation of access to congested or endangered sites (UNWTO, 2004a). Nonetheless, tourism data and statistics alone are not sufficient. In other words, urban destinations should upgrade their marketing from the one-way supply of information, to a more interactive communication approach, which builds on an improved knowledge of tourists' information needs and motivations (Antonioli, 2003). Within a sustainability perspective, efforts should thus be targeted at improving the tourists' awareness and interpretation of the multiple elements of the offering of art cities and to educate them to attribute a premium cultural value and price to high-quality experiences (i.e. cultural services, accommodation, local gastronomic culture etc.). This means to commit to "tourist education", in order to convert touch-and-go visitors into high-quality, repeat visitors, willing to get in contact with the destination, its culture and its residents and to preserve its peculiarities. In particular, communication initiatives targeted to long-haul, emerging markets should aim to increase their knowledge of European culture and to reduce their cognitive distance by providing them with links to their home cultures. Tourism education can find a useful support in ICTs, referring especially to the recent development of mobile technologies (i.e. tools for interactive interpretation and customized cultural itineraries' composition) (Antonioli and Baggio, 2010). This strategy, on its turn, calls for improved education and qualification efforts directed at the tourism industry, whose ability to improve service quality and interaction with customers should be encouraged through formal and informal training initiatives.

Consistently with the systemic nature of urban contexts, a major issue in cultural city tourism will be represented by cooperation among a large range of stakeholders. Partnerships appear as the most suitable vehicle for achieving shared benefits at four levels:

- intra-sector level (as regards the heritage industry, the creation of city-wide networks or circuits of sites and operators etc);
- inter-sector level (i.e. between the cultural and the tourism industry, which should learn to "adopt the same language" and to make communication and education efforts converging towards shared sustainable goals) (ETC, 2005);
- city level, wherein internal communication should raise the awareness of the importance of tourism within the local community (Snaith and Haley, 1999; UNWTO, 2004) and strengthen the relationships between different actors and urban districts (Antonioli 2000b);
- city network level (e.g. thematic routes and itineraries).

As can be seen, these strategies represent difficult challenges that will require a high degree of maturity by both

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[6] In particular, the monitoring of the impact of special events should be encouraged in order to assess the social and economic benefits of the human and financial resources absorbed against alternative allocations in the cultural sector.

tourism and cultural operators and institutions. But time cannot wait, if we aim to take advantage of the outstanding economic and social opportunities offered by cultural tourism at an European and global level.

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ENVIRONMENTAL AND CULTURAL SYSTEM (ECS) - 'LANDS OF LUPIAE' "NATURAL AREAS, ARCHEOLOGY AND CULTURE IN APULIA ON THE MESSAPIA COAST"

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THE SAFEGUARD OF CULTURAL HERITAGE

Aim and objectives

In October 2010 Apulia Region started its Cultural and Environmental strategy promoting Cultural and Environmental Systems (ECS) as "aggregations of organized resources" able to promote their cultural and natural heritage as potential developing resources.

In this direction the University of Salento has promoted five ECS proposals thanks to a territorial Protocol agreements, named "Public-private network for the integrated development of tourism in Salento", being responsible for methodology and co-planning.

In particular, the ECS *'Lands of Lupiae', natural areas, archeology and culture in Apulia on the Messapia coast* involves ten municipalities around Lecce and it promotes an innovative and integrated management of environmental and cultural heritage.

Strategic objetcives are:

increasing competitiveness of the area through improvement and increasing of territorial attractiveness;

diversifying socio-economic development of the area, leveraging on valorization of its environmental and cultural specific factors.

Operative objectives are:

Identify environmental and cultural resources aggregations to valorize;

Defying the 'Idea-strength' of valorization;

Defying governance model of management and organization.

Approaches:

Interdiciplinary approach;

Research – action;

Normative – planning (G.R. n. 332, 10 Feb. 2010 – n. 2329, 29 Oct. 2010).

Methodology

The paradigm of enhancement that inspired the planning methodology is based on "*the system value creation, within which different economic actors - suppliers, partners, allies, clients - work together in order to co-produce value*" (Normann & Ramirez 1995). It is composed by the following principles:

cultural heritage is conceived as a capital to which it is possible to match a potential flow of performances;

organizations concerning enhancement have a vital role through production of services/goods.

enhancing strategy consists in activation of synergies with different local actors in order to co-produce socio-economic value.

The ECS *Lands of Lupiae* should help all the involved municipalities to carry out their natural vocation to the development of a system. It should help to deseasonalized summer tourism boosting the *umland* and its cultural peculiarities; moreover, it will distribute Lecce excessive pressure of tourism demand through the ECS' territory. All the municipalities will be involved in socio economic dynamics activated by tourism.

For these purposes the methodological steps were:

A. Identification of environmental and cultural resources to aggregate;

B. Identification of key-stakeholders (Jamal & Getz 1995; Lazzeretti 2004);

C. Defining operations of integrated management.

Preliminary Results

The integrated planning process led to the formulation of the enhancing 'Idea-strength' and to the theorization of the governance, management and organizational models.

ECS idea-strength is based on the construction, triangulation and networking of three thematic "routes": *Nature route*, *Archeological route*, *Art and Crafts route* (Fig. 1). These represent the three main values of local cultural identity, upon which the proposal bases the total attractiveness of ECS area, considered as driving assets of knowledge and of innovative community-based management methods.

ECS governance is achieved through the collaboration agreement ex art. 15 L. 241/90 (community-based to legitimize economic entity) for the joint management in some business functions and in the three product areas (Nature, Archeology, Art and Crafts). The model is completed with the design of a matrix organizational structure to avoid costs due to the duplication of similar functions and activities and to point out areas of specialized expertise in specific products.

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ITC AND MUSEUMS: THE ROLE OF WEB SITES IN CREATING KNOWLEDGE

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THE SAFEGUARD OF CULTURAL HERITAGE

The artistic, historical and scientific heritage preserved by museums represents both a driving force for economic enhancement and a resource to be employed in the cultural development process of the community.

Through the evolution of marketing and management studies museums have been pushed into the marketplace and are now considered organizations producing services. This means competing for visitors with each other and with other cultural and leisure attractions and carefully managing resource productivity and economic responsibility. Authors therefore focused attention on the role of the curator (Bradford 1994), the relevance of personnel management (Friedman 1994), the outline of a financial mission, the need for museum planning (Hatton 1994) and in particular on the adaptation of marketing policies to non-commercial realities such as museums (Kotler and Kotler 1997).

Nowadays the current focus on management is increasingly enabling museums to grasp more firmly why they exist, what they aim to achieve, and how this can most effectively be realized. Museums exist because there is a collection and a cultural project around it; they can be thought as the memory of the past and the witness of a specific geographical area and context (Lazzeretti 2004) and it's through them that culture and knowledge can be not only preserved but also handed down to succeeding generations. Therefore the mission of a contemporary and active museum can't be limited to safeguard cultural assets as well as simply show its collection, but it consists of increasing and spreading knowledge in the community. From this point of view the main question is whether collections can be considered not just as rents but as resources not being directly exploited to gain profitability but used to produce high quality cultural services. Museums incorporate such a huge heritage of explicit and tacit cultural knowledge as well as specific know how, that they can be defined as "knowledge resource systems" and they can act as competence centres, so as to realize innovative cultural projects. That means revalorizing the "social dimension" of museums, leaving the creation of economic externalities to networks with businesses and local authorities. According to this perspective museums are means of communication with the public and their main purpose consists of encouraging visitors to see their collections, to gain a better understanding of works of art aa well as to have meaningful experiences.

Cultural assets have a rich cognitive value which, due to their considerable complexity, only people with particular skills and background can actually understand. From this point of view Information and Communication Technology can be thought as a crucial resource in a market-oriented perspective, by allowing museums to differentiate their product and to reach different segments of public in the most appropriate ways. Among the huge quantity of interactive multimedia (Fahy 2003, Fopp 1997) attention can be focused on web-sites, which can significantly improve the relationships with the public. They often represent the first contact (the Normann's truth moment)

between museums and different segments of demand as well as the only way to reach the large number of the non-visitors. From the structure itself of the web-sites it depends the possibility for museums to encourage people to know and see their collection. A web-site can include commercial news, information about activities, laboratories, exhibitions as well as on the one hand what we can call scientific products (e.g. digital archives, catalogues, data base) and on the other hand cultural products, which are specifically created for the public, such as explanations of the collection, virtual museums, visits on-line. Relevant peculiarities obviously characterize different categories of museums (e.g. scientific versus artistic museums; big museums versus small ones); however an analysis of museums web-sites allows us to distinguish between "product oriented web-sites", where the scientific section is the most important and the language is for experts only, and "market oriented web-sites", where attention is focused on attracting visitors through proposals of a wide range of activities, events, courses and trails. From this point of view the web-site reflects the mission of the museum and the analysis can result in showing best practices and market strategies to implement. In particular web-sites can facilitate the accessibility to museums both in a cognitive and in a physical way. As regards cognitive accessibility, web-sites provide museums with all those differentiation tools which don't exist in the real world; interactive spaces, exploring paths and cultural projects can be created in order to guide people within the complexity of collections so as to in-

crease their level of comprehension and appreciation. In addition new technologies allow museums to overcome the physical obstacles linked to the display of the collection; works of art which aren't physically accessible and visible to the public can be virtually shown. Especially in Italy not many museums are able to display their whole collection to the public: on the one hand bigger museums preserve a huge heritage within their deposits, because they often lack enough space to show it; on the other hand a great number of smaller museums, which consists of a culturally relevant "spread heritage", doesn't sometimes have even the resources to open to the public. Consequently the creation of itineraries through galleries, on-line tours, virtual thematic visits can be the only possibility to have a public fruition of a huge hidden cultural heritage. Virtual museums are an extremely effective means of communication with the public as well as a powerful way to create innovative cultural projects, which are impossible to realize in the real space: they can join collections which are even located in different contexts far from each other, they can include elements which are physically spread throughout several museums, they can integrate different elements so as to communicate the whole image of a geographical area or a historical period. What they can show is an "impossible museum".

Conclusively, in order to realize their social mission of creating knowledge, museums must learn to use Information and Communication technologies and web-sites not only to commercialize their product but also to "build" something culturally new.

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POLICIES AND MANAGEMENT OF THE HERITAGE MUSEUM IN THE DIFFERENT PERSPECTIVES OF VALUE: METHODS AND TOOLS OF MEASUREMENT AND COMMUNICATION THROUGH ICT

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Aim of the research project

The research aims to understand the ways in which museums and heritage (artistic, archaeological, ethnographic and anthropological, scientific, historical, environmental) spread in the Region of Tuscany, can be properly "evaluated". This "improvement" is implemented, combining the economic profiles with the cultural, social, ethical, aesthetic and educational profiles. The economic impact generated by this "improvement" can not be separated from the others, especially from the cultural value that includes the basic elements of our social fabric, such as identity, knowledge of their roots, link generations. Several factors pertains to the economic sphere, such as the intangible values which decrees the degree of attractiveness of a territory. Therefore it seems essential
to consider jointly the profiles considered relevant by linking together political and managerial choices. In fact, the enhancement of the Heritage Museum of the country can not be achieved except through a close connection between the time of formulation of the choices and their concrete realization. Too often, however, in the museum's interest and emphasis has been stopped at the policy level with no result in terms of implementation. And too often has been placed carefully on the programming phase without checking, during summary, the very real effects and real results. Attention has therefore focused on "management of the museum, without of course neglecting the related organizational aspects, but concentrating mainly on the size detected.

Subject of the research

The research project addresses the issue of measurement systems in the context of museums, with internal and external disclosure purposes. A measurement system, therefore, "integral", that is directed inwards, to support the decision-making processes of choice and control, and externally to encourage the reporting, disclosure and transparency to the community and "integrated", i.e. able to reconstruct the events to drive quality and quantity (monetary or otherwise) of management. In other words, a multi-dimensional measurement system that can provide all the information, such as to enable multi-stakeholder evaluation of the effectiveness, as well in view, productivity and efficiency of the institution-museum. For it must be matched by multi-level communication system, which tends to create a partnership - that can generate learning - both internally, through the development of programming systems and control, and outside, through various forms of cooperation between the institution and social actors.

Target of the research

Implement a multi-dimensional measurement model taking into account:

Financial dimension

Economic dimension

Social dimension

Cultural dimension

Sustainability dimension

Research phases

STUDY OF THE MULTI-DIMENSIONAL MEASUREMENT MODEL AND MULTI- LEVEL COMMUNICATION.

EXPERIMENTAL APPLICATION OF THE MODEL TO SCIENCE MUSEUMS (the

Museum of Natural History, University of Florence and Siena University Museum System)

DESIGN OF A TECHNOLOGY PLATFORM IN ORDER TO COLLECT AND STORE RECORDS AND INFORMATIONS IN A

CENTRALIZED DATABASE EXTENSION OF MODEL TO MUSEUMS IN THE TUSCANY REGION

TRAINING OF MUSEUM STAFF

ACTIVATION OF THE BENCHMARKING PROCESS IN THE MUSEAL ENVIRONMENT

This study means to obtain the necessary knowledge to establish "guidelines" to regulate the measurement and reporting of museums and create the conditions for the formation, at regional level first, and national levels, then, a culture accountability. reporting of museums and create the conditions for the formation, at regional level first, and national levels, then, a culture accountability.

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AGENDA FOR MUSEUMS: THE NEXT FUTURE

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THE
SAFEGUARD
OF CULTURAL
HERITAGE

The future of museums is closely related to the evolution of several interconnected factors. Among them, for example: changes in socio-demographic structure of population, with the related subject of social inclusion; the growing importance of new information technologies, with special regard to their impact on individual behaviour and on interpersonal relationship; the progressive cuts in public financial resources, with the consequent need to find new and more profitable collaborations with the private sector (volunteers, patronages, partnerships, etc.); the increasing competitive intensity with alternative forms of leisures, requiring the identification of strategic options in order to mobilise available resources and enhancing competitive abilities.

Below are some reflections about international emerging issues, clearly involving the development of an adequate debate.

1. The first milestone for museums future is the idea of a visitor at the very heart of any decision. Without visitors, museums lose their social *raison d'etre*, just maintaining the XIXth century one, as merely artworks warehouse. In this perspective, it will be necessary the development of new approaches to valorisation processes, based on a different communication framework and on the exploitation of information technologies; among them, we can refer to "location aware" mobile devices, that will redesign traditional visiting experience.

In such a new relationship between museums and their users, a growing importance will be held by visitors surveys, aimed not only at measuring customer satisfaction but also focused on finding out unexpressed needs. Such surveys will take advantage of increasingly sophisticated techniques and methods: for instance, researches based on the observation of behaviours can nowadays use detection and processing techniques that will made them easier to be introduced in museums ordinary research activities.

The further key of the new relation with visitors shall be new communication technologies, with special regard to the so called "Social Media", web-based communication tools transforming the (traditionally unidirectional) information flow into a dialogue with many voices. As a matter of fact, the individual addressed by a museum is not longer a user-viewer, rather a player inside the relation. The user, moreover, is not just the museum visitor but even the web surfer who interacts through internet with the museum and other individuals, with whom he/she builds a relationship based on information interchange and on knowledge and common interests sharing.

2. The second central topic for the future of museums is the relationship with the local community. Widely financed from public sector and then through tax levying, museum shall increasingly face the case of their own legitimacy not only, as in recent times, from experts and professionals, but also and above all from ordinary citizens.

To achieve such a legitimacy, museums shall deal with different challenges: firstly, the challenge of accountability, concerning how and how much public funds are spent, to be developed through communication tools as Annual Reports and, moreover, certification activities carried out by independent evaluators; secondly, museums need to submit their activities to economic impact evaluation using shared and verifiable methods, in order to measure the results of a public investment in their sector; the third item is museums role in strengthening the attractiveness of a region in cultural tourism market, within the destination marketing strategies developed by local authorities.

3. Another central subject in the future of museums is financing, that shall find new ways to weigh less on public spending, in some countries already being highly reduced. In this respect, the main pathways to be explored could be identified as follows: first, a wider and structural use of volunteers, through long-term agreements with local organizations; second, partnerships with private subjects in large-scale projects (see the recent Italian case of the restoration of Coliseum thanks to private enterprise funds), strictly dependent from the adoption by governments of special tax incentives; third, the internationalization of temporary exhibitions, through the development of "ready-to-go" exhibitions, with artworks even coming from museum deposits and addressed to new markets, with fall-outs on cultural and tourism promotion of the region where the exhibition is born.

4. At last, the ultimate modernization of museum leads to consider in a totally new way the issue of professionalism and to put human resources at the centre of the reflection about museums efficiency; such a topic shall be framed in the perspective of professionalization, training and commitment towards managerial matters.

5. All the above mentioned items shall be located in a museum governance framework different from the one characterising so far this sector, particularly in countries like Italy; this framework shall provide criteria of managerial, financial and recruitment independence; such independence shall be linked, thanks to appropriate systems, to responsibility and rewarding systems based on shared and comparable performance indicators, able in paving the way to accreditations schemes directly related to public financing.

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CULTURAL HERITAGE, TOURISM AND REGIONAL COMPETITIVENESS

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Policy makers are relentlessly seeking forms and arrangements for increasing the social and economic prosperity of their regions. International studies suggest that the prosperity of a region is directly related to its competitiveness, hence to the productivity of its economic systems and finally to the innovation capacity of its organizations (Porter, 2008).

Theoretical background

After many decades of relative neglect, cultural heritage has recently gained an increasing importance at different levels of the economy (Florida, 2002; Scott, 2002; Hesmondhalgh, 2002). More specifically, there is a growing awareness that regions may build their competitiveness leveraging their cultural heritage. Further, the erroneous idea that the economic enhancement of cultural heritage may hamper its safeguard and vice versa is gradually and globally evaporating. Cultural industries and high-culture regions are a fertile ground to study entrepreneurship, innovation, knowledge exchange and networks (Lazzeretti *et al.*, 2008). Innovation is key, as the long-term success of cultural organizations depends on the ability to continuously renew available resources and create new ones in an incessant entrepreneurial process. Within high-culture regions, networks constitute a strategic resource for nurturing different forms of innovation and for turning innovation into collective competitiveness and regional development (Porter, 2008). Along this line, there has been a growing debate in literature on the interplay between cultural heritage, regional competitiveness and entrepreneurship. Since 2007 several journal issues[1] have focused on the centrality of cultural assets for regional development (Cooke and Lazzeretti, 2008), innovation (Muller *et al.*, 2009) and competitiveness (Porter, 2008). Likewise there is large consensus that tourism plays a key role in the development and competitiveness of some regions, especially in relation to the tourism enhancement of culture (Cooke and Lazzeretti, 2008). The result is an increasing debate in literature on tourism clusters (sometimes overlapped with cultural clusters) and destination management.

Empirical evidence

Such a global shift in public policies leverages cultural assets and organisations to promote new forms of entrepreneurship and regional competitiveness, to attract tourists and strengthen destinations and to favour the centrality of knowledge workers and innovators. Several regions and cities have embraced a culture-based turn in their policies. Empirical evidence reveals a wide variety of strategies and policies on this side and often includes a mix of actions that ran-

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[1] We are referring to: the 2007 issue of *Journal of Organizational Behavior* on "Paradoxes of Creativity", the 2008 issue of *Journal of Economic Geography* on "Geography and the Cultural Economy", the 2008 special issue of *Industry and Innovation* on "Managing Situated Creativity in Cultural Industries", the 2009 special issue of *Human Relations* on "Managing in the Creative Industries", the 2009 special issue of *Innovation management, policy and practice* on "Creative Industries and Innovation Policy", and the 2010 special issue of *Industry and Innovation* on "Creative Jobs, Industries and Places".

ge from new infrastructures to cultural programmes to education policies, from huge museums to events and festivals. In general terms, two main ways for the leveraging and economic enhancement of cultural heritage emerge:

investing in infrastructures, architectonic and urban requalification, and great events (as a means for attracting new resources or restyling touristic destinations);

activating diffused and entrepreneurial micro-policies able to leverage a multitude of cultural assets and produce new culture.

This second approach interprets cultural heritage not as a mere legacy or a pure resource endowment to be purely safeguarded or even exploited, but as a means for generating new ideas, new knowledge, new industries, i.e. to foster innovation and entrepreneurship. Along this line, cultural heritage becomes alive and productive and becomes core for regional prosperity and competitiveness. Tourism plays a central role to this respect, activating important synergies with cultural heritage. Cultural assets are crucial in attracting tourists to a specific destination, while tourism brings new and fresh resources to the cultural sector, spotting new entrepreneurial opportunities.

Research gap and design

Despite this increasing debate in literature, the relation between cultural heritage and regional competitiveness remains vastly unexplored, especially in relation with the mediating role played by tourism. Likewise, empirical evidence on this topic is still anecdotic and descriptive and cases are still embryonic. Hence, a number of research questions arise:

Whether and how is it possible to ground regional competitiveness on cultural heritage?

How to set up a competitive cultural cluster?

How can tourism be synergic with cultural heritage in a cultural cluster?

How and under which conditions a cultural cluster can be a source of innovation opportunities?

In order to answer the above-mentioned research question the paper refers to an explorative case study, i.e. Motor Valley[2] (in the Modena area in Italy), that constitutes a benchmark for learning how tourism and cultural heritage may engage in a virtuous circuit for regional competitiveness and thus prosperity. Motor Valley is internationally recognized as an outstanding case for investigating the above mentioned research questions and its analysis has helped suggesting further research and policy challenges.

Future research challenges

Conceptual studies on the definition of cultural clusters.

There are several overlaps as well as contradictions in the way cultural heritage and regional development are put together in conceptual terms.

The process of clustering in cultural heritage and cultural industry.

How cultural clusters emerge and evolve through time? Spontaneous processes vs. top/down policy design?

How can former industrial districts become cultural clusters? How can touristic destinations become cultural clusters?

How to leverage sporadic cluster initiatives (events, networks, ...) to build up a cultural clusters?

Sparse and anecdotic evidence on cultural clusters and their links with tourism and entrepreneurship.

Need for in-depth comparative studies of cultural clusters around the world

How can cultural heritage become an engine for regional entrepreneurship and foster innovation?

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[2] In this case, the regional identity and heritage on the motor sport industry allowed the creation of a new form of cultural cluster, where major firms in the motor industry, artisans, tourism organizations, sport facilities, institutions and cultural organizations (corporate and industry museums, private collections, etc.) are beneficially tied together in a self reinforcing mechanism of competitiveness nurtured by tourism flows.

How entrepreneurial opportunities are generated, spotted and exploited in cultural clusters?

What is the role of tourism in culture-based competitiveness? How tourism is synergetic with cultural heritage? Under what conditions?

Future policy challenges

Beyond cultural heritage, towards its economic enhancement: to recreate authenticity (experience, ownership and identity) is the new frontier for policy makers and local governance

How to balance preservation of cultural heritage, exploitation, valorization and production in regional competitiveness policies?

How the economic enhancement of cultural heritage is compatible with its safeguard?

Which policies help to shift from the safeguard and valorization of culture to its production and renewal?

How to identify the social processes of both production of new and conservation of older, cultural heritage?

How to promote convergence between tourism and cultural industry in policy interventions, communication and education programs?

How to convert former industrial clusters in cultural clusters prepared to compete in the experience economy?

The governance of cultural clusters is the real challenge!

How to arrange meta-managers for a cultural cluster? How many? Public, private, PPP?

Which roles, duties, power and resources?

Temporary or permanent governance? Participatory, advisory or top-down governance?

Finally, there is a tremendous need for hybridization of competencies and redesign of curricula in the entire cultural sector (industry and heritage).

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KNOWLEDGE CITY STRATEGY: THE CASE OF BARCELONA

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THE SAFEGUARD OF CULTURAL HERITAGE

Since the late 80's Barcelona has become a global metropolis. Traditionally, Barcelona has performed an economic role of leadership of Spanish economy: about 17% of the Spanish production was concentrated there. The traditional industrial economic base was oriented to the Spanish market. Now its economy is oriented basically to the global market. The change of economic base is related to the existence of specific territorial competitiveness factors: urbanization economies, localization economies, knowledge externalities and network economies. The presentation offers the output of some researches concerning the dynamic of the metropolitan labor market, the network of cities and the knowledge based economy. There is an industrial network of cities with pre-industrial roots ("carrers de Barcelona") and some cases of historical industrial districts (as Mataró, Granollers, Sabadell, Terrassa) than explain the existence of an interesting polycentric metropolis. History matters.

In the second part of the intervention, we explain the knowledge-based Barcelona project. Knowledge is considered as a factor of production. The urban strategy of Barcelona is based on the concept of Knowledge-based economy. The new zoning changes in the functional planning. The new 22@ activities are organized using three criteria: density of knowledge, density of skill workers and density in the use of new information technologies.

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BUSINESS MODELS AND NETWORKS OF CREATIVITY IN HISTORICAL INDUSTRIAL DISTRICTS AND LOW-TECH SECTORS: CREATING COMPETITIVE ADVANTAGES FROM RESILIENCE

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Creativity and innovation have long been central concepts in a variety of literatures in management and organization, as well as related literatures on regional studies, entrepreneurship, economic development, and economic geography. Given the macro-economic importance of creativity and innovation for wealth generation and job creation, it is not surprising that there is growing scholarly interest in the conditions under which people can apply their creative energies to produce successful innovations. At the individual level, researchers have asked about the kinds of skills, talents, and motivations people need to possess to recognize and pursue new entrepreneurial opportunities. At the organizational level, they have studied factors at the workplace that facilitate individuals' creative contributions. And at the macro-economic level, they have investigated the technological, institutional, and territorial settings in which creative activities can flourish. The proliferation of studies devoted to the management of creativity continues unabated (Rickards et al., 2009).

Creativity and innovation are often treated as though they were identical concepts. However, there are distinct differences, with implications for the way they are studied (Sternberg and Lubart, 1999). Creativity is the production of new ideas or actions, whereas innovation is the larger process of both generating and applying creative ideas to obtain an outcome that is novel in some way. Innovation derives from the recombination of new ideas into a physical product or tangible service that enters the marketplace through the innovative actions of value-seeking individuals. "Creativity by individuals and teams is a starting point for innovation; the first is a necessary but not sufficient condition for the second" (Amabile et al., 1996: 1155). In many cases, creative ideas support innovation best if they are sourced outside an organization, as in "open innovation" (Chesbourgh, 2003) systems employed by an increasing number of firms in high-tech industries (e.g., electronics) and science-based sectors (e.g., biotechnology and aeronautics). In other instances, individuals and organizations are creative without necessarily producing any innovations, as in the case of many of Leonardo da Vinci's inventions that never become innovations.

The distinction between science and art highlights a key difference between creativity and innovation. Science is executed in systems driven mostly by a utilitarian logic. By contrast, art is normally considered anti-utilitarian or a product or service without external valuation. Creativity involves processes that are often highly personal, sometimes even illogical, following the logic of "arts for arts sake." By contrast, innovation represents a more calculative-rational and measurable process of producing and transferring new knowledge, as is typical in areas of science, although scientific work may involve significant elements of creativity as well.

Researchers have become increasingly interested in the many challenges of designing and managing creative organizations and the creative process. Studying the business and management aspects of creativity (in art and science) enhances our understanding by drawing attention to a range of related phenomena (e.g., problem-solving, learning), social mechanisms (e.g., imitation, legitimation), and levels of action (e.g., cognition, organization, community). At the level of the individual, creativity is often seen as the result of genius or talent. Individuals are often considered creative

if they produce new breakthroughs in products or generate a different understanding of existing reality, which requires cognitive capabilities that few people possess (Weisberg, 2006). Other researchers view creativity as requiring organizational support providing individuals with the necessary affective and instrumental resources. Innovation is seen as a painstaking process of trial and error in which many actors and resources may be involved (Arthur, 2007). Many important innovations are not the result of a single act but the cumulative outcome of small modifications, involving the combination of a range of resources and more or less tightly connected individuals and organizations.

A rich body of literature has emerged during the last few decades studying various managerial and institutional aspects of creative industries. Creative industries are economic settings characterized by variation in skills and talents, openness to novelty, and the exchange of ideas supporting innovation, in areas such as music, literature, media, film production, advertising, fashion, and design (Caves, 2000). In contrast to many manufacturing industries where the conventional approach to innovation involves organizational rules and behavioral routines oriented to producing relatively standardized goods, outputs in creative industries are often unique and very short-lived. Their production is usually organized on the basis of projects and coordinated through flexible networks of individuals and organizations. Issues related to the management of the creative process have been discussed most prominently in the social network literature related to science, arts, and organizational behavior. Networks come in different shapes and forms, adapted to the particular situations in which they co-evolve with the creative process. Spontaneous and informal networks are the central organizational form in the arts domain, and formal project-based research networks are the locus of creative activity in science. A basic unexplored question is related to level at which actors (individuals and organizations), communities and social networks give rise to mechanisms driving the creative process. A second important point is the linkages that exist among the existing business models of creativity in manufacturing, science, and the arts. A third interesting focus is on the distinctions between types of knowledge that are implicated in the creative process. The creative process is context-dependent. Understanding the context, such as the technological setting in which people "produce" science or art, is important for appreciating creativity as a collective and essentially open-ended process. The context also includes consumers and users who play an important role in the co-creation of value. A forth path of analysis is related to studies that examine creativity in a territorial context. Their main contribution is to draw attention to the role of "place" in the creation of novelty. They show that creativity is often embedded in a more or less heterogeneous social and institutional context which, while locally bounded, is also connected to a broader, often global, context. While groups of creative individuals and organizations draw important resources from geographically concentrated communities, many of these groups are not exclusively anchored to a particular territory. On the whole, the studies conducted highlight the multi-scalar geometry of relations in "creative fields."

Despite the industrial district model represents a specific ancient form of agglomeration of local firms, a multiplicity of possible evolutionary patterns of growth can characterize the actual transformation of the historical districts. In the last century, some old districts have declined, whereas others have grown and changed, and in the meantime new districts have emerged. Many authors have tried to interpret this dynamic process, focusing on the evolutionary pattern of industrial districts. In this debate, the use of science and the transformation of firms into global actors can play anchored to an old historical district can play a central role, and it will be able to contrast the centripetal force impressed to the new Marshallian districts in developed regions. Today many districts have evolved into complex systems with flexible boundaries. They must be able to "dominate" the transactions occurring in the international markets, within their newly global subcontracting chains. The modern new Marshallian district is based on a mix of localized and distance learning, due to a process of scanning, exploration and recombination of external knowledge. Today the role of spatial proximity seems to be less relevant. The application of the ICT technologies and the opening of new emerging markets have fostered the creation of long-distance relationships, encouraging the delocalisation of activities, the use of international subcontracting, and knowledge offshoring.

The fostering of creativity open up a space to the rejuvenation of historical industrial districts both in terms of: a) new applications of science to old low-tech firms localized in historical systems whose presence in Europe goes back to the last century (see the old British districts of Sheffield and Lancashire or the Italian districts of Prato, Arzignano, Montebelluna and Riviera del Brenta, etc.);

b) the introduction of innovative business models in traditional sectors, among which there is to note the virtualization of the selling functions, the activity of outsourcing/offshoring, and the valorization of the design function.

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EXPERIENCE ECONOMY

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Introduction

The notion of the Experience Economy focuses on and conceptualizes the transformative aspects that can be identified in relation to experience-oriented innovation of products and services (Pine & Gilmore 1998). Not only products but also places have become subject of experience based innovation and development. Experience based local development strategies have been applied in Scandinavia and elsewhere (for a survey see Lorentzen, 2009). The hypothesis is that places are becoming integrated in the experience economy through the development of still more challenging leisure activities, new advertising and marketing strategies and through the capitalization and development of place-based assets. Rural and remote areas are, to some extent, part of the trend as tourist resorts or as locations for the production of specialties for the global market. At the same time, cities are also involved due to the greater variety and density of activities and places hosted by them. This is illustrated by the fact that an increasing number of cities have embarked on strategies of experience-oriented growth. Cultural heritage is among the assets that localities mobilize to enhance their experience value.

Experience economy and place

Alvin Tofler introduced the notion of the 'experience industries' in his future vision in 1970. These were industries that were developed to offer psychic gratification to still more affluent consumers (Tofler, 1970). These include fashion, film industry and many other industries. His point was that today a whole new provision system is emerging involving industries as well as markets. His visions came true, and today many regions try to develop cultural industries (Scott, 1997) or creative industries (Howkins, 2002) as growth drivers. In relation to local development it can be argued that place-bound or attendance-based industries are of particular interest because of their immediate role for local employment, as well as for urban policy and planning (Lorentzen 2009). Place bound or attendance based industries draw on specialized local resources like agricultural produce, particular landscapes or competencies; They may also require the presence and or engagement of the consumer. The development of a locally specific of experience production often requires a variety of business and non-business stakeholders which involve in new forms of cooperation.

The economic role of experience consumption

Indeed today leisure and entertainment represent an important and increasing part of consumption patterns. Recreational goods and services represent luxury goods, which in economic terms are defined as goods with "income elasticity greater than unity". By rising incomes, the share of such goods in consumption will rise. And, incomes have been rising in the industrialised countries for a long period of time. Between 1870 and 2002, this growth was 2.3% an-

nually as a mean. In addition, the share of recreational consumption grew considerably as part of disposable incomes. An estimate of the OECD concludes that between

1975 and 2002 it grew from 8.1% to 10.3% in Denmark and in the UK from 5.9% to 13.2%. Again in the OECD countries, the shortening of the working day and the increase in the average vacation time contribute to this. In the advanced countries, people live longer, and the average age of the population is likely to increase in the future. In addition, the birth rate drops, leaving more money in each household for leisure consumption. The structure of demand for leisure activities depends on people's education; better educated people command a higher demand for knowledge-requiring consumption such as arts, such as museums, cinemas, live music performances and literature than among others. Therefore the "experiential production" coincides with a new segment of production directed towards luxury consumption. The industries are "experience industries" and the producers "experience makers" (Andersson & Andersson 2006).

The aestetization of everyday life and places

In the 1990s, sociology labelled the increasing focus on the non-material aspects of consumption as the aesthetisation of everyday life. The significant role of the aesthetic appearance of products, human relationships and human habits shows how a larger part of peoples' lives has turned into experience projects and the society into an experience society. An understanding of the new role that Experiences were to play in the portfolio of peoples consumption led to a broader discussion on the role of experiences as a strategic tool of business development, where competition is not on price but on a more sustainable market advantage, given by the uniqueness of the experience itself. Secondly, as a strategic management device, experiences will become part of marketing or a potential add-on to all goods and services for final consumption, as seen in the efforts to aestheticise products and develop interesting relating narratives. In parallel to this, place branding can be under-stood as a strategy involving the aesthetisation of places, the development of narratives about them, and as the staging of the city as an experience.

Experience products are, therefore, those that represent a narrative and some degree of involvement of the consumer, as an individual or as a group. Physical products as well as services can be enacted as experience products. These are either foot-loose (computer games), place-bound or attendance-based (a theatre play, a meal at a theme restaurant). Place-bound experiences can be considered of particular interest to local development, as places and activities can also be capitalized as experience products, directly or indirectly. Places may host experience services (stadiums, hotels) or they may in themselves represent attractive narratives, which motivate people to visit them (a historic castle, street of city). However, common to the different categories of experience products is the appeal to the feelings of the consumer. The definition of experience products is concerned with the relation between the consumer and the product. Experience-based growth and innovation may take place in rural as well as in urban areas based on local initiative and public–private partnerships.

The urban and the rural experience

The creativity involved in developing experience products benefits from what we call economies of urbanization. This refers to the diversity and the density of cities, which implies that the likelihood of creative entrepreneurs to spontaneously encounter tacit knowledge and learning is high. It has been shown how many of the worlds' creative' neighborhoods exhibit particular conditions of diversity and density. On the other hand, in rural areas the experience product is likely to draw on a unique resource either of historical, cultural or natural value. Here the value added is to transform a coastline, a river or, say, tradition in cheese making into a unique experience that can be lived and therefore consumed only in that place (Scott 2010).

The cultural heritage and the experience economy

From this perspective cultural heritage can be regarded as an asset and a resource which can be innovated as a product and even developed into a production system, a heritage industry (Meethan, 1996), involving the production and marketing of many bundled products for a market of consumers, visitors or citizens. On the one hand this perspective, which is actually applied in many contexts, entails a commercialization, which may on some points be damaging the heritage values. For example, many visitors may ruin a place, physically or visually which will decrease its experience value. On the other hand the experience economy perspective involves a need to communicate very carefully with the visitors in an engaging way. A careful communication implies a better cultural education and the development of identity of place.

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CULTURAL AND CREATIVE INDUSTRIES

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THE SAFEGUARD OF CULTURAL HERITAGE

A research agenda

Definitions: creative, cultural and experience industries

The current debate on the 'value creation economy' is facing a definitional bottleneck. The debate of creative industries has been led by the Anglo-American literature which has focused on industries such as Advertising, Architecture, Arts and antique markets, Computer and video games, Crafts, Design, Designer Fashion, Film and video, Music, Performing arts, Publishing, Software, Television and Radio. The UK government has focused on these and to some extent also the contributions that have spawned from Florida have tended to be within such categories. The advantage of such a clear cut definition has been that it has enabled researchers to study and analyse them extensively providing evidence-based policy recommendations.

This classification overlooks however some important cultural experience-based activities. The reason for this is twofold: one, an appreciation of creative industries develops within a techno-scientific paradigm which privileges technology–intensive sectors, that pivot around technology platforms such as digital, design, and green tech. The other reason is that creative industries -as defined by the British Government- are most private-sector driven as they include commercially viable and profit making firms. In other words, they do not require public investment as cultural and arts activity would do.

As important as creative industries can be in promoting radical innovations and technological leaps, they do not exhaust an economy's innovation capacity, which also include culture and leisure activities. Indeed, the latter are not only able to generate soft and incremental innovations, but they are key users of technologies like design and digital, which in turns can spawn further innovations. On the other hand, it is increasingly evident that also creative industries need public intervention for instance in terms of providing a regulatory framework for IP.

Overall the debate is mature for a deeper and more robust understanding of the culture and experience economies. These coincide with an ample sector of the economy that has expanded over the last decades as societies have become more affluent and eager to consume leisure goods and services.

Some interesting preliminary contributions that have suggested that cultural and experience industries are different as they are characterised the authenticity and the immobility of the cultural asset.

Further research lines

– Definitions: What are cultural and experience economies? This is an area where the leadership of the EU Commission is crucial.

– What does authenticity really means in the age of virtual multi-media?

– How can the immobility and peripherality of cultural and experience asset become a trigger of local economic growth rather than a hamper.

Cultural Heritage: innovation and regional growth

Cultural Heritage is a broad term that probably encompasses a range of cultural assets: these can be cultural places (e.g. Stratford-upon-Avon), cultural objects (e.g. the Guggenheim in Bilbao, the Battistero in Florence), cultural traditions (e.g. the Holy Week in Sevilla) or cultural events (e.g. a play in London Globe Theatre). What these have in common as engines of socio-economic local growth is still little known. The impact they have on the local economy and on the local communities goes beyond narrow tourism. Cultural Heritage is immobile and embedded in the place where it is located. Cultural assets become engine of local economic development when local stakeholders are prepared to invested in so that it is able to catalyse a critical mass of economic activities. There is some evidence in existing studies suggesting that cultural assets tend to co-locate with the provision of amenities to enable attendance, namely restaurants and hotels. Such supporting industries enable the asset to be accessible, liveable, *experietiable*.

Cultural Heritage can therefore become a place of production and consumption to the extent that both create jobs and therefore growth. More interesting however, some preliminary studies have shown that both the consumption and production of culture in places of Cultural Heritage can generate processes of innovation.

Further research lines

– How can Cultural Heritage assets become Cultural Heritage capital? How does it change as the assets change in their nature?

– How does cultural production interject with other sectors? How can cultural production (Cultural Heritage) generate (hard or soft) innovations that can become inputs for other sectors? How can other sectors feed their innovations into Cultural Heritage to make it more accessible, and to enable conservation?

– How can Cultural Heritage directly impact on the economy by producing high-value added goods and services that reach final consumers?

Creative, cultural and experience industries and space

Economic activities are never space blind. Qualifying characteristics of places have somewhat determined the type of economic development in such places, and some of such trends have shown path dependency as the anchoring factors of economic activities have changed over time.

Whilst creative industries tend to locate in urban spaces, some evidence suggests that cultural and experience industries tend to spread across urban and rural economies, as well as in peripheral areas, promoting a more balanced and diffused economic development.

Creative industries benefit from the same agglomeration and localisation economies forming creative clusters. At the same time, they tend to benefit from urbanisation economics, i.e. from being located near other non-creative industries thanks to unexpected, serendipitous innovations that proximity can generate. Studies of *cultural and experience clusters* are still trying to ascertain if they also benefit from agglomeration and urbanisation economies.

Creative and cultural clusters tend to spawn around cross-sector technology platforms whose knowledge spillovers on the wider economy enables technology upgrading. Design and digital platforms have the potential to enable sectors' renewal through cross-sector fertilisation. A more rigorous understanding of the inter-sectoral connections will shed light on the knowledge spillovers and potential innovation channels.

Further research lines

– Where are cultural and experience economies? To what extent they are in peripheral and rural areas?

– How can cultural and experience cluster trigger local economic growth?

– How can co-location empower communities of cultural stakeholders? How can they create community-to-community networks?

– What role does technology –i.e. design and digital- play in creating or opening to virtual communities of cultural producers and consumers?

The artistic, social and economic value of Culture

The creative economy is complex to the extent that it includes very activities that have very different economic, social and artistic value. Culture and the arts often require public support due to market failure –externalities and public good. As public funding is becoming increasingly thin, public investment in culture and the arts needs to show that it producing socio-economic value. There is an emerging literature on this, but few applications.

Cost-benefit analysis has been used to measure the economic value of creative activities. However, true costs and benefits cannot always so easily be identified due to the presence of externalities when some of the benefits or costs are intangible and cannot be monetised. Important measures of the economic contribution of a creative activity could be the income generation and employment of a place, this being a community, a city, a region or a country (DCMS, 2010 and HM Treasury 2003)

Creative activities can also contribute to develop the social dimension of a community through, for instance, social inclusion, multi-cultural tolerance, preservation of heritage and traditions, and civic engagement. More broadly, there is an emerging interest in measuring the subjective wellbeing (drawing on the HM Treasure 2008): such evaluations are contextual and based on soft information. Key issues are the relationship between income and wellbeing, and between engagement and outcomes.

Further research line

– How to design better methods and applications to measure the socio-economic impact of culture?

Policy for smart and inclusive growth: Realising the Agenda 2020

Overall the 'sustainable recovery' of the EU economy coincides with an economic agenda that hinges on regional resilience. There are strong arguments suggesting that a renewed local and regional growth will depend on places' ability to adapt and adjust to internal and external shocks; regional resilience in turn depends on having a well-balanced regional economy in terms of sectors and jobs. Creative and cultural industries in this respect can play a crucial role in opening up opportunities to service sectors whilst enabling the upgrading of sustainable high-value added manufacturing activities. The key issue is whether their innovative potentials are sufficient to grant these industries the credit of powering a new economic paradigm, the creative economy.

Further research lines

Smart growth would require policies that Cultural Heritage with other more or less tech sectors to activate innovation spillovers across sectors.

Which stakeholders would support this? Is the triple helix model working? For inclusive growth, how can Cultural Heritage trigger or support local economic growth? Can Cultural Heritage create a platform for places to link up with other places? What policies can activate that?

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COGNITIVE-CULTURAL CAPITALISM AND THE URBAN PROCESS

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Three distinctive waves of urbanization can be recognized, each of them associated with a major historical phase of capitalist development (Scott, 2011). The first wave can be identified in terms of the 19th century industrial town characteristic of early factory and workshop capitalism. The second wave culminates in the great industrial metropolis of 20th century fordism. The third wave involves an emerging global system of urbanization associated with the rise of cognitive-cultural capitalism in the late 20th and early 21st centuries.

The cognitive-cultural economy is based on digital methods of calculation, communication, and information storage combined with the accelerated mobilization of the mental and affective capacities of the labor force. The sectors at the leading edges of the cognitive-cultural economy are high-technology industry, business and commercial services, and the creative or cultural industries from fashion-oriented craft production to film, music, and the media. This new economy is transforming the character of many large metropolitan areas all over the world.

Two of the distinguishing features of the cities that are most representative of this emerging phase of capitalism are that they are foci of creativity and innovation and that they function as key nodes in an intensifying network of relationships that is nothing less than global in extent. The first of these features has led many urban theorists and policy-makers to conjecture that this third wave of urbanization is associated at its highest level of development with the formation of "creative cities." The second feature means that the urban system as a whole can no longer be described in purely national terms, but is effectively an integrated global phenomenon. In this regard, it is important to note that the emerging cities of the third wave are found not only in the global North (New York, Los Angeles, London, Tokyo, etc.) but also and increasingly in the global South (Shanghai, Seoul, Bangkok, Mexico City, etc.).

This new phase of capitalism and its associated forms of urbanization involve two further important theoretical and empirical issues.

In the first place, a new division of labor is now strongly evident, with major implications for the restratification of urban labor markets and urban social life in the more advanced capitalist societies. One important element of this division of labor coincides with a new class of cognitive and cultural workers possessing high levels of formal qualification and human capital. These workers are variously referred to in the literature as the "cognitariat," "symbolic workers," "knowledge workers," or the "creative class." This upper social stratum is complemented by a low-wage "new servile class" or "precariat" whose economic functions are primarily focused on direct servicing of the upper tier of the labor force (child minding, domestic help, gardening, etc.) and on maintaining the basic private and public services that secure effective social reproduction of the urban system, such as janitorial activities, taxi driving, street sweeping, road mending, building maintenance, and all the rest.

In the second place, the economic and social transformations currently under way in large urban areas are provoking

significant changes in the physical milieu and built form of cities. These changes range from residential gentrification to what I call "aestheticized land use intensification." This phenomenon is manifest above all in the large-scale iconic architectural forms that increasingly characterize the major metropolitan areas in cognitive-cultural capitalism. The latter point can be exemplified by reference to the Petronas Towers in Kuala Lumpur, the Disney Concert Hall in Los Angeles, and the "grands projets" of contemporary Paris.

As this third wave of urbanization, in combination with globalization, develops apace, so is it also raising a variety of new policy and planning issues, and all the more so because, the major cities that represent this wave are more appropriately thought of a "city-regions," namely extended metropolitan areas or even coalescent metropolitan areas with extended hinterlands that may themselves be sites of further urban settlements.

Numerous experiments in building new institutions of collective management and coordination at the level of individual city-regions are proceeding apace in response to the weakening of the protective umbrella of the national state and the deepening of global competition. The search for some measure of overall governance is especially imperative in city-regions with a high quotient of cognitive-cultural industries, for the persistent market failures and the sometimes wayward evolutionary pathways embedded in agglomerations of these industries mean that they are susceptible to significant underperformance under purely market rules of order.

In many countries, then, national urban policy has turned away from old fordist-era strategies of locational decentralization in favor of measures that encourage cities to develop their own growth potentials on the basis of their own local assets. The rationale underlying this policy shift is partly founded on the renewed innovativeness of localized industrial clusters in an economic environment where the cognitive and cultural assets of the labor force play an ever augmenting role in the development process.

An important corollary of these various points is that the dire warnings of culture theorists in the 1960s and 1970s about the incipient standardization of world culture under the sign of the imperial US multinational corporation now have less force than they once did, though, certainly, important questions remain about the increasingly commercial origins of this culture and the threat it poses to many time-honored traditions and ways of life. The rise of city-regions all over the world with distinctive creative economies – many of which are now successfully contesting markets all over the world – means that the global cultural landscape is actually becoming more not less variable. Even Hollywood, as dominant as it may continue to be, is nowadays beset on all sides by competitive products emanating from film, television-production, and music-recording centers in many other parts of the world.

Accordingly, the city-regions of the modern world system are far from converging toward some sort of monochromatic sameness; rather, they constitute the vital cores of what is currently crystallizing out as an assertively polycentric and polyvocal cognitive-cultural global capitalism.

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URBAN REGENERATION THROUGH CULTURAL CREATIVITY AND SOCIAL INCLUSION IN JAPAN

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With a major shift toward globalization and knowledge-based economy, the industrial city is already declining. In Japan, new creative industries tend to concentrate at central Tokyo, and now almost all cities except Tokyo face serious economic and unemployment problems. This is one reason for the growing interest in creative cities and urban regeneration through cultural creativity and social inclusion.

The concept of 'the creative city' refers to a mobilization of the 'creativity' inherent in art and culture to create new industries and employment opportunities. In addition to addressing the problems of homelessness and the urban environment, it is believed that such an approach can foster a comprehensive urban regeneration.

Part of the broader diffusion of the creative cities ideal has come through the launch of UNESCO's "Global Network of Creative Cities" in 2004, and interest has quickly spread beyond the confines of Europe and America to Asia, and developing countries throughout the world. Now 28 cities in the world and 3 cities in Japan, Kanazawa, Kobe and Nagoya are registered to the global network.

This paper aims to clarify the achievements of forward-looking creative cities policies in Kanazawa, Yokohama and Osaka. Kanazawa is a human scale city of 450,000 that is surrounded by mountains that are the source of two rivers that run through the city. Kanazawa has also preserved its' traditional cityscape and traditional arts and crafts. As a mid-sized city Kanazawa has maintained an independent economic base while also maintaining a healthy balance in terms of development and cultural and environmental preservation. At the end of World War II Kanazawa soon established the Kanazawa Arts and Crafts University. In addition to nurturing traditional arts and crafts, the city has also produced leaders in industrial design, and local talent that have become innovators in the traditional crafts. Kanazawa has also become a national leader in historical preservation, as is evident in the meticulous preservation of the Tokugawa era castle town district. We can call this method of developing new industry for the development of the city economy through high-quality cultural capital the "cultural mode of production utilizing cultural capital."

The "culture based production systems" at which Kanazawa aims consists of the following.

In Japan and other developed societies, since a mass production/consumption system of cars and hi-tech electronics has declined in current global economic crisis, it seems that a shift towards creative economy based on the "cultural mode of production utilizing cultural capital" becomes the urgent problem.

In stark contrast to the image of Kanazawa as an Edo era castle town with a long and rich history, is the image of Yokohama, a port city that is 150 years old and has become one of Japan's largest urban centers. At the height of the bubble economy the city of Yokohama pursued a large-scale waterfront development project to create a new central business district with the aim of shedding its image as a city of heavy industry. However, with the collapse of the bubble economy
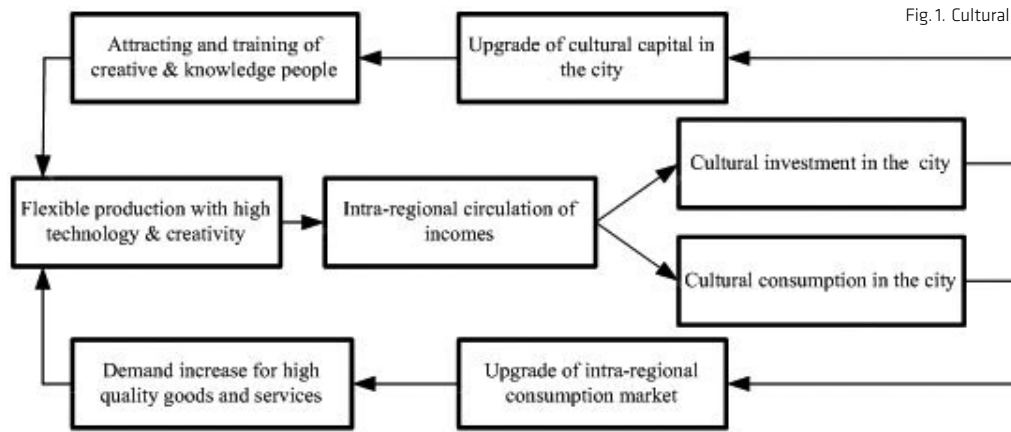
Fig. 1. Cultural Mode of Production Model

and subsequent construction boom in central Tokyo, Yokohama suffered a double blow. From the beginning of 2004, however, Yokohama embraced a new urban vision and embarked on a project to reinvent itself as a 'creative city of art and culture.'

At the center of the Creative City Yokohama has been the establishment of several 'creative core' districts in the general vicinity of the port. These creative cores utilize numerous historic buildings such as old bank buildings, warehouses, and vacant offices to house new 'creative spaces' for citizen artists and other creative individuals. The 'Bank ART 1929' project was the start of this ambitious undertaking. This project is under the guidance of two NPOs that were selected via a competitive process and are in charge of organizing an array of exhibits, performances, workshops, symposiums, and various other events that have attracted participants from Tokyo. In Yokohama, old bank buildings become an incubator to new creative small business.

Osaka has experienced many years of economic decline and has a municipal government facing a tremendous financial crisis. Amid such daunting challenges, in 2003 Osaka City University opened a Graduate School for Creative Cities, and by 2006 it had devised a creative city strategy for Osaka. However, in the fall of 2007, former Mayor Seki, who had embraced these policies and incorporated them into his campaign platform, lost the mayoral election. Despite this less than ideal political environment there are still some notable grassroots developments in the realm of what could be called a socially inclusive creative city strategy.

Notable example of grassroots action in Osaka would be the NPO-like work of Oten' in Buddhist temple, which has converted its' main ceremony hall into a small theater to support, and provide a venue for public performances for young artists in the area. In this same area of the Uemachi Plateau, traditional, wooden nagaya, or long houses, that have survived from the prewar years have been preserved as 'cultural commercial space' as a showcase of the culture and artwork of the area. The success of this project was facilitated by the efforts of the shops of the Karahori shopping arcade. Another notable project is the 'Ogimachi Incubation Plaza,' or Mebic Ogimachi. The Mebic Ogimachi was opened in May of 2003 in the old building of the Osaka City Water Works Bureau. The retro architecture of this building that was built in the early Showa era, provides the perfect ambience for the creative work of the plaza which, through two 'creativity managers,' aims to build networks in the fields of art and high-tech industry. The aim of this network building is the construction of a creative industry cluster in the Ogimachi area where over 2,000 small creative small companies locate, that will allow for the creative talent that is still in Osaka to continue working, despite the ongoing concentration of the creative industries in Tokyo. And by harnessing creativity through such clusters of creative industries such as design and contemporary art it is hoped that Osaka can be reborn as a 'creative city'.

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PRESERVING URBAN CULTURAL HERITAGE: AUTHENTIC LOCAL SHOPPING STREETS

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Questions of cultural heritage are often discussed in terms of preserving the built environment of cities, where structural density, geographical centrality, and historical layers of architectural design produce both material and symbolic landscapes of social identity and power. Underlying arguments for preserving buildings, however, is a more general anxiety about losing control over the symbolic landscape; specifically, a sense that globalization, migration, and gentrification are destroying an "authentic" experience of urban life. Repairing this sense of loss requires an understanding not only of the preservation but also of the social production of cultural heritage.

For longtime residents of European as well as North American cities, the loss of authenticity reflects, on the one hand, a homogenization of the urban landscape connected with economic and cultural globalization and gentrification, and, on the other hand, an increased heterogeneity of the low-income population due to international migration. All around us we see taller, standardized buildings, chain stores selling global brands, and expensive upgrading of central districts for a mobile, transnational upper middle class of cultural consumers. Yet we also see street vendors from Asia and the Global South, construction workers and hotel employees from Eastern Europe, and shopkeepers from every region of the world. Government plays a crucial role in mediating these processes. On the national level, political parties translate people's sense of loss into critiques of "multiculturalism" and European economic integration. On the local level, both homogenization and heterogeneity of the urban experience challenge public officials to re-create an "authentic" experience for longtime city dwellers as well as tourists and newcomers.

The experience of authenticity depends at least as much on "distinctive" social spaces as on buildings of "historic" character. Local shopping streets, which are both sites of social interaction and clusters of small-scale economic activity, offer opportunities for residents and business owners to develop the social and cultural practices that create a district's distinctive character. They are both a public face of the district and its public space. The local shopping street represents in many ways a district's DNA.

Whether stores are old or new, they construct a sense of place by the small scale of their enterprises, the intimacy of their interactions, and—in contrast to official discourses of social integration—the concentration of people of shared cultural origins on specific streets. These social spaces produce a sense of ownership, identity, and authenticity that is visual, sensual, and attractive to many different groups, suggesting a possible strategy for preserving old as well as creating new cultural heritage.

But research on cultural heritage tends to focus on either "stones" (historic buildings and districts) or "values" (cultural practices). There is less emphasis on examining the geographically and culturally bounded social spaces where people interact every day, experiences and identities are formed, and heritage is produced. When researchers do study such spaces, they investigate broad issues such as tolerance and intolerance, feelings of security or insecurity, and general rubrics of social inclusion and exclusion. This approach is good for addressing the right to be in public space, often identified with Henri Lefebvre's celebrated but elusive "right to the city." However, it does not address the social dynamics of

Fig. 1 Amsterdam local shopping street. Photo by Richard Rosen.

how cultural heritage develops in public spaces.

If cultural heritage is seen as an ongoing set of social and cultural practices, it is simultaneously created from above by policies of the state (from national immigration policies to local zoning laws) and capital investment or disinvestment and created from below by media representations of different districts of the city and city dwellers'—or consumers'—tastes. Important among these is a taste for authenticity that may be provided by old or "original" cultural products on the one hand and by new or "creative" cultural products on the other. We often see these tastes commoditized and promoted in gentrified and "creative" districts.

Most commonly a taste for the "old" gives rise to gentrification: restored residences in historically valuable but economically undervalued buildings, usually occupied by working class and immigrant communities, beginning more than a half-century ago in Hackney in London, continuing on to the Marais in Paris, eventually the Jordaan in Amsterdam, and Monti in Rome today. Taste for the "new" encourages the emergence of "creative" districts around studios and lofts of cultural producers, and gradually a critical infrastructure of bars, boutiques, and cafés in cities such as London, Copenhagen, and Milan.

Two strategic factors connect "original" and "new" forms of authenticity with the built environment: adaptive reuse of old buildings for new economic activities and people, and a shift from using these spaces for production to using them for consumption. In both cases, a critical mass of new economic sectors, consumption practices, and aesthetic motifs produce a new cultural heritage while conserving elements of older forms. The challenge for researchers is to identify the social processes of both production of new, and conservation of older, cultural heritage. Local shopping streets offer a public face of these changes; they are in effect a specimen of a district's cultural DNA.

While residential gentrification has been documented in a wide variety of cities, much less is known about local shopping streets that cater to different social groups. Locally owned businesses are rarely at the center of local government's attention. Though sociologists and urban planners do study migrant entrepreneurs, they consider them in terms of economic and social rather than cultural capital. But their stores, and the local shopping streets in which they operate, create an authentic experience of place that is doubly embedded in both specific ethnic traditions and European civil society. Local shopping streets are—or could be--a cosmopolitan bridge to a new cultural heritage.

Sharon Zukin is professor of sociology at Brooklyn College and the City University of New York Graduate Center. She spent November 2010 to April 2011 as a visiting professor in the Urban Studies Program of the University of Amsterdam, and has held a visiting professorship at the University of Western Sydney, a Gould Fellowship as a visiting professor at the Ecole Normale Supérieure in Paris, a Fulbright Fellowship for research in France, and a German Marshall Fund of the United States fellowship for research in France and Yugoslavia. She is the author of *Naked City: The Death and Life of Authentic Urban Places* (2010), *Point of Purchase* (2004), *The Cultures of Cities* (1995), *Landscapes of Power* (1991), *Loft Living* (1982), and *Beyond Marx and Tito* (1975), as well as co-editor of *After the World Trade Center* (2002) and *Structures of Capital* (1990) and editor of *Industrial Policy: Business and Politics in the United States and France* (1985). Zukin has received the Lynd Award for career achievement in urban sociology and the C. Wright Mills Award.

THE INTER-MILIEUS CITY

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THE SAFEGUARD OF CULTURAL HERITAGE

Since the twentieth century, the city has been at the heart of the debate about the future of our planet. The contemporary city has lost the capability to be an expression of each milieu that composes it, becoming the place of impression for just a few acts. It has become a place of dissociations: a fragmented city made up of populated enclaves that do not have any kind of connections beyond their limits; a deterritorialized (Deleuze & Guattari 1980) city that transformed the territory into an anonymous area. These dynamics have created a city that threatens the land and forgets its value as a weave of different wires (cultural, historical, social, natural…).

To envisage the future of the cities, it is essential to rediscover the interdependence of the milieus. The regeneration of the city goes through a metamorphosis where by the culture of the interaction has a decisive and active role. In this approach, the project takes the people as the main actors of the territory and allows the passage from one milieu to another. The inter-milieus city lives by involving every milieu that makes it what it is. The city therefore requires *reliance*[1] projects that provoke people to recognize themselves as part of a community and to encourage them to take an active involvement in urban governance. This provocation has virtuous implications: it is not a decision tool, but rather it takes people to be aware of their own actions and the responsibilities of the human species. The provocation-project rediscovers the city as a place of historical heritage and vital resources for the future, as a place of coexistence between nature and culture, and as a system of articulation between the local and global scales. The inter-milieus city works by opening new possible scenarios for the future, and by involving every living milieu that composes it in undertaking local projects and making global considerations[2].

## The city as a place of historical heritage and vital resources for the future

The city as a territory[3] summarizes the meaning of values and resources. Territorial values, heritage and the memory of sites- where the territory roots its essence- are created through passage of time. The human and environmental components of a territory play an essential role in the formation of past, present and future values (Magnaghi 2000). In order that the city can be a place of interaction and regeneration, it should not be understood as an object inherited from the past that we cannot change, but rather as a flexible social construction. This proposal overcomes the contrast between objective and subjective or between Nature and Culture: these terms need not be dealt with separately, as the exclusion of one another, because they are two sides of an indivisible same reality.

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1 The reliance concept reformulated by Edgar Morin in *Ethique* (2004), refers to the act of linking and connecting.

2 This expression was used by Réne Dubos in the first environmental summit in Stockholm in 1972.

3 According to Deleuze and Guattari, the territory, before being a measurable space, is an act of expression. The living being transforms the terrain in territory where indicates a space own. The territory is an appropriate space.
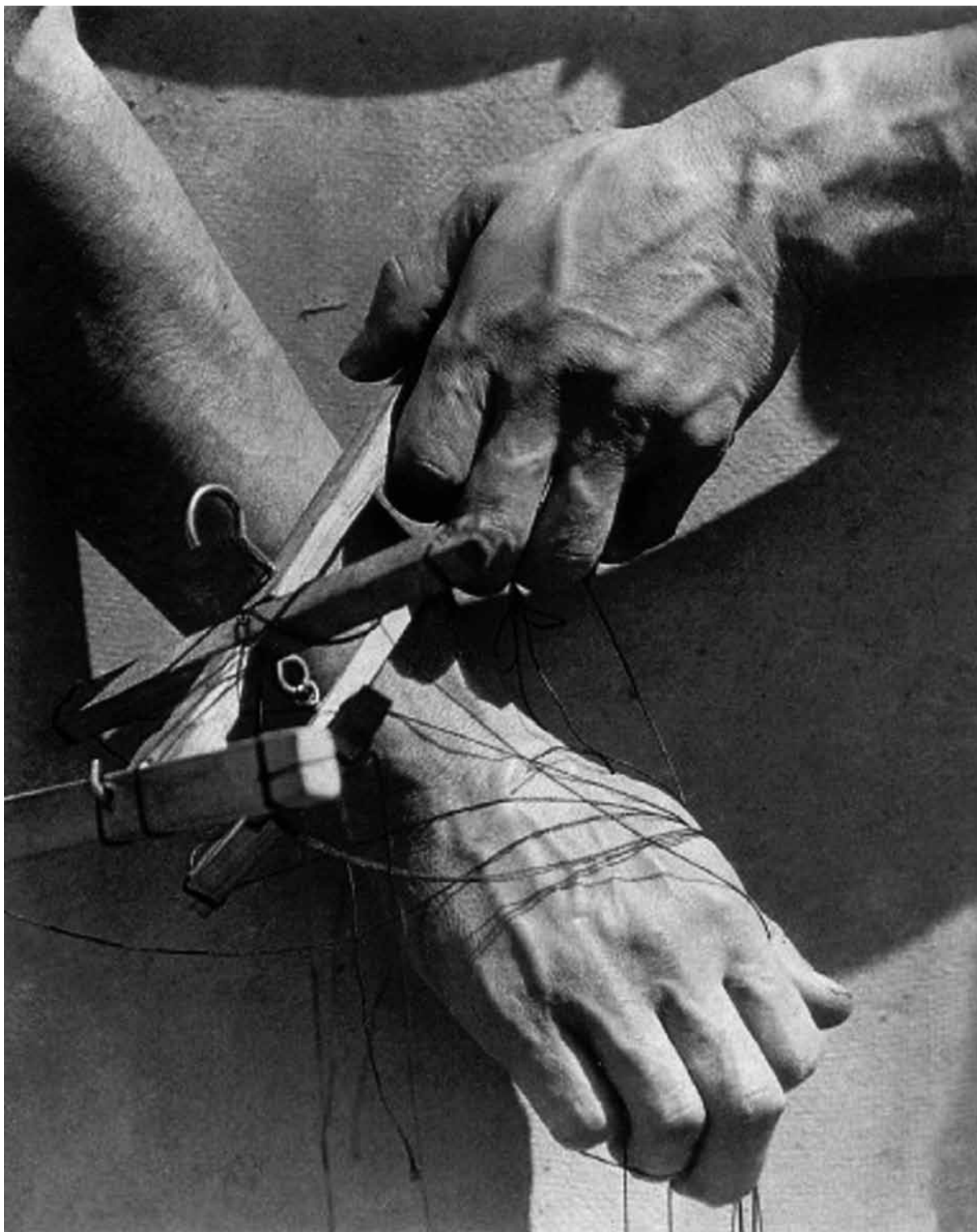
The city as a place of coexistence between Nature and Culture

The inter-milieus city is a project based on a pact between Nature and Culture where people live their lives in harmony with all forms of life and more specifically with the natural environment. People, buildings, and nature are at a changing point in the history of cities. They cannot exist separately, and the aspiration to develop sustainably can only take shape if there is agreement among all these elements with respect to the living environments. In this approach, the

project proposes a broad strategy that involves a multiplicity of actors – the inhabitants, elected representatives and the city councils. The inter-milieus city is required to combine Nature and Culture in a landscape project combining a multitude of living environments.

The city as a system of articulation between the local and global scales

The articulation of the local and global scales crosses territorial issues and allows one to make responsible decisions. If global decisions affect local life, it is also true that small-scale urban strategies can cause echoes worldwide. The logic of intertwining the local and global scales is that it allows one to create devices that connect architecture to the territory. The subject of the transformation cannot be confined, as it relates to broader dimensions: a network of influences, references, and multiple proximities. The architecture consists not only of the buildings, but also the terrain, the environment, the connections between Nature and Culture, the neighborhoods, the landscape, and the resources: it gives all the power to the notion of scale and relationship. This architectural hypothesis refuses to separate itself from the analysis of the project, rather it is determined by the successive approaches of the urban project[4] (Bonnet, 2010). In this way, the inter-milieus city is an efficient system of local scale connections which make links and synergies together with the global scale.

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URBAN ECOLOGY AND CULTURAL HERITAGE VALUES

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THE SAFEGUARD OF CULTURAL HERITAGE

The Nature of the new European City:

An Urban Ecology between Cultural heritage, externalities, and common goods

In the context of globalism and the knowledge society, ecological improvement of cities is a new, complex subject involving a multidisciplinary analysis of place as an urban landscape value with a hybrid governing mechanism across multiculturalism, cross communities, and multi-level hyper-networking: an *ecology*. However, the question remains as to the nature of the specifically urban *ecology*.

First, the city is the focal point of most peoples' lives: over the next two decades, two thirds of the human population is expected to be urbanites, partly due to increasingly efficient transportation centered in cities (train, car, aircraft, etc.).

Second, the city is a growing relational space among people, companies, and institutions, pushing the value of virtual connectivity that can generate competitive cities in the global economy and the knowledge society.

Third, the city is a *bio-structure* of diffuse knowledge, largely bottom–up, and multiple space sharing between long and short distance communication for convergent/divergent stakeholders.

Last but not least, the city as a context of self-organization and high interdependences mixes local and global resources with private and public ones, connecting knowledge, relationships, and motivation able to endure competitive advantages oriented to stimulate emergent and future potential (Coase, 1960; Seeley Brown and Duguid,1998).

We see a new emergent form of the city over the Fordist towns of the late 18th-early 19th centuries as a hierarchy (manufacturing and services functions) between central and peripheral structures, mediated by urban/land revenue (costs of place), that locate services in the city-center and peoples' home in the periphery with a simple form of governance segmented by land prices and political lobbying (central location by manufacturing and services) (see Graph 1). Congestion charge and pollution are largely a result of the emergent city-form. However, the present model in the post-Fordist, post-Berlin Wall age in Europe is a more horizontal town. This model is characterized by bottom-up partnership governance, high speed transport (in-city and inter-city), and high broadband line: a collective brain sharing of a cognitive "integrated" ecology (centrality of location on the grounds of hyper-networking and invisible resources) to reduce congestion and pollution for a harmonious, sustainable, and connected emergent city (see Graph 1). This is posited as a "happy, responsible city" involving a mix of tolerance, talent, and technologies (*à la* R. Florida), maintaining strong social cohesion and extended citizenship responsibility where everyone is an intelligent user and a potential contributor to value (Pilotti, 2004).

The emergent *spiky world* of R. Florida shows "*how economic advantage accrues in some places more than others, details the new migration of talented and skilled people to a small set of regions, and documents the forces driving the*

ups and downs of the housing market. It also describes the trend toward the clustering of high-tech jobs in Silicon Valley, finance in New York, London, and Hong Kong, filmmaking in Hollywood and Bollywood (India) and music in Nashville, Tennessee."[1] One of the main factors of those processes is culture as a glue of interrelationships, transferring and accumulating people with competences and ideas in the same place able to produce growing appropriable externalities.

In that context, strategic governance as an activity reducing transaction cost is not enough (Coase, 1960) because it is consistent with given knowledge (reducing cost of non-knowledge) but not with emergent or potential knowledge; nor is it connected with direct knowledge innovation (knowledge investments). The trajectories of transformations of the emergent city in post-industrial society (and in the knowledge economy) require new models of governance as complex multi- stakeholderships: an Ecology Governance to mine value in the future and not in the past, exploring potential in the next brain community.

Perspectives and the Work Hypothesis in transforming network *cities' value.*

The main purpose of this brief summary is to examine some consequences of using cultural resources (in the context-specific appearance as urban ecology landscape) to describe the knowledge dynamics of economic systems and their impact on places as a territory of complex agents and institutions. The focus is on the ability of economic growth to guarantee sustainable use of arts or cultural resources as knowledge resources under a concept of economic progress as a sustainable development, which signifies the whole range of structural, economic, socio-cultural, and institutional changes accompanying growth between identity and trust.

First, we often see the diffuse externalities emerging in the urban context as a mix between heritage trajectories of cultural resources building the identity of a city (internal governance), and trust (among agents and institutions) as a present and future leverage to upgrade this identity with new projects aimed at maintaining social cohesion and stakeholder partnership. Knowledge emerging from culture and arts in the city is a tool to know as a collective brain and to learn as an eco-system.

 Second, externalities in the city (taken as economic progress) could be seen as synonymous with a better *quality of life* or *happiness,* not only as growth in GNP. This involves growth in income, but it is important to consider non-economic variables like cultural resources governance, which generates services and functions contributing directly and indirectly to individual and collective well-being, as well as supplying the factors necessary to support productivity as creativity, innovative form of organizations, sense making, and new tastes and preferences. Sustainable development (also as sustainability of cultural resources) means an increase over time of a better quality of life because of better knowledge of ourselves transforming the city into an integrated community of non-self-interested agents. The cultural and art resources of the city as a rich component of the environment (in all its aspects) must (and can) "support" this notion of the economic system, enabling it to live and grow (Pilotti, 2001, 2003, 2004). Generally speaking, quality and wealth in the city as an ecology sustained by cultural resources and community trajectories should not be a tradeoff; rather, an "open partnership approach" is required, also adopting general self-sustainability of cultural resources as a part of complexity of environmental eco-system resources, where ecology prevails over strategy. In cities or greater metropolitan areas, eco-systems of culture, heritage, and museum networking in a specific place defines better examples of identity tools as a source of ecology value in the governance complex global interdependencies(Throsby, 1995). This definition of cultural resources heritage as a highly competitive *embedded*

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[1] R. Florida (2008), *Who's your city,* p.10

value covers every culture/artistic eco-system function, producing utility and profit as well as factors supporting quality of life on the metropolitan or national levels. In any case, we wish to underline the culture's multi-functional nature as a fuel of externalities and interdependencies in a city as an eco-system: ecology connected by networking and modules re-building connections between center and peripheries able to transform *common goods appropriability.*

Methods and approaches

The purpose of these brief introductory considerations is to underline the consequences of using cultural variables when elaborating models to describe the dynamics of economic variables, as in the case of the specific context of a city, its externalities and interdependencies able to create community value (also in the sense used by Mintzberg regarding the emergent community company). In other words, the focus is on the ability of economic growth to guarantee sustainable use of cultural resources to generate and promote value of both a city and a Metropolitan area.[2]

Everybody knows that economists have treated, and often still treat, the terms *economic growth* and *economic development* as synonyms (Harrod, 1939; Domar, 1946; Duesenberry, 1958; Kalecki, 1954). This is more useful to analyze the emergent and complex economics of a city as a *common goods bundle*, where cultural heritage is a fundamental connected resource between past, present, and future. Historically, sustainable growth has been used with environment resources; this is transferable to another complex area of studies as cultural resources exploring the ecology of the city (see Perrings, 1993,1996; Zeleny, 1997, 2000):

In this sense, cultural resources are complex, adding to new dimensions of life quality (in terms of time or running the future both as a stock of collective brain resources) or the fuel for emerging knowledge society as creativity of network communities: a learning bridge from the past to the future of civil awareness. A growth of cultural heritage resources enlarges life quality and grows the wealth of cities (and of nations), enlarging new knowledge value bases of reproduction for both material and immaterial resources (for a diffuse *reflexivity* of resources). The symbolic and cognitive sense of cultural resources are: identity of cities, collective consciousness, better relationships between citizens and institutions able both to connect local values of resources to global ones and enlarge "social-diversities" as a tool of civilization In other words, with direct effects on the expected life cycle, extended education, and health of citizens, diffusion and awareness of scientific thinking or democratic consciousness (external benefits).

The new city in the post industrial society : Towards invisible resources

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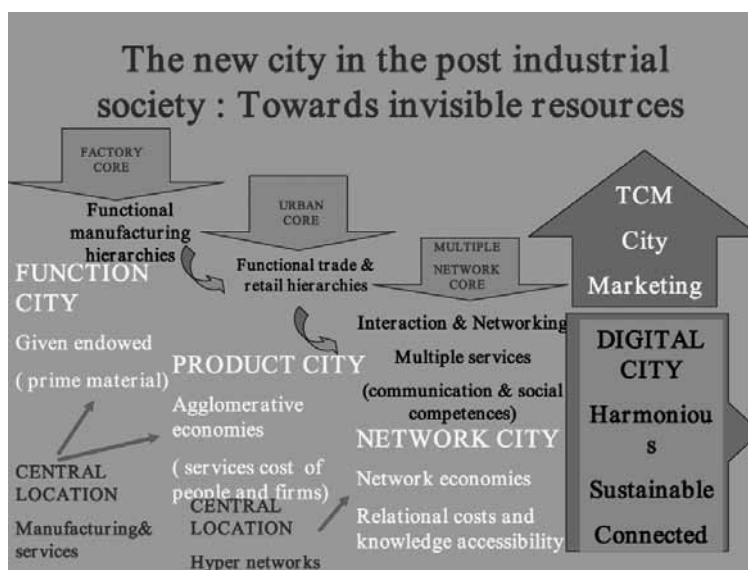
[2] Empirically, exploration could be a substitute dynamic optimization technique in the standard theory of optimal control (Kamien and Schwartz 1981).

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URBAN REGENERATION AND SOCIAL COHESION. USING CULTURAL HERITAGE FOR URBAN REGENERATION AGAINST SHRINKAGE: THE CASE OF AVILES, SPAIN

Jose' Prada

Aviles is a medium-sized city situated in Asturias (Spain). In 1957 the Spanish Government decided to build an integrated iron and steel plant in the city. At that time Aviles had a population of about 21,000 inhabitants. In less than twenty years Aviles' population grew to 85,299 inhabitants by 1975. The city's economic and social environment turned to the new activity and its traditional identity as a commercial city was relegated to a lower level.

However, the crisis of the 1970s confronted Aviles with the deindustrialisation. As many other European old-industrialized regions and cities, Aviles entered a process of decay. Work destruction and depopulation were the two most visible problems in the city. Nevertheless, discouragement and discontent extended among the local population, fuelling social problems like alcoholism, drug use and prostitution.

Since the 1990s, the Spanish Government and the regional and local administrations have been involved in finding alternatives to shrinkage as well as a new model of urban development. This model recognises several strategic aims: the restructuration of steel companies or the promotion of a new economy, based on innovation and culture. Another goal would be the improvement of the urban environment, to accomplish by taking measures such as the safeguard of cultural heritage, the rehabilitation of the historic city centre, the environmental restoration, the enlargement of the harbour or a wasteland recovery.

The historical centre of Aviles resulted seriously damaged due to the consequences of several decades of industrialisation, the pollution and the exit of population to the new neighbourhoods in the outskirts. However, the old town was a very valuable example of a small commercial city. There were examples of cultural heritage whose preservation was not assured at that moment: traditional houses of fishermen, small palaces who belonged to the commercial bourgeois, medieval churches or even, an important theatre who had closed years before.

Different building refurbishment programmes were developed from 1990 in the historical city centre. Among other interventions, we can mention housing and squares rehabilitation, public buildings restoration, urban landscapes recuperation as well as the renovation of urban infrastructures and services. The idea was to recover the city centre as a place for commercial activities, tourism and residents. In order to reach that aim, there was public funding coming from the Spanish and regional governments and the local authorities; these investments covered up to 50% of the private property rehabilitation. In addition, new uses are given to historical buildings (New art centre, pilot municipal units, museum-historical municipal archive, tourist office, music municipal school...).

The result of these measures is a new image for Aviles. Buildings, the theatre, squares, palaces and monuments have been recovered and new activities have emerged. The city centre has also renewed its population thanks to the arrival of young people and it has become attractive for tourism. Aviles has also developed the enlargement of the harbour with remarkable improvements such as a new fish market, a sports area or a sea-front promenade. The third piece of the Aviles' strategy is the *Oscar Niemeyer International Cultural Centre*[1], who has recently been inaugurated. The

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[1] The International Cultural Centre is a project designed by architect Oscar Niemeyer, assigned to the Government of the Principality of Asturias as thanks for having received the Prince of Asturias Award for the Arts in 1989. It has been inaugurated in April 2011.

current marketing strategy of the city benefits from the success of this project, whose aim is to position the city on the "map" of internationally recognised cities, for example by inviting famous celebrities to promote the local culture, music, theatre, tourism and cuisine. In this regard, the city of Bilbao is a primary reference for the Aviles' urban renovation process. As an example of this success, the number of visitors at Easter holidays was four times bigger than last year, according to the Aviles' tourist office. The amount of hotels in the city has increased by 54% between 2006 and 2011, and the number of restaurants, by 68% in the same period.

In conclusion, Aviles has developed a strategy based on the economic revitalisation, the attraction of new functions for the city and the revalorisation of its cultural heritage. The aim of it has been a new image for the city, as a place to work, to visit and to live in. Aviles has recovered partially its pre-industrial identity by preserving its cultural heritage, and nowadays it is developing a positive demographic growth and a dynamic economy.

REGENERATION OF INHABITED MILIEUX

Chris Younès

THE SAFEGUARD OF CULTURAL HERITAGE

Everything is born and continues to be in birth. The word 'nature' firstly refers to a living nature and a repeated genesis as indicated by its Latin etymology 'natura' (from the future participle of nascere) which signifies "that which gives birth", the act of being born, that which presages the thing and which corresponds in part to the ancient Greek word physis (of which the root phù signifies growth, growing, blooming and is related to vegetation). Aristotle makes a distinction between natural beings and manufactured beings in that they are endowed with a principle of self-movement and rest, bearing within themselves the possibility of becoming other, growing or diminishing[1]. They proceed by a continually renewed genesis and by metamorphosis.

This deeply biological design was substituted by a mechanical design of nature. The Western modernity of the Modern Times thus arose to oppose man to nature, following the dualist representation initiated in the 17th century by Galileo, Bacon and Descartes, of a nature external to man, which he could govern from the moment he knew its laws. But the irreducibility of nature which haunts urban dwellers today is more than just nostalgia for village life or a rejection of cities or towns. It is linked to the vital natural cycles whose the impact and desire develop at the same time as the urban world spreads itself, as if the forces of culture should align themselves with those of nature for the world to remain inhabitable. An imaginary technicism which orientated a certain modernism was superimposed by that of a resourcing by the "natural of nature" according to an expression by Heidegger[2]. Nature cannot be reduced simply to metaphors, to green issues, to plants, to the invocation of the countryside or to silk-screened signs. This word designates water, earth, fire, fauna, flora, the rhythm of the seasons, days and night, heart and breathing, wakefulness and sleep, birth and death, the cycle of transformations. "It is in us and it bears us in it" explains Merleau-Ponty[3]. Its polysemy hatches the real, the imaginary and the symbolic.

Generating and regenerating

The anxiety linked to the devastation of ecosystems and the growing awareness of the finiteness of planet Earth, of its vulnerability and that of humans, insistently leads to questions concerning the sustainable relationships to be established between nature, *techne* and society. The art of human settlements has always established relationships with the natural milieu which are both interior and exterior ones, whether it is by controlling it to better use it to the point of blindly exploiting it, by keeping it at a distance due to fear or respect, or by attempting a symbiosis[4]. The current debate concerning the regenerating capacities of urban milieus, their resilience, reveals most particularly the crucial issues of reconfiguring these territories. If being modern, as deemed by the Athens Charter, was to fa-

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[1] Aristotle, *Physics* II, 1-192
[2] Heidegger, M. "Hebel - friend of the house" [1958], *Questions IV*, trad. Julien Hervier, Paris, Gallimard, 1966, p.58
[3] Merleau-Ponty, M. 1995, La nature, Notes de cours du Collège de France, Seuil, Paris
[4] These different positions were clarified by Younès, C. & Mangematin, M. 1999, « Médiation architecturale entre l'homme et la nature », in *Ville contre-nature* (ed. C. Younès), la Découverte, Paris

vour the 'tabula rasa' and to free oneself from the context, the challenge from now on is to understand and to imagine other possible elements from the resistances and resources of the milieus: different types of alliances aiming to capture, reveal, treat with care and revive whilst at the same time taking into account the geographic, tectonic, atmospheric, biological, cultural elements. By notably reflecting on the place of the fundamental biophysic elements which are water, air, earth as well as that of artefacts. In *Les trois écologies*[5] Félix Guattari insists on the need for an ecosophy, in other words "the environmental ecology which is an integral part of the social and mental ecology via an ethical and politically-based ecosophy" given the irreversible nature of technoscientific creations. Thinking about inhabited milieus, is thinking about the balance between nature and artifices, agricultural and urban cultures, ecosystems and anthropization. In fact, there are paradigmatic changes in the ways of apprehending the relationships of humans in life environments, which we are committed to, whether it is by Hans Jonas with the *Principe Responsabilité*, Michel Serres with *Le Contrat Naturel*[6], Augustin Berque with "ecumene"[7], Peter Sloterdijk with the question of biosophy[8] or Henri Maldiney who believes in the 'existential dimension – that it is in man's nature to be open[9]: "When I talk about an animal, it's simple; its nature is its life. And nature is its vital space. This is not the case for humans. It is more than the biologic and the historic, man arises by existing the entrance in the presence of art and of man in art results in man recognizing himself in the moment when, truly in the presence of the oeuvre, he goes beyond his biological dimension without alienating himself historically".[10] Time in relation to nature and time in relation to *tekne* is not the same, but the principle common to both these methods of production which are nature and *tekne* (of which the Indo-European root 'tik' signifies generating) is the principle of generation. But what are these generations? What cycles and recycling are at stake? Does not production in the technical sense have its possibility in nature first? There is, explains Aristotle, in Nature, an initial power. But there is also a becoming other than what which comes from nature. It is the law of becoming (metabolian)[11] Heidegger wrote that technique does not have the privilege of adding a human world, but that modern technique restricts nature to its impossible, in other words that which it could never do itself, because it is its destiny to settle as the master of the land. Thus artificial milieus act as a substitute or become competitors of the natural milieus. In the artificial, which means "made by art" (*arte facere*), designating skill, know-how, craftiness, there is the possibility of an excessiveness, a violence, a violation, a promethean desire which steals something from the gods. But there are possible choices. Beyond representations which consider nature as a lost paradise or a hostile environment, and humans as disturbers or masters of the world, the quest for appropriate natural-artificial rhythms constitutes an aesthetic oeuvre and a critical ethic: establishing a lively relationship between nature and culture, life and *tekne* by exploring different paths of regenerating synergies.

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July 11th- 13th, 2011
Florence, Italy