Techniques for cultural heritage research in the Pomerania region – case studies

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1 Introduction

The use of coherent light sources in the restoration science and practice has been preceded by an extensive research over past decades. Nowadays, the numerous experiments and case studies confirm that lasers and other photon- and particle-emitting radiation sources can be applied as efficient, non-contact tools for the analysis and treatment of the cultural heritage objects. This is to large extend the result of collaboration of the natural scientists with conservators, art restorers, and conservation researchers. The multidisciplinary activity is supported by international programmes such as the COST Actions G7 and G8, EU-Artech, MOLAB and dedicated projects [1]. The range of applications of the optoelectronic techniques broadens continuously. The laser ablation is applied for surface cleaning, removal of the encrustation and overpaintings or damaged / polluted varnish layers. Recently, this technique can be used complementarily to these applied traditionally by conservators, and allows to avoid problems arising typically when using the established chemical or mechanical cleaning methods. Moreover, the modern analytical techniques provide sensitive, in most cases non-destructive diagnostic and identification of materials, analysis of the chemical composition of the surface and underlying layers [2, 3]. This contributes to knowledge on objects and museum collections (origin, provenance, historical routes), and supports the preventive conservation, e.g. by revealing the presence and locations of stress and structure defects [4].

In this work the results demonstrating the application potential and role of the modern technologies in the conservation practice are discussed for some case studies regarding: the monuments of Gotland sandstone, historical documents on paper, and mural paint layers. The results of laser cleaning, techniques of the process monitoring, materials analysis and the post-processing effect being of importance for conservators are considered. The experimental data obtained by means of the colorimetry, SEM/EDX, and spectroscopic techniques such as LIBS and XRF applied *in-situ* are presented and discussed.

For the case of the Gotland sandstone which was frequently used in Northern Europe in the past for construction, decorations, and sculptures some problems related to the surface cleaning are still open [5-7]. The obviously applied methods such as washing, mechanical abrasion, ultrasounds, are hard to control and often result in damage of the original substrate. Here, the ablative laser cleaning represents an interesting alternative. This technique studied and developed during last decades becomes a standard tool in the conservator's practice [5-7]. However, negative effects of the laser interaction such as discoloration, accelerated ageing and yellowing are discussed in the literature recently [8-10]. In case of documents and artefacts on paper the urgent demand for conservation treatments of the historical documents promotes the

laser cleaning particularly in case of non-aqueous conservation required e.g. for the wood-pulp paper objects from XVIII-XIX c. The ablative laser cleaning provides a precise local treatment especially advantageous in case of the fragile, old documents. However, the correct application of this technique requires a selection of laser interaction parameters (wavelength, energy dose, penetration depth) depending of the chemical composition of the paper substrate and stain contamination as well in order to reduce the risk of object damage [11-16]. For diagnostic of the laser cleaning the spectroscopic techniques such as LIBS and LIF are successfully applied [17-19]. For the XV c. mural painting investigated in situ by means of the XRF technique the original pigment compositions and mapping are obtained and results of the PCA analytical procedure are discussed.

2 Restoration and analysis of the Gotland sandstone

2.1 Encrustation removal and process monitoring

Samples for experiment were extracted from stone elements of historic buildings in Gdansk. For surface cleaning the pulsed Nd:YAG laser (6 ns) operating at 1064 nm was used. A lens telescope assured the control of the beam position and focusing. The cleaning was preceded by selection of the interaction parameters and threshold values for damage and ablation. For the moistened, crusted surface an optimal fluence of 0.5 J/cm^2 was obtained, and the black, 200 μm thick crust was completely removed after 10 – 15 laser pulses.

The progress of laser cleaning obtained as the dependence of the acoustic signal amplitude due the laser pulse interaction with the cleaned surface, on the total energy deposited at given location, are summarised in Fig. 1.

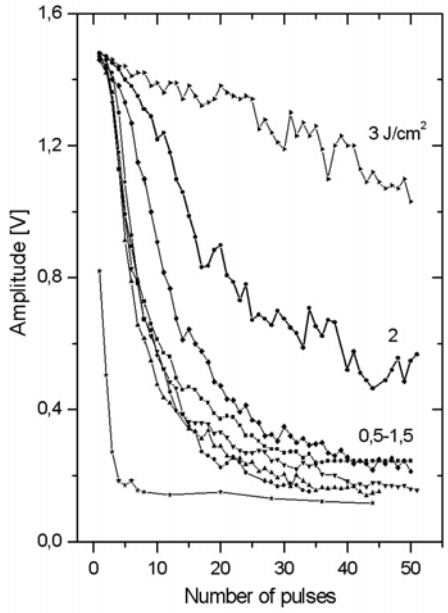

Figure 1: The dependence of the acoustic signal amplitude on the pulse number measured at energy fluences in the range 0.5-3 J/cm^2

The strong correlation between the acoustic signal and the thickness of the removed layer is exploited for the process monitoring. The curves represent series of experimental data obtained for different pulse energy fluencies applied, and the lowest curve represents the reference signal corresponding to the crust-free sandstone. The data contains complete information required for selection of the optimal laser cleaning parameters [7]. In case of the sandstone cleaning by laser

only a few data are published regarding application of the LIBS spectroscopic technique for the process diagnostics [2, 8]. Here, spectra in the range of 370-780 nm recorded under excitation at 355 nm during laser cleaning recorded and averaged for successive cleaning pulses are considered. The irradiation-dependent intensities of the Si spectral line (substrate), and of the most prominent contaminant elements Ca, Al, Mg, Ba, K, Na and Li (crust) belonging to the removed layer are shown in Fig. 2.

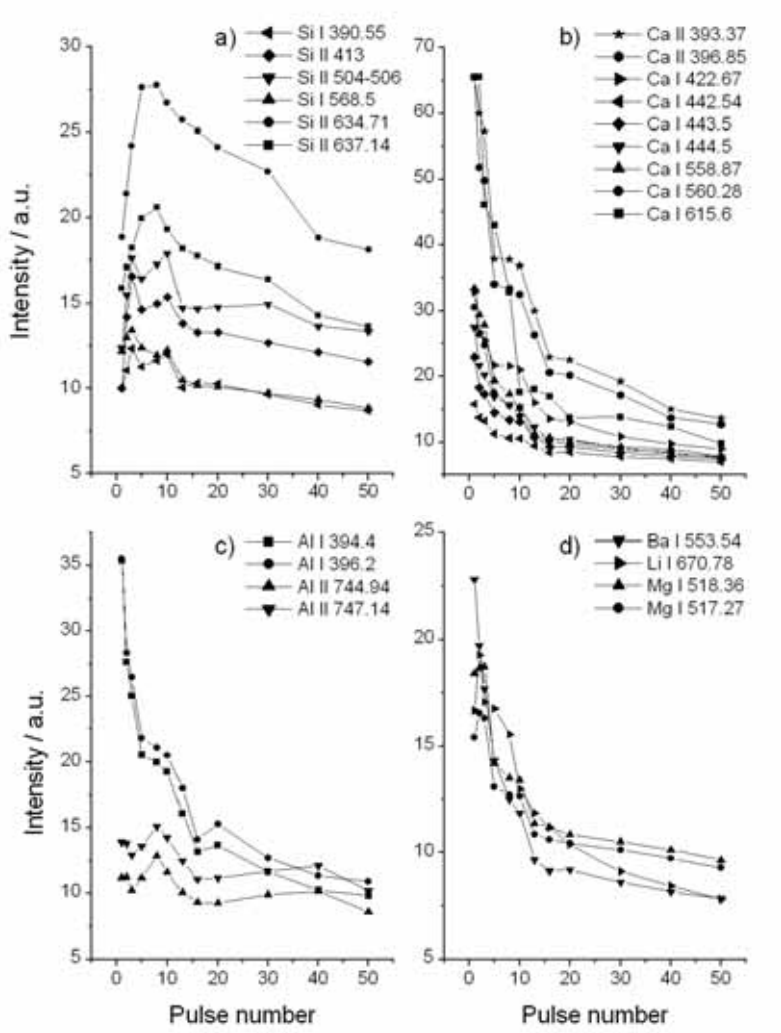

Figure 2: Dependence of line intensities of the LIBS spectra recorded under 355 nm excitation on the laser pulse number for selected elements: a) silicium, b) calcium, c) aluminium, and d) barium, lithium and magnesium

For contaminants the intensity peaks decrease markedly under prolonged irradiation, and for some of them (Ca, Al) the decrease proceeds to the reference level after several pulses The result is in agreement with the dependence of the encrustation removal on the acoustic signal amplitude described above, and is confirmed by the SEM/EDX study, too [9]. The presence of Ca at the surface and also in the sandstone bulk is ascribed to the natural binder and its decomposition products.

2.2 Surface analysis and elemental composition

The top layer of the historical stone reveals a structure composed of weakly joined quartz grains. An intergranular spaces ought to be filled with a binder, which is absent because of stone

degradation. Instead, these spaces are partially filled with contaminants. The region covered with black crust is smooth. The laser irradiation results in removing of the crust particles and uncovering of the quartz grains – Fig. 3. No concrete component can be recognised among dirt particles; it seems, they are composed mainly of soot and incomplete combustion products. In the cleaned region uncovered quartz grains and residues of black crust in the intergranular spaces are visible.

In contrary, the particles of remnants observed on the substrate grains after laser cleaning are granulate-like, round and stuck together indicating on partial remelting – Fig. 3 b. The additional SEM data (not shown here) characterizing the sandstone cross-sections at different depths indicate, that for the degraded sandstone surface just bellow the crust layer the natural binder is not present. Its absence is due to prolonged interaction of the aggressive environmental pollution.

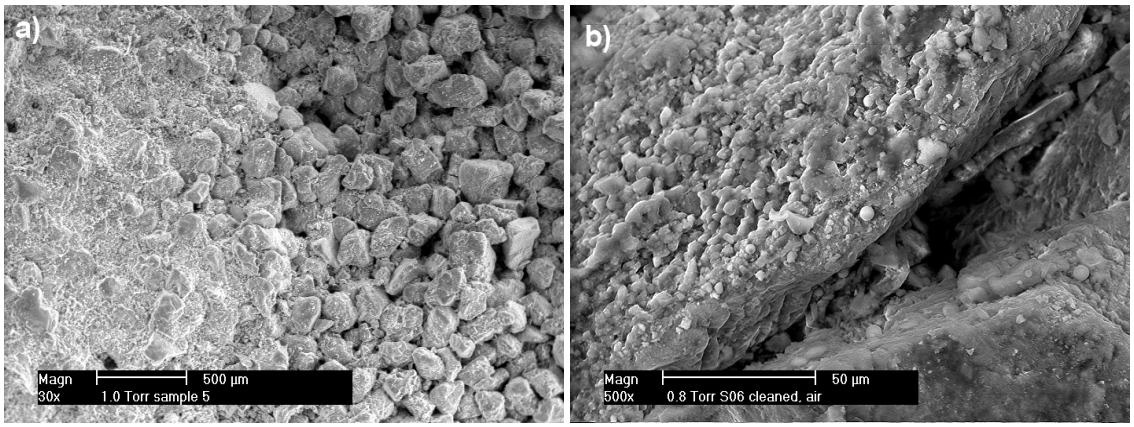

Figure 3: SEM pictures: a) the interface region between the non-treated (left) and the laser-treated sandstone surface (right), magnification – 30×, and b) edge of the irradiated grain – 500×

The chemical compounds of the crusted sandstone surface after laser cleaning are analysed for the transcrystalline fracture of the quartz grain (Fig. 4a) where only silicon and oxygen are detected, while on the grain surface of the cleaned sample also C, Al and Fe are observed in agreement with the LIBS spectroscopic data – Fig. 4b.

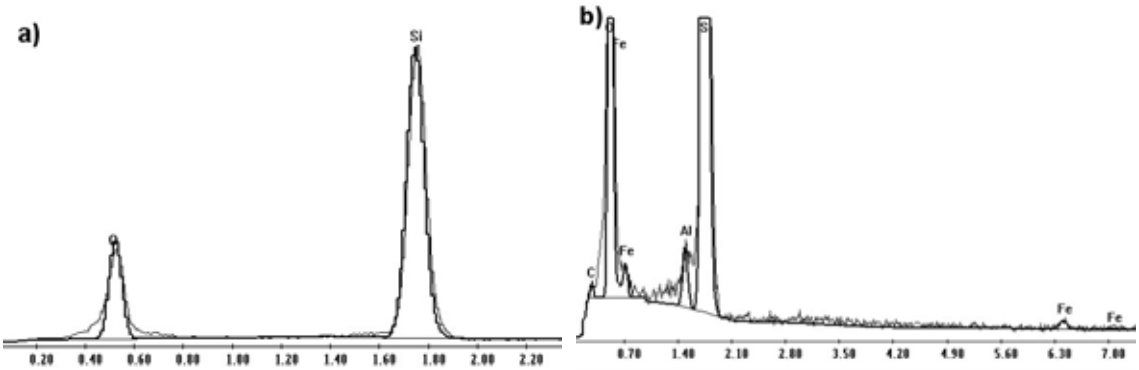

Figure 4: The EDX analysis of the a) transcrystalline fracture of quartz grain and b) surface of quartz grain after laser cleaning

2.3 Colour changes due to laser interaction

The colour changes such as yellowing or decrease in lightness due to laser interaction originate from uncovering of pre-existing yellow layers, presence of soiling residues perhaps transformed by laser radiation, scattering of the light on particulate residues and irregularities or small cracks, and also substrate damage: physical or visual, such as charging and melting [10]. The oxidation of particles (e.g. iron) of the crust layers during laser irradiation is supposed to be one of the causes of yellowing, too [5].

The colorimetric data were collected for the original one, and the model encrustation composed of graphite and gypsum, in order to minimize the effect of the natural colour variations. Results were compared for the laser cleaning performed in the ambient air and under conditions of the N_2 flow at 0.2, 0.3 and 0.5 m/s providing minimal kinetic influence on the laser interaction region. The hue of the samples was observed according to CIE L*a*b* standard and results due to laser cleaning are summarized in Fig. 5.

The hue measured for the stone substrate and also for stone covered by the model crust, both processed by laser under conditions of the nitrogen shielding, indicated the darkening slightly stronger than for samples processed in the ambient air, while the difference in yellowing was within the experimental error. The effect observed for N_2 was independent on the gas flow velocity.

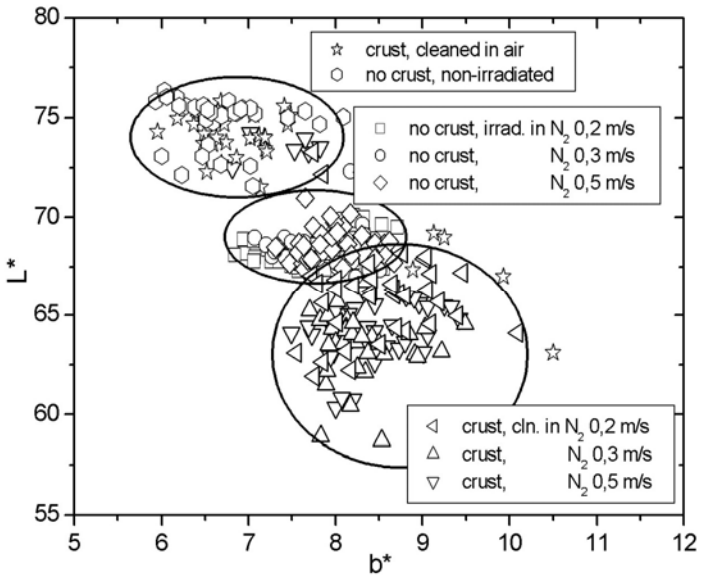

Figure 5: Surface color changes of the Gotland sandstone due to laser irradiation, observed via lightness L and saturation in yellow b*, for samples: crusted, cleaned in air (*), non-crusted and laser irradiated in nitrogen flow (0.2, 0.3 and 0.5 m/s) (□, ○, ◊), cleaned in nitrogen (Δ), and for reference samples (no crust) non-irradiated (hexagons)*

Results obtained for artificially encrusted sandstone are in general agreement with these of naturally contaminated ones and reveal the same effect of laser irradiation. For model samples and the N_2 case the effect is even more pronounced. The study of the related photochemical reactions and long-term alteration due to laser cleaning is in progress.

3 Laser surface cleaning and analysis of historical documents on paper

3.1 Contamination removal

Samples of historical documents originally contaminated and locally covered by pigments, and for reference also the model samples made of wood-pulp paper according to the XIX c. production recipe were investigated. The paper for sample production was sized with the resin glue (Sacosel 309) and the pH value of the model samples was in the range 4-5.

For the paper surface cleaning the pulsed Nd:YAG laser (6 ns) operating at 266, 355, 532 and 1064 nm at 20 Hz or in the single pulse mode was focused onto the sample surface to spots of 1.5-4.0 mm. Depending on wavelength applied the average pulse fluence was selected from the range 0.3-1.3 J/cm^2, and samples prepared for testing of the mechanical and chemical properties were irradiated at fixed fluence of 0.6 J/cm^2.The ablated and reference samples were artificially aged in the climatic chamber during the period of 10 days, at 80 °C and at relative humidity of 65 % which corresponded to 50 years ageing under conditions. The tearing strength was measured in conformance with standard PN-EN ISO 1924-2 and the cellulose solution viscosity was obtained by means of the capillary-type viscometer. The copper index, defining the content of low-particle products of the cellulose transformation was derived from the weight measurement of the copper oxide in the dry cellulose mass, according to T430 om-94 standard.

3.2 LIBS analysis of contamination, paper and pigments

The LIBS spectra were recorded for the most typical surface contamination, i.e. dust and for pigments Examples obtained for the archive document and the hand-made, blue pencil pagination on the back cover of the Leopolita's Bible (1561), both from XIX c. are shown in Fig.6. The LIBS spectrum originating from first laser pulse, recorded for heavy dusted document is showed in Fig. 6a. Lines of elements Mg, Si, Fe, Al, Ca, Ca$^+$ ion, and also Ba, Ti and Mn can be ascribed to paper as well as contamination, due to laser fluency selected above ablation threshold of paper. Spectra for successive pulses correspond to changes in composition of the ablated layers and together with changes in peak intensities are shown in Fig. 6b.

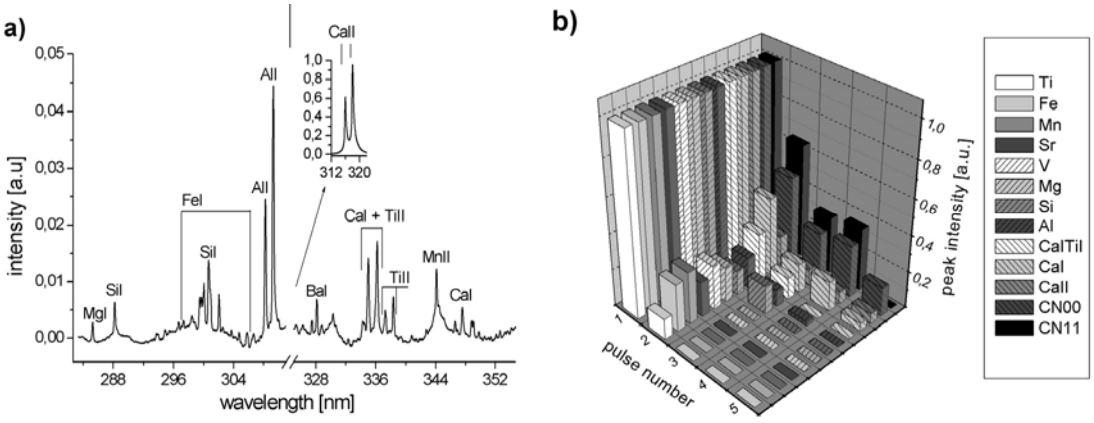

Figure 6: LIBS spectrum of contaminated paper document from XIX c. measured for the first laser pulse (a), and intensity changes of peaks ascribed to elements for consecutive pulses (b)

Some of the detected peaks are revealed in spectra obtained for the 4th and 5th pulse and the other ones vanish for the 3rd laser pulse. This indicate that peaks of Ca, Al, Si and CN$^-$ bands originate from paper substrate while Ti, Fe, Mn, Sr, V and Mg can be ascribed to contamination. In case of the laser cleaning of hand-made, blue pencil pagination on the back cover of a rare example of the Leopolita's Bible (1561), originating most probably from XIX c. the precise positioning of the focused beam in order to measure the pigment signal was required. Despite

difficulties, a wide spectral area of considerable differences was recorded for removal of the coloured trace – Fig. 7.

The structure containing a number of intense Fe and Ba lines is superimposed on the background signal in the spectral range of 404-442 nm of the recorded emission, and characterise the historical, blue pigment in comparison to the pigment-free substrate surface.

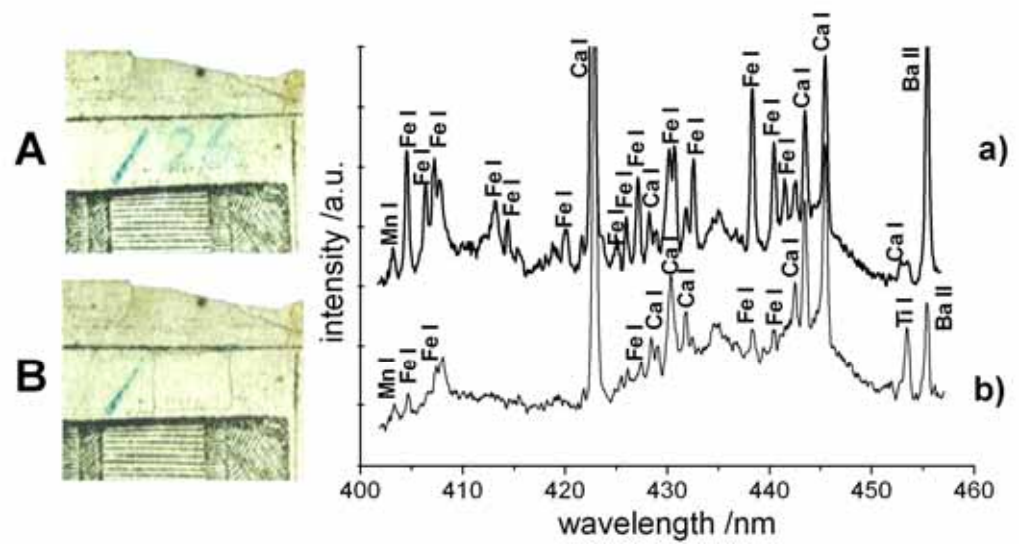

Figure 7: Blue pencil mark on the Leopolita's Bible from XVI c. before (A) and after laser cleaning (B), and the corresponding LIBS spectra of the coloured (a), and laser-cleaned paper region (b); the reach content of Fe lines in (a) corresponds to pigment Prussian Blue

3.3 The post-processing effect due to laser interaction

The laser ablation applied for surface cleaning of the model, wood-pulp paper artificially soiled with dust resulted in a decrease of the tearing resistance (TR) by about 7% and 14% when going to shorter irradiation wavelength of 355 and 266 nm, respectively – see Fig. 8a. This was due to the effect of the UV radiation on the paper fibres which leads to breakage of the cellulose chain bonds and creation of shorter chains. Ageing resulted in further decrease of TR because of the additional destructive factors such as high temperature and humidity. They cause breaks of the hydroxide bridges of cellulose chains and result in a decrease of the polymerisation degree [11]. For non-aged samples irradiated at 532 or 1064 nm the TR changes were negligible.

A similar dependence on the laser irradiation was observed for the elongation resistance (tensile strength) – Fig. 8b. In case of sized paper this parameter decreases markedly in relation to the reference value by 59 %, 53 %, and 23 % for samples irradiated by the 266 nm, 355 nm and 532 nm laser, respectively. The irradiation at 1064 nm and ageing lead to insignificant changes of the elongation resistance for all paper samples.

This was confirmed by measurements of the cellulose solution viscosity for the case of non-sized samples shown in Fig. 9a. This factor represents important paper characteristic, and allows to conclude on the polymerisation degree / degradation of the cellulose fibres.

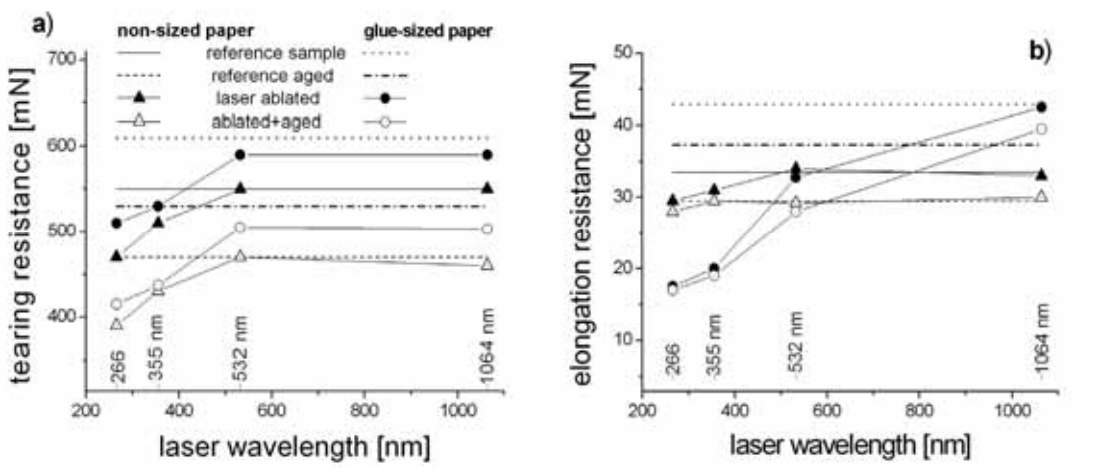

Figure 8: Dependences of the paper tearing resistance (a) and elongation resistance (b) on the laser irradiation wavelength for the model paper made of cotton cellulose and wood-pulp

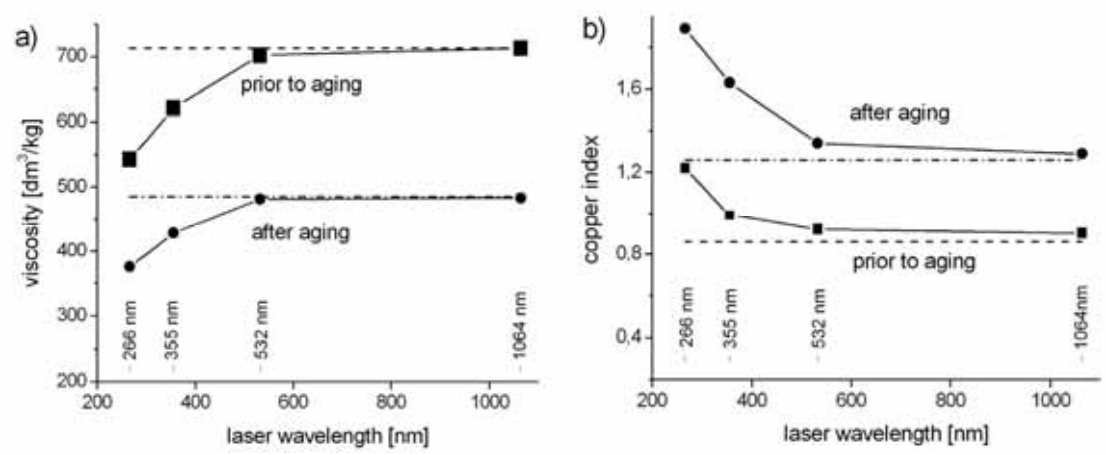

Figure 9: Cellulose solution viscosity (a) and copper index (b) vs the laser irradiation wavelength at fixed laser fluence of 0.6 J/cm^2; wooden pulp paper with admixture of cotton cellulose

The decrease of viscosity by 25 % and 13 % in case of the 266 nm and 355 nm laser irradiation, respectively, was observed in comparison to the reference value of 715 dm^3/kg. The further drop of viscosity by about 30 % in case of all samples resulted due to ageing.

The above result coincides with that obtained from measurement of the copper index. Its value describes quantitatively the low-particle products of the cellulose disintegration, and allows to conclude on its de-polymerisation degree. For sample irradiated by the 266 nm laser a considerable increase by 42% of the copper index from the value of 0.86 (reference sample) to 1.22 is observed – Fig. 9b. The laser irradiation at higher wavelengths resulted in smaller changes in the range from 15% (355 nm) to 5% (1064 nm). The ageing process caused an increase of the copper index value particularly for the UV-irradiated paper due to de-polymerisation enhanced by the environmental influence. The negative effect of the UV laser radiation has been observed in the SEM images and the surface perforation was concluded from comparison of the images obtained prior and after laser treatment at 266 nm. In contrary, after photoablation at 532 nm, and 1064 nm under the same conditions no deterioration of the fibers was observed. The stratigraphy of the laser-irradiated layer revealed the micrometric amounts

ablated due to individual pulses. The penetration depth increased with the laser wavelength applied and the maximal depth not exceeding 20-25 μm was estimated for irradiation at 1064 nm. This confirmed the nearly non-destructive character of the LIPS technique applied for study of the depth profiles of elemental composition of historical papers and pigments on paper in agreement with literature.

4 In-situ XRF study of the XV c. mural paintings

The wall paintings located in the Little Christopher chamber of the Main Town Hall in Gdansk were discovered in 1891 by judge Engel from Gniezno after stripping of old paneling and wallpapers that hided the frescos – Fig. 10. The chamber of interest is the smallest of two under-tower chambers situated one above another. Those chambers called Great and Little Christopher used to be a chapel and a storage place for money deposits, royal mail documents and secret archives (*Archivum secretius*), precious table sets, etc. An ironwork door enters the Little Christopher chamber which is 3.55 m long and 1.93 m wide and it is lighted up with one small window. The entire surface of the walls and vaulting is covered with mural paintings currently under restoration.

Figure 10: Fragment of the XV c. mural painting presenting scene painted by means of the malachite and azurite based pigments; the orange-brown color on the face contains HgS

The measurements were carried out by means of the portable XRF spectrometer completed at the IF-FM Pol. Acad. Sci, Gdansk. The spectrometer consists of the 60 kV X-ray tube for excitation delivering collimated beam of 4 mm in dia, and the X-ray detection system equipped with thermoelectrically cooled silicon drift detector. The spectra were recorded for selected locations on the wall, characteristic both for the different pigments as well for different details of the paintings. The spectra were accumulated during 120 s each, and processed using the principal components analysis (PCA) procedure of "Mathlab ©" – see Fig. 11.

The Little Christopher's mural paintings palette is limited to green, red, blue, brown, yellow and black pigments. The main elements composing those colors are copper, lead, iron, mercury and calcium and also traceable amounts of antimony, barium, cadmium, tin and molybdenum. On the basis of sufficiently large amount of data obtained from every figural and ornamental details of the Little Christopher's paintings palette the five base pigments: chalk, malachite, azurite, read lead and ochre were found. The results are of importance for the painting conservation being in progress.

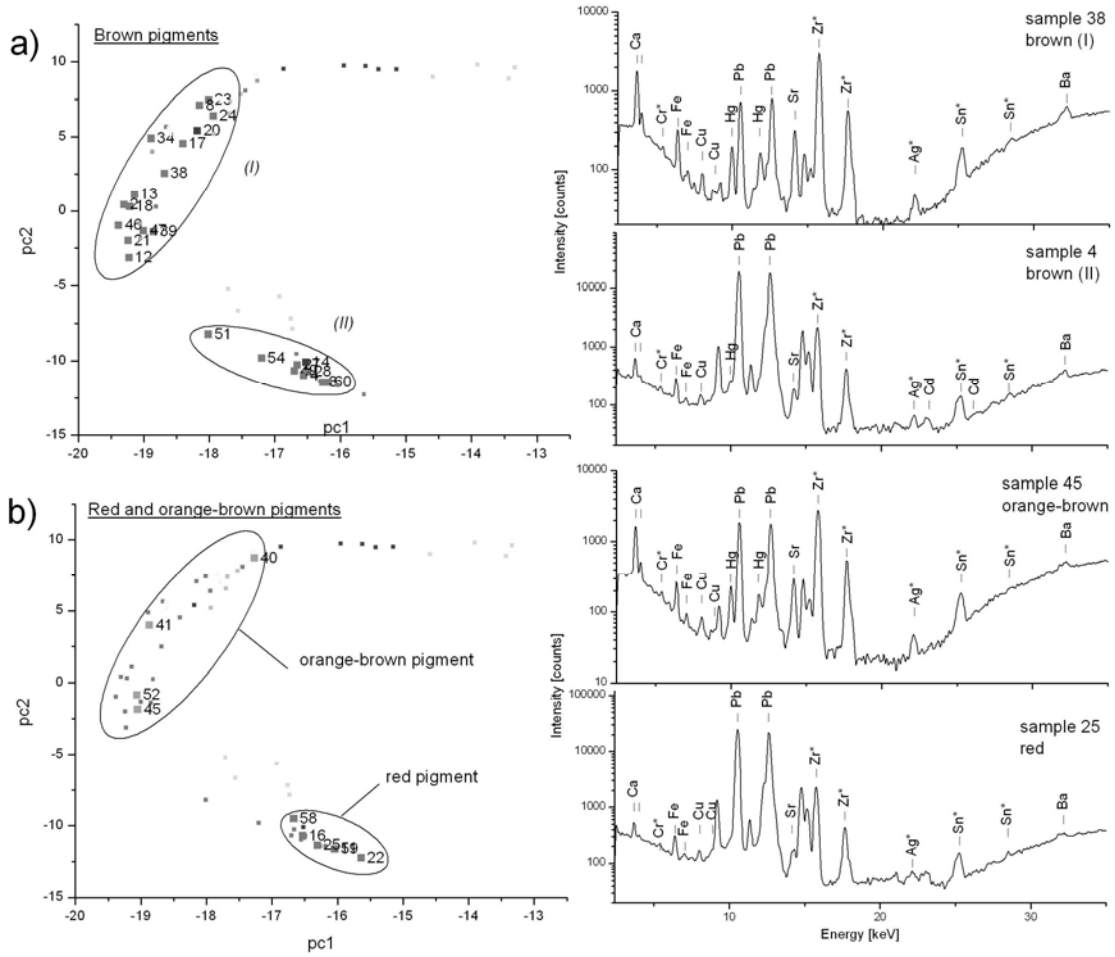

Figure 11: Two first principal components obtained by the PCA technique applied to spectra of the brown pigments (a), re- and orange- brown (b), and spectra representative for each color

5 Conclusion

Case studies on historical objects using the restoration and analytical techniques available at the Pomeranian Laser laboratory were performed. For the Gotland Sandstone and also for the localized surface cleaning of the fragile, historical documents on paper laser cleaning was applied. From colorimetric data the negligible discoloration and yellowing of stone surface was concluded for the properly selected interaction parameters. The spectroscopic measurements revealed a strong correlation with the cleaning progress allowing for process monitoring. Results were consistent with surface inspection revealing structure changes due to laser cleaning. LIBS spectra for historical documents allowed for identification of the contaminant elemental composition. For paper the best cleaning results were concluded for samples irradiated at 532 nm and at laser fluence below the substrate damage threshold of 0.6 J/cm^2 which is in agreement with literature. For samples irradiated in the UV range, and particularly at 266 the SEM inspection confirmed the local damage of the cellulose fibres. This was accompanied by the decrease of mechanical strength of the paper. The effect was more pronounced after artificial ageing. By means of the portable XRF spectrometer the *in-situ* analysis of painting materials of the XIV c. frescos in the Little Christopher Chamber in Main Town Hall of Gdansk was performed. For mapping of the paint material the spectra were acquired non-destructively and the entire color palette was analyzed by means of the PCA procedure for needs of the recent conservation work.

Results of this work were obtained mainly in frames of the COST actions G7 and G8 based projects SPUB-M / Cost G7 /DZ-220 “Laser Techniques for Cultural Heritage”, SPUB-M / Cost G7 /DWM 119 Renovation of Historical Paper Documents by means of Laser Tools, and SPUB-M / Cost G8 /DWM/102 “XRF Technique for Pomeranian Museums and Conservation Works”, supported by The Ministry of Science and Higher Education. The methods, analytical techniques and also the experimental capacity of the Pomeranian Laser Lab. in Gdansk are attainable for the European community of conservators and museum curators.

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Session V

Impact of EU policies and directives on European cultural heritage diversity and sustainable safeguarding; impact of cultural heritage research results on society and support for policy needs

The challenge of EU policies for cultural heritage management: what is the problem with some EU Directives?

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Key words: research support to policies, EU legislation, directives, impact on cultural heritage

1 What is the problem with some EU Directives? Which are the causes?

An important job of the European Union is the protection of cultural heritage. Cultural heritage, after all, is a reflection on the identity of the different European nations. What's more, cultural heritage plays a significant role in the tourism and economic sectors. The European Union, likewise, has an important part to play in drawing up legislation, for example, with respect to the protection of the environment and the improvement of working conditions. Nevertheless, in a number of cases, legislation drawn up by the EU has – unwittingly – had a reverse effect on the safeguarding of Europe's cultural heritage [1].

The problem consists of a number of EU Directives – legal acts – that become incorporated into national legislations and which have to a greater or lesser extent a detrimental affect on the sustainable preservation of the European cultural heritage. In regards to the built cultural heritage the Working Group has identified 16 detrimental directives. 2 Directives have been checked out as not being detrimental. A further 3 directives are under scrutiny, and 1 directive is potentially positive. Of the non detrimental directives; Limitation of Volatile Organic Compounds 99/13/EC has an exemption clause included through lobbying by Working Group members. A full list of directives is printed in the article.

Can the EU legislate in cultural matters? Or what is the relationship between the EU Treaty and national legislation in the field of culture? The organs of the EU have only those competencies which have been attributed to them (the principle of attributed powers). This is important for the EU competencies to regulate culture related questions. Article 151.4 gives the EU the right to initiate supportive measures, but not restricting measures.

The rules concerning the 4 freedoms have a wide scope and may have indirect repercussions on the cultural sector. But cultural considerations are recognised in the EC Treaty and in the practice of the EU-court as legitimate reasons for trade restrictive measures in areas not regulated by directives. Article 95 opens for member states to have other rules than those that follow from a directive, where this is necessary to preserve for example national treasures of (amongst others) historic values.

The matter is actually further complicated by Art. 151.4 of the Treaty which calls for the general inclusion of cultural aspects in all Community policies. On the one hand, this article gives the EU the right to initiate supportive measures, but *not restricting measures*.

The (growing) emphasis on cultural policy in Brussels was underlined when the EU Commissioner Jan Figel stated:

> ***"****a common vision for cultural heritage is an absolute necessity, especially in the light of art. 151-4 of the Treaty, which calls for the general inclusion of cultural aspects in all Community policies****"****.*
> (…) [2]

So, the conflicts ensuing from the implementation of the EU Directives, on one hand, and sound heritage conservation practice, on the other hand, takes place at *national*, rather than at *EU or international* level. The conflict stems from EU Directives from policy areas that are within the EU competencies; such as international trade competition, personal and public health, safety, and conservation of the natural environment.

The structure of the European legal framework is important for the understanding of why this field is becoming a major problem for the cultural heritage sector. The legal acts in question were never meant to be applied to cultural heritage conservation. Or at least those who formulated the directives did not take cultural heritage needs into consideration. What may seem as clear cut delimitations on attributed powers in the Treaty are not so clear in everyday practice. The EU legislative competencies do impact on cultural heritage preservation and management and the impact is often detrimental. The support offered though the EU Culture 2000 and Research programmes do not in any manner mitigate the negative impact of the mentioned legislation.

How can this problem be solved? And who must act to solve it? This question was put to the EU *Commissioner* for Education, Training, Culture and Multilingualism Mr. Jan Figel in December 2005, and the question was:

> "The Commission might in the future consider accompanying its legislative proposals with an additional "fiche" indicating the *compatibility of a given Commission proposal with the provisions of article 151.4 of the Treaty."* [3]

The Commissioner Mr. Jan Figel answered:

> *"*However, I do *not* feel that an effective implementation of art. 151-4 does *require* a cultural–impact assessment or *a permanent monitoring system*, nor periodical reports on this subject. I think this proposed approach would add more burden on the resources of the European Commission, without providing a clear value added for our actions." [4]

So it is not for the Commission to scrutinise whether art 151.4 is upheld. This therefore must be a task for the cultural heritage sector. But, if this is the case a further complicating element is found in the perceptions of national culture and cultural heritage administrations – the competent cultural heritage authorities. Almost all these public authorities act as if cultural policies are not influenced by the EU competencies, they lack a focused European political agenda, and, at the national level, they are not involved in the review process of national legislation prior to its adaptation into national law (one exception being legislation which explicitly touches on national cultural heritage policies. The problem of the EU directives is just not on their agenda – yet.

2 What is the scope of the problem?

A list of directives has been compiled by The "*European Working Group on EU Directives and Cultural Heritage*". The list indicates some of the problems created for accepted practises of conservation by EU legislation. The list also indicates the scope and diversity of the problem. More research into the actual effects and both legal and mitigating measures are urgently needed.

Directive name & nr.	Detrimental effect on Cultural Heritage
1. Biocidal Products 98/8/EC	Aiming to assess all biocidal products on the European market. Producers of wood tar are not able to produce product information required, leading to a prohibition on the market of this tar. Wood tar is used for preserving old boats, wooden buildings and stave churches in Norway, Sweden, Finland and Denmark. A Nordic initiative to prove non-biocide effect in actual use and remove wood-tar from list of substances is initiated.
2. Construction Products 89/106/EEC	Requires standardisation of construction products. This is a threat to some traditional building materials and traditional conservation methods.
3. Energy Efficiency 93/76/EEC	Aims to limit carbon dioxide emissions. Requires application of ventilation in old buildings. General indoor climate requirements are hard to fulfil for old buildings without also affecting the cultural value.
4. Energy Performance in Buildings 2002/91/EC	Attempting to reduce the use of fuel in the EU. This leads to implications for replacement of original windows in old buildings etc. * Has an *exemption in art. 4* for certain protected buildings.
5. Environmental Impact Assessment 85/337/EEC	Assessing certain public and private projects on the environment. Controversial when related to mixed areas of cultural and natural heritage.
6. Health Conditions on Fishery Products 91/493/EEC	Requires the use of smooth surfaces when handling fish and fishery products. This creates difficulties for traditional wooden fisheries to continue their production. It requires huge investments to satisfy the standards. Most owners cannot afford this.
7. Lifts 95/16/EEC	Concerning lifts permanently in service. Requirements for accessibility of disabled persons can be a problem fulfilling in protected buildings without also affecting authenticity and cultural value.
8. Machinery 98/37/EEC	Machinery shall be properly secured for the sake of workers. This is a challenge for building conservation.
9. Natural Habitats 92/43/EEC	Aiming to protect biodiversity. One consequence is that intrusive vegetation disturbing cultural heritage values in a habitat protected by the directive cannot be removed. Cultural heritage values in these areas must succumb to the conflicting nature interests.
10. Passenger Ship Safety 98/18/EC	Protected passenger vessels in service must apply to strict safety requirements that are non-adjustable. Application to certain passenger vessels also removes the cultural value of the ship.
11. Toxic Products 76/769/EEC	The removal of substances dangerous for the environment also affects materials and treatments of protected cultural heritage as they cannot be preserved in a traditional manner.
12. Working Places 89/391/EEC	Safety requirements for workers may damage protected buildings with e.g. scaffolding bolted into the wall surfaces or create problems for use of traditional tools and techniques.
13. Purchasing Directive (Directive COM (2003) 503)	Amending and consolidating Directives 92/50/EEC, 93/36/EEC, and 93/37/EEC coordinating the procedures for the award of public works contracts, public supply contracts and public service contracts. Poses serious and sometimes impossible problems for acquiring materials from a specific geo-location to replace damaged materials in protected monuments, buildings and sites.
14. Directive relevant to fire safety regulations	Source Directive not identified. Objective to improve security and escape routes for public. Negative consequences: All doors in buildings where the public has access must open outwards. Consequence: All doors in historic buildings open to public must be changed. Almost without exception doors in buildings built prior to 1900 have doors opening inwards due to the demand for security and escape as it was seen in those days.

Directive name & nr.	on the agenda, Paris meeting November 2005
15. EU-Directive 2000/60/EG, The water Directive	For improved water quality and reduced run-off from agriculture. Negative effect for canalisations, sites and cultural landscapes. New on list and to be discussed in Paris November 2005. Comments after the meeting (February 2006): Special treatment of cultural heritage is indirectly authorised by the Directive when in keeping with the condition that a cost-benefit analysis is first used to decide removal or non removal of the object in question. The results of this analysis may, in any case, be overridden by "overriding public interest" or "legitimate use of the environment", when no substantial pollution to, or additional deterioration of the water is caused thereby.
16. EU Draft Directive on reduced rates of VAT COM (2003) 397 final	This is a potential amendment to the EU Sixth VAT Directive 77/388. EC. Intends to harmonise use and levels of VAT in the EU. For several years an experimental "Annex K" in operation that has permitted the lower rate for repairs and maintenance of housing, but it ran out at the end of 2005. In 2006 the Annex K, was extended until 2010. But the timeframe for reporting use to Brussels was extremely short and discriminated many national actors from profiting from this possibility.
17. Proposal for Directive on Geographic information in the EU (INSPIRE) COM (2004)516	Wishes to establish a unified system for geographic information in Europe, for monitoring and safeguarding of nature areas and pollutions control. Cultural heritage objects and buildings not included, and consequently will not be included in the planning tools emerging from this unified GIS system. Status after Paris: There seems to be an opening for including cultural heritage. The question is if national authorities / experts will 'push' to have it included. There was no general agreement at the Paris meeting that this was advisable.

Directive name & nr.	New Spring 2006
18. EU Directive 2002 95/EC, Restriction of Hazardous Substances	EU Directive 2002 95/EC RoHS (Restriction of Hazardous Substances) and EU Directive 2002 96/EC WEEE (Waste Electrical and Electronic Equipment). This combination of directives are stopping repairs of organs were some pipes need changing. Organ pipes are of lead or contain high quantities of lead. What about glass windows with lead? Ref.: http://www.pipes4organs.org/
19. EU Directive 2002 96/EC Waste Electrical & Electronic Equipment	EU Directive 2002 96/EC WEEE (Waste Electrical and Electronic Equipment) and EU Directive 2002 95/EC RoHS (Restriction of Hazardous Substances). This combination of directives are stopping repairs of organs were some pipes need changing.

Directive name & nr.	Checked out by the working group
Limitation of Volatile Organic Compounds 99/13/EC	Intention is to reduce atmospheric and air pollution fro volatile organic compounds. A limitation on use of VOCs reduces the possibility for using authentic paint and varnishes for historical restoration. Clause of special consideration achieved for ch, spring 2004. *"For the purposes of restoration and maintenance of buildings*[4] *....designated by competent authorities as being of particular historical and cultural value, Member States may grant individual licences for the sale and purchase in strictly limited quantities of products which do not meet the VOC limit values laid down in Annex II"*[5]
COM (2003) 319, on the management of waste from extractive industries	Intends to curb pollutions from extractive industries. Cultural heritage values not mentioned in text, and it is apparently unrecognized that some sites of extraction are cultural heritage e.g. County of Cornwall, which is rich in historic mining and the World Heritage site of Røros in Norway. Result: will not affect closed down mining activities, follows from 'use area' and definitions of the directive as given in article 22. From this article it follows that the directive will not impact on 'closed' deposit sites.

The problem becomes manifests as we are confronted with some of the following consequences of the legislation. The legislation results in:

- Performance demands only to be solved by intrusive techniques and modern products.
- Problem for continued use of historic buildings and techniques; either not allowed without damaging interventions and/or made too costly or cumbersome to be applicable.
- Obstructions and difficulties for production and procurement of traditional materials.
- Lengthy and costly specification procedures to be able to procure materials from specific geographic locations (due to free competition across Europe).
- Obstructions and difficulties for use of traditional techniques and skills; for buildings as well as artefacts. Sometimes traditional skills become impossible to apply in practice.
- Demands that traditional wood tar no longer be bought or sold, which again affects historic ships and wooden architecture.
- Demands that all doors where public have access must open outwards! This implies changing the direction of the doors in all buildings from before 1890.
- Stock fish can no longer hang on wood as has been tradition a thousand years. Favours capital intensive fisheries to the detriment of existing local fisheries and costal.
- Pipe organs cannot be repaired.

The scope of this problem makes it one main contributor to a development which threatens the historic authenticity and attractively of the European cultural heritage. In 2002 this heritage created a turnover of € 335 billion and created 8 million jobs in Europe. Very few people hold the opinion that our heritage will have the same attraction value if it became transformed into a "Disneyland"-like attraction. So what we are discussing also has great economic and employment consequences for Europe (and the Lisboa goals of the Commission).

3 What research will support policy needs?

Research has an important role to play, and it can contribute in many areas. The cultural heritage community has, so far, concentrated its research on the objects and artefacts. The field of delivering research based knowledge to support policies has been underexploited. There are now signs that this community too is waking up to the need to supply research based knowledge which supports policies more than supporting professional restoration and conservation work.

Figure 1: Viscri-Weisskirch, Transylvania; Ro. affected by Biocidal Products 98/8/EC, © T. Nypan / Riksantikvaren

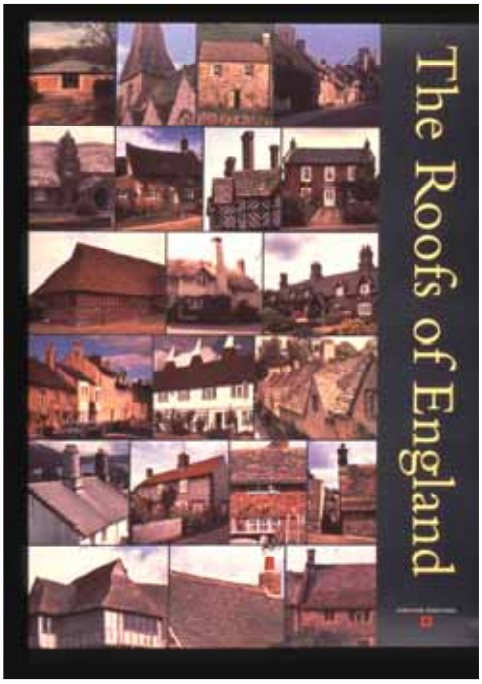

Figure 2: Types of roofing disappearing due to law on construction products. © English Heritage, D. Heath

Figure 3: Detail of door at main gate, Hobluka Castle, Cz. Should open outwards, threatened by fire safety regulations © T. Nypan / Riksantikvaren

In appraising the effects of a constraining or problematic law, research is one of the most powerful tools at our disposal. Research is collection of empirical facts and the methodological analysis of these facts. The title of this session of the Conference is "Support of Cultural Heritage to Policy Needs". Research in the cultural heritage field should therefore immediately:

1. Map and determine the scope and consequences of this legal problem.
    a. What are the long term effects?

   b. How can the research community contribute better to our knowledge of the relationship between a given law and the consequences in the field or 'in situ'?
   c. What are the wider consequences for cultural heritage and society at large of a given law?
2. Monitor the legal process and seek solutions; a field for social scientists and lawyers,
   a. Assist government and other agencies in supplying background documentation (refer 1.).
   b. legal research into competencies and their delimitations for the players
3. Develop new products and techniques that could remove or minimise problems created by substitution of products, development of alternative techniques or alternative methods for applying techniques, etc. This is done today and must be continued. But this research must also take into account.
4. Not all the problems created by the legislation may be solved by new approaches. In many cases this is not even something we wish for as our job is to restore, not only maintain. Therefore it will be just as important to focus on and document the need to keep old techniques, materials and practices and to prove that they are not substitutable. Or, if they are substitutable, this has other consequences lie affecting historic authenticity, attractiveness and other positive effects generated by true historic environments.
5. Focus research on the economic income and employment potential of cultural heritage and their main attractors for consumers.
6. Research and develop communication tools and strategies for cultural heritage to strengthen "a common vision for cultural heritage (is an absolute necessity, especially) in the light of art. 151-4 of the Treaty, which calls for the general inclusion of cultural aspects in all Community policies". (…) [6].

4 Is there a solution to cope with this challenge?

The cultural heritage authorities and community must develop instruments, avenues and communication modes that can transmit findings in a form attractive to the key players in the policy field. This is also a research challenge.

First it is necessary for competent national cultural heritage authorities, who are the government agencies and parties to the legal development, to follow more closely the EU legal processes. They need to be timely informed and to take action when a potential problem is discovered.

Authorities and policy makers need the correct legal 'instrument' (s) to use when problematic directives etc. are identified. Both these demands would be satisfied if a Legal Observatory for cultural heritage was established and the "Clause of special considerations" became recognised as the appropriate legal instrument [7].

In the 'clause of special considerations' the legal authority in a field of EU competency is transferred to the "competent national authorities" for cultural heritage, when the consequences of the directive impact on cultural policies. Or to state it differently; the EU recognises that EU competencies to legislate in specific areas may infringe on the prerogatives of national cultural policies and states that, if this is the case, the competent national authorities for culture (and cultural heritage) can make exemptions from the directive. More legal research and clarification is also needed to highlight the case.

At the national level Cultural heritage authorities should, in the future, assure that they are consulted in all legal procedures relevant to pollution control, environment, the common market and health and security at the working place, etc. This is the only manner in which competent

authorities can ensure that necessary special considerations for cultural heritage taken in Brussels are implemented at the national level.

Other national agencies may argue that since the EU competencies do not cover the cultural heritage sector there is no need for such involvement. Our findings prove the opposite. Of course, this means an additional working burden on cultural heritage administrations. But refraining from such an involvement may, on the other hand, have very serious consequences. In national legislation, as in EU legislation, discovering problematic consequences after the legislation is enacted is too late!

5 Summary and conclusions

The EU legal acts that impact negatively on cultural heritage administration and conservation stem from areas inside EU competencies. The cultural Heritage sector is not informed about the development and implementation of these legal acts. Therefore the competent cultural heritage administrations discover the detrimental effects too late. This can be countered by a legal observatory serving all cultural heritage administrations and other players. The sector can then influence the legal acts on a pro-active basis and propose a clause of special consideration fro cultural heritage.

Research must play and important and active role both in monitoring the issue and researching and documenting consequences, research on new or alternative solutions for products and processes as well as on traditional techniques and their necessity in maintaining a sustainable management. Not least, research has a tremendous challenge in developing documentation of the economic and employment potential of cultural heritage for Europe, its importance for creating attractive locations and urban spaces and the tools for harvesting the befits from deploying cultural heritage as an active factor in social development.

What we must avoid is the “Disney”-fication of Europe and the subsequent loss of all types of values and employment potential based on our common European cultural heritage.

6 References

[1] Mission Statement of the Working Group on EU Directives and Cultural Heritage.

[2] Culture Counts for Europe, Brussels December 7, 2005. Organised by Europa Nostra, in cooperation with the European Economic and Social Committee.

[3] Ref. note 2. Proposal from Europa Nostra and Mr. J. Figel speech http://www.europanostra.org/downloads/speeches/jan_figel_speech_forum_7december.pdf .

[4] The generic term for buildings would be cultural heritage buildings, sites, landscapes and other objects …. As designated by….

[5] Refer list of directives, Directive COM (2002) 750, amending Directive 1999/13/EC, on the limitation of emissions of volatile organic compounds due to the use of organic solvents in decorative paints and varnishes and vehicle refinishing products.

[6] as [4].

Impact of EU directives on small enterprises acting in the cultural heritage field – monumentenwacht experience

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The effect of European legislation is felt most keenly at the workplace. Small organisations are confronted with measures based on somewhat obscure rationales that may be detrimental to the preservation of cultural heritage.

Legislation regarding cultural monuments is primarily an issue for the member states. However, damage to cultural heritage usually relates to the side effects of legislation in other fields in which Europe takes precedence, such as the environment, safety and the economy.

We must also point out that no one in the European organisations will intentionally harm cultural heritage. It is usually the damaging side effects of legislation that are to blame. These effects are unnoticed when a law is implemented because no 'cultural heritage test' has been carried out. Only in retrospect, after implementation, does the practical damage to cultural heritage become apparent.

1 Damaging side effects

Some damage caused to cultural heritage by European legislation can still be repaired. However, this has to be carried out by each individual member state, which means that there is inconsistency amongst countries in the application of regulations. It is better to consider possible negative consequences of laws and regulations for cultural heritage in advance.

1.1 Some examples

If the European environmental legislation relating to the composition of paint was applied literally this would adversely affect the authenticity of paintings by artists such as Rembrandt, Van Gogh and Mondriaan. During their lives they used extremely common types of paint that contained substances including lead. Paints containing these harmful substances were recently strictly prohibited throughout Europe due to environmental considerations. This would prevent the restoration of old paintings, and this could cause enormous damage to the cultural heritage of the Netherlands. Naturally, this enactment has been amended by the Dutch government. But are these individual exceptions valid in countries where the works of these artists are exhibited? Naturally, it would have been much better if experts had brought the importance of cultural heritage to the attention of the developers of these European instructions. They would have permitted exceptions for the restoration of special paintings under certain conditions.

2 Demolish all church doors?

Uniformization in the field of for instance fire prevention is also important at the European level. Research, including the European Cost 17 programme, is currently being conducted on this subject.

However, if we stringently apply current European legislation on this issue there will be a tremendous problem for all our historic churches. As you are doubtless aware, church doors open inwards as a symbol of hospitality. European fire prevention regulations specify that all doors of public buildings must open outwards due to fire safety considerations. Do we now have to demolish all the doors of historic churches and replace them with new doors? Would it not have been possible to find a solution to this specific problem if the developers of this legislation had consulted with experts at an early stage?

3 Not always consistent

European legislation can also be inconsistent in other areas. European countries also occasionally block the implementation of some European regulations on the basis of completely inappropriate arguments.

3.1 An example from my country

Improvement of the quality of the air that we breathe is a core issue for Europe. This quality is below the European standard in some parts of the Netherlands due to the emission of soot from diesel engines.

It is understandable that the European Commission wants the Netherlands to implement measures to improve air quality.

The Dutch government has developed a plan to make soot filters compulsory in diesel cars, which will significantly improve the air quality.

However, the same European Commission claims that this measure distorts the internal European market. This means that the Netherlands is denying diesel engine vehicles without a filter access to the Dutch market. The Dutch authorities feel that the Commission is excessively influenced by the car industry because all the car manufacturers can produce cars with a soot filter. This has been compulsory for the American and Japanese markets for some time.

This type of measure, whereby economic motives prevail over environmental motives, is incomprehensible to the people breathing the dirty air.

4 Employment conditions

A safe workplace for all tradesmen is a justifiable spearhead of European policy. My organisation supports this wholeheartedly. However, one problem is the pace of the implementation of legislation on employment conditions. Methods that are still permitted in some countries are fined in others.

It will surprise no one that tradesmen working on high roofs must be provided with sufficient safety equipment. No concessions must be made in this area.

For example, working on high gutters involves specific safety issues. This is not a problem for anyone. However, different methods can be used to put these measures in place.

Obliging a painter standing on a small ladder to wear a safety line is obviously excessive.

In the Netherlands in particular, regulations relating to employment conditions have been enforced extremely stringently during the last few years. For example, there are far-reaching conditions attached to climbing ladders.

It was not possible to conduct work directly on any historic roof without fitting the entire roof with certified climbing hooks.

Can you imagine the extra expense for the owner of the historic building? Can you also imagine the terrible effect this has had on the appearance of a number of historic buildings? A hook on your roof every two metres, never mind the increased chance of leaks.

Fortunately, the Dutch government has recently realised that the regulations relating to safe working were being applied extremely rigidly. Half of all legislation on this subject will be scrapped in the near future, and this will certainly not lead to increased risks for employees.

5 Conclusions / recommendations

Create an observatory or a committee that can evaluate all forthcoming laws and legislation at an early stage and indicate to the developers of the legislation where the problems are in terms of the maintenance of cultural heritage.

Involve experts in this process. They will certainly provide broad support for this initiative. However, this must be coordinated by the European authorities or governments.

Study the economic significance of cultural heritage in Europe, not forgetting that cultural heritage is a far more important economic factor than many may assume. Here, I refer to the results of a study conducted by our Norwegian colleagues that is certainly available to you. Take a look at this study, the findings will be a positive surprise. If European citizens do not feel that European legislation is a threat to their cultural heritage but actually protects it, this will certainly increase the level of acceptance of a united Europe.

6 References

www.monumentenwachtbrabant.nl

The preservation of the cultural heritage of property through an analysis of European regulations regarding building materials used in restoration

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Key words: technical specification, standardisation, material building, lime

1 Communitarian policies for the cultural heritage

In the field of culture, community action is characterised by valorisation and development of the knowledge of the European cultural heritage. In respect of the cultural and linguistic differences of all the member states, the European Community has long since engaged in improving the knowledge of different cultures among its citizens and is now occupied with the realization of a cultural union. This cultural union has to be understood principally as an addition to and the completion of the existing economic and monetary union.

The Treaty establishing the European Community provides that the activities of the Community shall include among its aims a contribution to education and training of quality and to the flowering of the cultures of the Member States (article 3q).

Action by the Community, according to Treaty establishing the European Community, shall be aimed at encouraging cooperation between Member States and, if necessary, supporting and supplementing their actions in: improvement of knowledge and the dissemination of the culture and history of the European peoples; conservation and preservation of cultural heritage which has a European significance; non-commercial cultural exchanges; artistic and literary creation, including the audiovisual sector (article 151). Article 151, which is dedicated to culture, provides some principles, and these have a fundamental prominence, since the member states must standardize their legislation according to these same principles.

Culture is therefore, a fundamental right in the Union. With this in mind, the Charter of Fundamental Rights stipulates that “the Union shall respect cultural, religious and linguistic diversity” (article 22). Whilst the Charter has no direct legal effect, the same cannot be said of the Treaty, which constitutes the primary source of Community law and places culture among the principles of the Union.

Hence in 1974, the European Parliament adopted a resolution which mentioned the need for Community action in the cultural field, especially action to protect cultural heritage. In 1993, the Treaty established that the European Community provides a legal basis specifically for activities concerning the preservation and enhancement of cultural heritage.

The Treaty declares that the Community must support and supplement actions by the Member States in order to conserve and safeguard cultural heritage of a European significance. Initially, the Community limited itself to supporting the restoration of that which was considered the heritage of buildings. From that time, the Community has looked after the heritage of buildings and so-called movable goods, archaeological and architectural heritage, natural heritage,

linguistic and gastronomic heritage and traditional occupations. Community action takes into account both the cultural and economic aspects of heritage.

In Europe, cultural heritage is a vehicle of identity. Knowledge of and respect for cultural heritage depends both on the quality of its promotion and on the capacity of European people to be aware of their own culture and those of other European States.

Community action which is aimed at the preservation and enhancement of cultural heritage permeates various programmes for cultural cooperation. Among these programmes, we cannot fail to recall "Culture 2000", which supports projects for conserving European heritage of exceptional importance, the so-called European heritage laboratories; "Media", which supports the European audiovisual industry; "Socrates", which supports educational projects in the field of cultural heritage by involving schools and museums; "Euromed Heritage", which supports the development of cultural heritage in the European Mediterranean area; "Eumedis", which supports the development of digital services in Mediterranean countries, such as multimedia services which provide information about cultural assets and tourist sites.

There is a danger of neglecting the need to protect and to enhance the cultural heritage which transcends European boundaries. The Union joins forces with international organisations and non-member countries through agreements for cooperation or for the creation of associations. In this respect, the European Union collaborates with the Council of Europe and UNESCO to preserve, European and world cultural heritage respectively.

Cultural heritage is moreover, a treasure for Europe, not only in the strictly cultural sphere, but in economic terms too. With this in mind, the Union fosters some projects in the field of vocational training, regional development and the use of digital content relating to culture. Cultural heritage, as the wealth of all European people, must be protected and is protected at both national and European levels. Among the various European programmes, "Culture 2000" promotes the mobility and training of those working in the field of cultural, archaeological and architectural heritage; "Leonardo da Vinci" supports projects which provide training in traditional occupations; the "European Regional Development Fund" (ERDF) provides financial assistance for heritage restoration projects which are part of regional development programmes, innovative action and community activities like "Urban" which covers urban areas in crisis and "Interreg" which promotes regional cooperation among the EU Member States; "Leader" provides financial assistance for the renovation and development of buildings, cultural sites, furniture and other objects; in the same way as "Sapard" fulfils this function for those countries of the enlarged community; "Life III" contributes to the Union's environmental policy encouraging the enhancement and management of natural and cultural sites; the sixth framework programme for research and technological development includes a priority "Support of other EU policies" which includes research activities in the field of cultural heritage.

Last, but not least, we must not forget the community action directed at the solution of issues relating to illicit imports and exports and the trafficking of cultural goods. The protection of cultural property is primarily the responsibility of Member States, according to the provisions of article 30 of the Treaty. However, since these goods could be transported without any customs controls between the Member States, within the common framework of an internal market, the European Community ensured the return of cultural objects unlawfully removed from the territory of a Member State in Council Directive 93/7/EEC of 15 March 1993, and for the export of cultural goods to third parties outside the Union, in Council Regulation (EEC) 3911/92 of 9 December 1992.

With this in mind, it makes sense that a serious programme of European programmes and a balanced use of legislation is fundamental in the preservation and enhancement of European cultural heritage.

2 The role of standardization in European legislation

The European Community operates and makes use of regulations, directives and decisions on the one hand, and recommendations and opinions, on the other. Regulations, directives and decisions differ from recommendations and opinions, in that the former are binding on Member States.

On a judicial level, with the exception of recommendations and opinions, which do not have the force of law, when talking about law, people think of a legislator and a rigorous prescription, which is binding upon all subjects. Beyond the legal field, in the economic sphere, there are different laws: differently drawn up and operating differently in the community. These laws are the standards. They emerge from market forces which, warning of the need for an official frame of reference, seek to standardise the framework of the law. The standard in question is "a document, established by consensus, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context" (ISO/IEC Guide 2). According to article 1 of Council Directive 98/34/EEC and the previous Council Directive 83/189/EEC, the standard essentially is "a technical specification approved by a recognised standardisation body for repeated or continuous application, with which compliance is not compulsory". The term 'technical specification' must be understood as a specification contained in a document, which lays down the characteristics required of a product, such as levels of quality, performance, safety or dimensions, including the requirements applicable to the product as regards the name under which the product is sold, terminology, symbols, testing and test methods, packaging, marking or labelling and conformity with assessment procedures. In other words, standards are a summary of best practice. The standard can be international (ISO), European (EN) or national (for example UNI in Italy, AFNOR in France, DIN in Germany, BSI in United Kingdom, JISC in Japan). It can be adopted by an international, European or national standardisation organisation and made available to the public for a fee.

There are different bodies engaged in the process of standardisation. At international level, there is the International Organization for Standardization (ISO), at European level there is the European Commitee of Standardization (CEN), nation-wide standards are developed by national technical bodies.

The standards are identified by acronyms. UNI, for example, represents the Italian standards. If there is only an acronym, that means that the standard is directly produced by national bodies. EN represents the standards produced by the European Committee of Standardization. These standards have to be integrated by Member States of CEN and in Italy the acronym becomes UNI EN. These standards are useful in the uniformisation of technical legislation in Europe, therefore at a national level there cannot be specifications which are not harmonised with this content. ISO specifies the standards produced by International Organization for Standardization. These standards apply all over the world. Each state can also decide to strengthen these by accepting them as part of national specifications. In this case, in Italy the acronym becomes UNI ISO (or UNI EN ISO, if the standard is accepted at European level).

While the social and productive system becomes progressively problematic and the government control is less and less intense, forms of delegation are extended and necessarily we are seeing the improvement of standards.

Compared with the usual legal norms, the standard is a flexible tool: it only suggests a path, which can be travelled to reach to a certain point, allowing different operatives to act in different ways.

Consensus, democracy, transparency and a voluntary nature are the most significant characteristics of standards.

There is another fundamental difference between the law (which is binding) and the standard (which is consensual and voluntary): respectively the presence or the absence of a body of sanctions. The seeming weakness of a consensual system, because of the lack of coercive power, really translates into a strength, appropriate technical specifications have sufficient force to be accepted and observed.

The main characteristic of standards is the consensuality between all parties interested in the standardisation process. According to ISO/IEC Guide 2, consensus is a "general agreement, characterised by the absence of sustained opposition to substantial issues by any important part of the concerned interests and by a process that seeks to take into account the views of all parties concerned and to reconcile any conflicting arguments". But consensus need not imply unanimity.

Requests for the development of standards, from the private or public sector, must be submitted to the Technical Board (BT), which decides whether or not a project will be pursued and, if so, how it should be dealt with, in the light of all relevant information. Elaborating standards is the task of the Technical Committees (TCs). The TCs may set up Subcommittees (SCs) and Working Groups (WGs) for certain clearly defined tasks, e.g. drafting specific standards.

The drawing up of a European standard can be split into the following stages. First, the needs of the partners are identified. The appropriateness and the technical-economic feasibility of the proposed standardisation project are analysed on the basis of two determining questions. First, will a certain standard provide a technical and economic "advantage" to the sector? Secondly, is the knowledge required for the drawing up of a standard available? Subsequently, there is joint programming, in other words, there is a reflection on the identified needs, the available means and the priorities, then there is a decision regarding registration in the relevant major standardisation programme (e.g. construction or environment). After the registration, the participants, represented by experts gathered together in the standards commission, work out the drawing up of the standard. Among the participants, there are: a) national standards bodies, who are members of CEN and constitute the final decision-makers within CEN; b) interest groups of various sizes at European level who are associated members, e.g. ANEC – which defends consumer interests, NORMAPME – which represents crafts, trades and small and medium sized enterprises, FIEC – the European Construction Industry Federation, CEFIC – the European Chemical Industry Council; c) national standards bodies from central and eastern Europe, which are affiliated members and plan to become CEN members; d) governmental bodies and other public authorities, including EC and EFTA; e) producers; f) distributors; g) end-users; h) consumers; i) public and private institutions, including universities and other academic bodies; j) laboratories. Members may participate in all activities of CEN and have voting rights, according to a weighted voting system. In this system, the preferences of some voters (i.e. Italy with UNI, France with AFNOR, Germany with DIN have 29 votes) carry more weight than the preferences of other voters (i.e. the Czech Republic with CSNI has 12 votes, Sweden with SIS has 10 votes, Denmark with DS has 7 votes, Ciprus with CYS has 4 votes, Malta with MSA has 3 votes). The various affiliated and associated members may also participate in the activities of CEN, but without voting rights. In the next stage, the draft standard has to receive the consensus of the experts. Validation is achieved through a widespread consultation, in the form of a public enquiry among all economic partners, in order to ensure that the draft standard conforms to the

general interest and does not give rise to any major objection. After the analysis of the public enquiry, there is an examination of the comments and the consequent finalisation of the definitive text of the draft standard. The standardisation body passes the text for publication as a standard. Finally, the relevance of the application of all standards is regularly assessed by the standardisation body. This assessment allows the identification of when standards need to be adapted to new needs. The democratic legitimisation of European standards can only be achieved by following this process. As mentioned above, national standards bodies have the obligation to implement (usually within 6 months after approval) the European standards as national standards and to ensure that conflicting national standards are withdrawn and that European standards are translated in national languages. The current agreement of CEN requires that during the period of establishing an European standard, national standardisation dealing with the same area should not take occur.

The beneficiaries of this system, both of the process and of the standard, are industry, services, commerce, other market players and public and private institutions; public authorities (the EU and EFTA have decided on a general policy of referring to European standards in legislation and on harmonised procedures for assessment of conformity); other interested groups, such as consumers, environmental protection associations, trade unions, and the conformity assessment community. These subjects are key players in the market and without them, no system can work.

Standards can be considered as customs and although they are written down, there is no single source which generates them. (In reality, the Committees cannot be deemed as this source). Like every custom, standards are norms which are *extra ordinem*. Recourse to standards is increasingly frequent and suggests a weakening of traditional legislative powers to the advantage of legal sources like customs. Standards predicated on a consensus which is aimed at the retention of a market or at most, in our case, of an interest in the preservation of cultural heritage, and are independent and self-regulating.

Indeed the principal source of norms, i.e. the law, seems to be moribund and to have been superseded by another set of rules, which are more effective, since they are developed more speedily. These standards appear moreover, able to regulate social involvement and to achieve market transformations.

In substance, the development of voluntary standards arises from the crisis of the normative system. In other words, society requires some standards, because it needs to have certainties, not only technical ones either. Standards, in so far as they are objective and specific rules of international scope, are hard to better in their content.

Standardisation is an integral part of the strategy of the EU to achieve the Lisbon goals of carrying out better regulation and of simplifying legislation, of increasing competitiveness of enterprises and of removing the barriers to trade at an international level, contributing to the enlargement of the Union.

The task of framing standards that provide technical solutions for manufacturers seeking to comply with EU-directives is assigned by the European Commission to the European standardisation bodies. These standardisation assignments state guidelines within which standards need to be framed to meet each directive's essential requirements. All standards must be based on sound scientific knowledge, fit for their purpose, mutually consistent and rapidly modifiable to keep pace with technological innovation. Once a harmonised standard becomes available, a manufacturer can declare that his product conforms to this standard and therefore national authorities presume that his goods comply with the directive's essential requirements. These goods can thus be placed on the market based on the manufacturer's declaration and with

a simple certification procedure. This certification is an activity by which a recognised body, independent of the interested parties, gives a written assurance that a product, process or service conforms to the standards.

In this paper, we present one of these European standards, which contains technical rules about building materials used in the restoration of this cultural heritage (C.N.).

3 An example of standardization in order to evaluate the effectiveness of community policies: the norm EN 459

The quality and effectiveness of norm EN 459 (use of lime in construction) can be used as case study to demonstrate the effectiveness of standardization as a tool which is useful at a community level in regulating the field of restoration and conservation of buildings that are part of the cultural heritage.

The norm in question singles out various types of bonding, among which it is possible to identify products which are clearly destined for the restoration sector and other classes of product which if they were used in constructions of historical importance, would give unsatisfactory results.

The classification contained in this standard is the only one currently available at a community level and for this reason, in the work of restoration, is a very important point of reference. The obligation that the norm lays down to use a label on the packaging which indicates which type of material it contains, has the effect that on the building site these ‘standardized designations’ are important indications for all who work there, from bricklayers to architects.

A technical examination of the official Italian version of this norm (including the correction AC:2002) and an assessment of its effects in the work environment, will allow a practical evaluation of the quality and the effectiveness of the work of standardization in the European Union in the field of the preservation of cultural heritage. It will also provide some useful suggestions for interventions to improve this activity.

3.1 The technical qualities of the European norm

Following on from the above, by means of a technical examination of the document in question, it is possible to highlight that among the various types of bonding proposed in EN 459-1, only the lime designated as ‘calcic lime’ (CL), ‘dolomitic lime’ (DL) and ‘natural hydraulic lime’ (NHL) can be used in the field of restoration. The definitions that are given, the chemical and physical characteristics, etc. that are required by the norm seem to offer a solid guarantee of the quality of this class of products and demonstrate their merit as being compatible with traditional materials.

On the other hand, those products such as ‘hydraulic lime’ (HL) which are classified as equivalent to those mentioned above, but defined as artificial mixtures of lime and other hydraulic elements, can certainly be sold for various purposes. The do not, however, guarantee sufficient compatibility with traditional materials which probably make up the majority works to be restored.

Specifically, as regards the correct technical characteristics required for a product to be included in the category of material suitable for restoration work, it is useful to point out that the chemical characteristics demand a minimum content of calcium and magnesium oxides for ‘calcic lime’ (CL) and ‘dolomitic lime’ (DL). For hydraulic lime, there is a maximum level of free calcium, for air limes, a maximum level of carbon dioxide and a maximum level of sulphates of $\leq 2\%$ for air limes and $\leq 3\%$ hydraulic limes. These specifications seem to offer

a sufficient guarantee for the end user, and achieve the aim of the norm to preserve the cultural heritage.

The quality requirements which the document contains are a real tool for safeguarding the materials. However, in the commentary on the text there are a series of dubious assertions which do not seem at all in line with the aim of the norm, as outlined above. In seems quite inappropriate that some natural hydraulic limes (NHL) can be classified in a sub-group 'Z', for example EN 459-1 NHL 3.5-Z. This group can also include hydraulic limes that were originally natural, but to which otherwise unspecified pozzolanic or hydraulic materials have been added to a maximum of 20% by volume. The increase in the maximum permissible level of sulphates from 3% to 7% introduces another element of uncertainty into the norm. Faced with these concessions, it is clear that hydraulic lime that was once natural, but now has additives such as cement (which widely used in these products), can be classified as a natural hydraulic lime (NHL). These artificial limes are incompatible with traditional materials and can seriously damage historical buildings.

Continuing this analysis of the norm, and summarizing the concepts it contains, it can be said that from the technical point of view, EN 459 is a valid benchmark for all those engaged in the work of restoration and preservation of the cultural heritage of buildings. Militating against this great value, however, the norm itself has some ambiguous features which could have been avoided if there head been a greater scientific awareness and a different balance of interests during the drafting of the text. In this way, a better final product would have resulted and this would have had more positive implications for the conservation of historic buildings.

The effects of this norm, both good and bad, have still to be evaluated and for this reason, before summarizing the data connected with the operation of the standard, it might be useful to examine briefly the various practical aspects of restoration work and the history of the production of building materials. This consideration will permit a better understanding of the points that will be made subsequently and of the conclusions that will be drawn at the end (G.P.).

3.2 The effects of standardization in restoration practices

Among the numerous types of construction materials, lime is, without a doubt, one of the most historically utilized materials in the building trade, either in the mortar's slowness in drying for re-facing work or the cement used to create imitation natural-looking stone. Ample utilization of such a binder in historic construction and the negative outcomes proven over time and what other binding materials have demonstrated is creating a renewed interest in the comparison of lime with cement, above all in the area of restoration, though also reflected in the most recent examinations for technical standards.

From the 3rd century B.C., lime was abundantly utilized until the beginning of the 1800's, a period in which a "new" material called cement was introduced onto the market, with characteristics of resistance and quickness in setting, which in those times, was astonishing. It was then in this manner that the comparison of the older product and cement began, in a phase of a project and/or the realization, the progressive substitution for lime, as a construction material, cement became more favourable, with the conviction that the "new" building material provides fortification under every profile type and was better than the older one. First of all, the structural substances, in virtue of their resistant union between cement bonding and metal bars, were successful also in architectural and decorative components. The process of progressive substitution also involved other materials, such as ceramics, used as floor-tiling, and regarding metals or wood, in urban style furnishings.

3.2.1 The scientific research as a base of the standards of restoration

At the same time in which radical changes were in operation, which involved the world of production, of project planning and, not the last, building sites, another and more profound revolution moved the sphere of knowledge. In the 1900's scientific research for an explanation of the base of all experimental evidence and, in parallel, a lot of data derived from empirical knowledge, all to often undervalued the profound value connected to centuries of refinement. Until now the selection, the production, and putting into operation materials which were in fact based on data from practical experience verbally passed on through the apprenticeship mechanism and in modern times also through bargaining. Notwithstanding one is dealing mostly with texts written by those who did not directly follow the work, however it is still interesting as authors of the times, had well presented the dates of the traditional experience, daily verifiable of the "know-how" of producers and artisans. By the Eighteen hundreds experimental aspects of empirical knowledge became stronger and there were not only a few, also in the fields of binders, the experimentation of new and old material, but only in the 1900's scientific research much like arms and becoming always more necessary for satisfying the needs of the market and production. Also when financial investments reversed on research applied to binders, by that time lime had become a minor material in the building field, in which the quantity of production was and is until now, insignificant with respect to the market for cement. Therefore, the benefits of the scientific research, moved from vast economic interests, fell only upon cement, the object of deeper and constant study and for numerous specific analytic publications. For this reason, the process of production and placement on the market lime just like any other type of natural binder (lime, gesso) was never really studied in a rigorous or consistent manner, but rather only in a sporadic way and always tied to situations in diverse sectors from building.

Scarce interest of research regarding such materials, consequently, almost caused a total abandonment on the inside of the building warehouses and of the progressive loss of experience connected to the capacity of utilizing, reflecting also on the European norms – EN 459 – which, as the way they are definite in the so-called National Premise of the European Standards itself, these expressions of the "real state of the art of material". Notwithstanding there has been notable advances in these last few years, in the direction of the recovery of natural binders and of their utilized knowledge also in the ultimate version of the standard, re-arising in 2002, tangibly influenced by ample experimentation on cement. It is particularly evident above all in the experimental part in which the methods of proof for lime reappearing, those employees for making verifications of cement were those who were verifying also lime. On the other part the preparation of the European Standard for lime used in construction has had initially through resolution n.107 in 1988 of the CEN TC 51 Cement and Lime for Construction and, FUNI EN 196 Methods of Testing the same admission of the UNI, was utilized as a base cement.

An ulterior motivation of such influence could be found in the system of volunteers who are the basis of the formation of organic, technical competent, structures, as we have seen, in work groups consisting of experts who represent the economic and social interests section (professionals, producers, technicians of the sector, centre for research. public administration, etc.) In the case of lime, the competent organ for following the European work on this particular question is Italy, UNICEMENTO – Ente di Normazione dei Leganti Idraulici, Malte, Calcestruzzi e Cemento Armato, group federal all-UNI, the name leaves the vocation of the study transparent also for hydraulic binders, cement. The organism of normalization develops a function of coordination of work, while placing at the disposal the organizational structure itself, while the contents of the standards are defined by the external experts who, in the European and international circles, are nominated by the single states. It is probable that the experience in the field of cement binders has had influence, for example, on the choice of classifying the hydraulic, natural or not, based upon the minimum resistance of compression evaluated after 28 days of curing. Like we seen after, this is not only one of the parameters of

evaluation possible but it is the one in which is based the classification of lime. In such a way it was possible to distinguish only the nature of the binder and one of its characteristics, perhaps not even the most significant.

Nevertheless, the classification is simple and fast because the identification code is retained, in the internal part of the technical cards of products, the only reference of the normative. Next as indication on the work of classification. Making reference to the professionals more attentive and the choice between diverse types of lime utilizable as a base only through the valuation of two characteristics of the product (primary materials folded and minimally resistant to compression). Often however, the classification contained in the norms UNI EN 459-1 is not even noted by the professionals who do not revenge the autonomy of the will and knowing choice but with trusted volunteers in the delicate phase of selection, of the production company, and our commercial assistance or of the operators of the business.

The passive behaviour of many professionals who with guilty disinterest, leave the others to drive: committees, producers, salesmen, or manufacturers with the choice of materials is the basis for numerous errors which, perhaps even in part, could be avoided. On the other hand the same procedure of formation of the norm technically would consent, as we have seen, an ample participation of the social part and economic interests both during the writing of the first draft of a document either during the public hearing, or the project of norms approved becomes made notable to the market for the purpose of gathering comments and retaining the highest level of consensus of the subject who could not participate in the first phase of the discussion. A more profound knowledge of the characteristics, propriety and compatibility of binding material, or a norm expressing responsibility to trace guidelines for a better choice that could avoid more evident mistakes at least, like using cement in an historical building constructed with malt lime.

3.2.2 The European standardisation between information and formation in the field

Until the act of sensitivity regarding this and other aspects that regard interests of cultural goods will be efficient, it is necessary to act on more than one front, among which the norm, intervening not on the type of act to adopt as much on technical research that establishes the content and on balancing interests. However, it cannot be forgotten that this is just one of the possible arms for better use of binding materials. Therefore, formation becomes essential for everyone who is involved in production, commerce, choice, approval and not last the use of the materials. For the same reason practical and theoretical formation courses for managers, professionals and functionaries with property custody responsibilities, technicians restorers that operate in the territory. It is a valid and well proven formation method to stimulate young people or professionals entering the job world, but it is not very successful with people who have been operating in the field for several years and are suspicious with everything new. Paradoxically, lime, material used since the beginning of the century, is today a material to rediscover and it appears “new” to those who have always worked with cement.

In this regard it appears particularly interesting that the formation on a job site that has been experimented since 2005 in a particularly decayed area in the old town of Genoa: the Ghetto. It is a “difficult” area where serious problems due to the decaying structures overlapping with the ones fragile social context. If for one the absence of interventions on the structures and the marginal social structure have permitted material and social decay which still exists, on the other hand they have permitted conservation of material witnesses of particular interests that, don’t have custody of property. The challenge of the city of Genoa with an experimental program, is to allow the privates to participate in the process of the regeneration of an area, through giving out grants equal to 30% of the total amount of the works.

The initiative, guided from a well proven experienced past in other programs in the field of regenerating other areas in the historical centre of town, (particularly the Organic Program of

Intervention of Via dei Giustiniani, with incentives from the city for regenerating private buildings in the heart of the old town of Genoa), had very great success, as because 59% of the private buildings present in the ghetto area have adhered to the project. The overcome result of adhesion is much more significant, considering the known characteristics of the widely present social poverty level. This has been possible also with the support of an information desk in the heart of the city. This reference desk will stay open for three years, duration of the area contract, and it was essential at the beginning of activity.

The economic incentive has been important to create interest and expectations of social – economic revitalisation, however, it wouldn't have been enough to transform the neighbourhood in a moment of formation. Therefore, the City has organized a series of "supporting" activities to privates, helping to improve the quality of building interventions, particularly regarding the use of materials (i.e. lime) and technologies of the historical Genoese way of building.

There will be an activity of informing how to build in historical times and the use of traditional material. During the different phases, the single projectors and the managers and the workers had and will have the possibility of projects-intervention of consultancy with a specific team of experts in various fields.

However, especially in the building and restoration field, a practical apprendship period is needed, and for this in case the worker is not ready to do restoration it was possible through a group of professional restoration workers, to transfer through practical demonstration on the job site, the necessary knowledge of how to work properly. This last aspect is fundamental, because only in this way public funding will have double fall: regenerating an area so much in decay as well as interesting and in the formation on the job site, able to work on historical construct even though not linked to the restoration world.

3.2.3 The last barrier: the tools of restoration (e. g.: price list for building industry)

In the Ghetto case, as for other interventions, the amount disbursed by the City of Genoa, has been determined on the base of economical-technical estimated sums, done by professionals on demand of the customer. For this reason the City has proposed a protocol agreement with the association of building contractors, the ones most representative at city level that have been available to distribute, at no cost, to whoever was requesting, the preliminary technical documents required to define and to determine the cost of the regeneration intervention. The estimates have been done in accordance with the average Regional Price List of the Building Industry published by Union of Liguria Chamber of Commerce.

The Regional Price List is the official reference document for public Works, but is also used as a reference for private works and it contains the definition and the quote of supplied materials, but only the ones that are mostly used, and on finishing work. The Price List was intended as a tool to control prices of the production of the building industry, and even though today has added the title of "Materials, the renovation of green areas, maritime and restoration works", it still shows traces of its initial definition. The language used in the field of restoration are still few and not well organized yet, and since 2005, one of the Commission appointed for assembling the language of/and price analysis has set the objective of inserting in the 2007 volume at least the most needed language in the restoration field. An efficient act of information and sensibility on the theme of binding, as with other materials, can't avoid the language on Price List. It is evident that the prices referring to the materials in volume to execute the work cannot be found and/or at the worksite where one would like work to continue creates doubts or makes one take a step back from the initial selection. The listing of the Regional Prices are elaborated by numerous Technical Commissions, composed of businesses, professionals, technical and specific operators for the diverse typology of the elaboration, without having to be controlled by Public Agencies, businesses and professional organizations. Through this it is

important to act for closing the gate on the actions of sensibility of the correct use of binders for the restoration of historic buildings, estimated and encouraged by community norms (R.V.).

4 Conclusions

This examination of the legal aspects and the practical experience of European norms in the use of lime in building is an example of the effect of these standards on the preservation of cultural heritage. Considering then what can be deduced from this examination, it is possible to affirm that currently these norms represent one of the few instruments which really are useful in choosing the right materials to use in restoration works and therefore, the right way to preserve a cultural heritage which is present all over Europe.

From the point of view of the legislation on this topic, it can be said that the development of technical standards has reached a good level. On the one hand, with respect to the other bodies of law used at a Community level, this process allows a broad participation of interested parties in the drafting of the text of the norms both in the initial and final stages. On the other hand, this development also ensures the reception of the norms by each and every nation in Europe.

By contrast, from the point of view of practical experience, the use of simple labels on packages, allows easy and rapid verification of the quality of the materials being used. Often the descriptions which come with these materials are poor.

As with many of the activities which are performed daily in the field of restoration and preservation, there would be room for improvement in these norms, if the norms were applied better. First, it is important to note that from the point of view of the law, given the need for transparency and a widespread knowledge of the norms during the drafting process, it is equally necessary that they be widely published and easily available also without fee once they have finally been approved.

Secondly, it also seems to be necessary that all the technical aspects of the norms (as with all standards of this nature), should be evaluated solely on the basis of further scientific research which is carried out by independent bodies (such as universities, autonomous research institutes, and so on). These institutions are able to guarantee a better assessment of the right characteristics which identify those products that are truly valid. In this way, it would be possible to reduce the need for producers to have scientific facilities, which as has been shown in some cases, only serve to buttress low quality products using a sort of moral persuasion. In order to achieve this goal of independent research, it is obviously necessary to fund these autonomous institutes, and this too should be envisaged in the norms themselves.

Thirdly, it is also necessary to provide norms which allow the body of legislation to be employed effectively, In this respect, the meaning of the standard quality designations (which, it is worth repeating, are the only really useful means of aiding restorers), is often not known by many who work in this field. For this reason, it would be opportune to have training courses for various categories. These would allow everyone, from bricklayers to architects, to understand the meaning of the abbreviations used and therefore to render them really effective.

It would also be useful to amend all the instruments which are needed by the body of European norms. For example, a greater diversification of products and prices in the catalogues of each country or region, where there is often a lack of specific indications on materials for restoration, might help the European standards to reach their desired goals.

There is much work to be done, but the path chosen by Europe would seem to be the right one and to offer a suitable solution. There is no need for shyness in carrying out the necessary

actions if they are supported in all possible ways, both at a scientific and a bureaucratic level. In this way the hoped for effect will be reached: an adequate conservation and valorisation of the European cultural heritage (C.N., G.P., R.V.).

An analyses of research projects on conservation of paper and textile artefacts of historical, cultural and artistic value financed under EU Programmes (period 1995-2004)*

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Key words: conservation of textiles and paper, European Union programmes, international consortia

Introduction

The study here performed presents the results of an analysis aimed at assessing the typology and goals, the kind of participation, cooperation and coordination of *International Projects for the conservation of cultural heritage constituted by paper and textile artefacts of historical, artistic and cultural value* financed under EU actions and Programmes. The period of time taken into consideration runs from 1995 to 2004, period during which the European Union has supported the development of scientific and technological solutions to protect and rehabilitate European and Mediterranean cultural heritage through the aggregation of many different actors such as scientific community and end-users, enterprises, national and local authorities, private owners and managers of cultural heritage, architects, restorers and policy makers. EU has fostered, indeed, the creation of international consortia in which project partners were given the opportunity to develop and compare methods, tools and materials, to identify and test the best technologies and techniques in the field concerned and to spread good practice rapidly and widely. This is also referred to the new methodologies, innovative materials and processes that come out of research related to paper and textile artefacts, a patrimony culturally and economically valuable but also particularly fragile. It is, indeed, a multidisciplinary field encompassing many areas of arts and humanities as well as the physical-chemical and social sciences.

The present work is articulated in two parts:
PART 1 related to an analyses of research projects on *conservation of paper artefacts* of cultural value financed under EU Programmes;
PART 2 related to an analyses of research projects on *conservation of textile artefacts* of cultural value financed under EU Programmes.

The collected data are intended to provide a critical assessment of research cooperation in the field, as it has been developed and supported at European Union level, particularly fostering a sustainable aggregation of ideas, people and capacities.

Objectives

The aim of the research, hereafter illustrated, is to assess typology and goals, kind of participation, cooperation and coordination of *International projects for the conservation of*

* The research work was performed within the activities of PAPERTECH Community research project "*Innovative materials and Technologies for the Conservation of Paper of Historical, Artistic and Archaeological value*" financed under the VI Framework Programme for RTD.

paper and textile artefacts of historic, artistic and cultural value, financed under EU activities and programmes with reference to the period 1995-2004.

In particular, the analysis was finalised to determine the distribution of

- Projects per Community Programme;
- *National Participating Legal Entities (NPLEs) per geo-political macro-area*, namely EU (European Union), MPCs (Mediterranean Partner Countries), NIS (New Independent States), Switzerland and Russian Federation;
- The coordination role of projects per country;
- National Participating Legal Entities (NPLEs) per country;
- *National Participating Legal Entities (NPLEs) and Coordinators according to the typology of belonging Institution***:** namely HES (Higher Education), REC (Research Organisations), PRC (Private Commercial Organization), GOV (local, regional or national public or governmental organization), OTH (Others).

Furthermore, for what concerns projects on paper, they have been assessed according to three different typologies of artefact identified: a) Books; b) Materials of Archive; c) Graphic artworks.

Description of the methodology

The sources utilised for the present study are:

- CORDIS (the Community Research and Development Information Service – http://www.cordis.lu) [1] instituted by the European Union to facilitate the exchange of information between the various players active in the field of RTD and technological innovation, especially concerning Framework Programmes for RTD;
- EUROMED HERITAGE REGIONAL ACTION (http://www.euromedheritage.net) [2] financed under the MEDA PROGRAMME, has the specific purpose to further the Mediterranean partners' ability to manage, promote and preserve their cultural heritage; the *Euromed Heritage* programme represents the first '*regional cultural programme'* launched within the framework of the Euro-Mediterranean Partnership;
- CULTURE 2000 (http://europa.eu.int/comm/culture) [3] a Community Programme created to promote artistic and cultural cooperation in Europe, intercultural dialogue and knowledge of the history of European people.

1 An analyses of research projects on conservation of paper of cultural value financed under EU Programmes

1.1 Results and Discussion

According to the analysis performed it emerges that in the period 1995-2004 the number of projects dedicated to the conservation of paper artefacts of cultural interest and financed under EU Programmes was equal to 26 [4].

1.2 Distribution of RTD projects per use function of artefacts

Following the international current point of view, paper artefacts may be grouped on the basis of their use function as follows [5]:

Books – may be manuscripts or printed books and may have, as a base, parchment or paper, (both of them are paper in the etymological sense of word); they are vehicle of texts and illustrations which are painted or printed often assuming a value of artwork.

Figure 1: Turkish manuscript – Central Library of Cairo University, Department of Ancient Manuscripts

Documents of archive – include a typology of objects which is the largest and most differentiated among the typologies of paper artefacts taken into consideration. Documents of archive may be collected in volumes and so have features which are similar to books; may be also constituted by paper which can be untied, handwritten, typewritten, printed or produced with modern means of reproduction (i.e. photocopiers, fax, electronic printers). Other times they are constituted by paper works which are very similar, concerning the technique, to prints and drawing, also acquiring an artistic value.

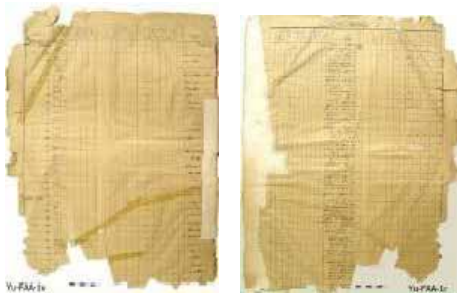

Figure 2: Records of the Ottoman archive – Jordanian Department of Lands and Survey

Graphic artworks – the great majority of graphic artworks is constituted by prints, drawings or paintings, particularly the last two mentioned can be formed with different supports (paper, cartoon, parchment), with materials and techniques which may differ also, such as, for example, pencils, metallic points, inks, pastes, calks, water-colours, acrylic colours, tempera colours, *collages* and so forth. The various characteristics imply very dissimilar problems of conservation and restoration; the format itself, which may vary from few centimetres to several metres, may imply different methodologies of intervention.

Figure 3: Map by W. & J. Blaeu

Typical examples of paper artefacts belonging to the three identified categories – part of a catalogue of ancient and modern samples realised in the framework of *PAPERTECH*

Community research project, INCO-MED Activity, VI Framework Programme for RTD – are illustrated in figures 1, 2 and 3 [6].

The distribution of projects, financed under the different EU programmes, according to their use function as above indicated, is shown in figure 4. Over a total of 26 projects financed, 13 (50% of the total) are related to books, 10 (38%) to graphic artworks and 3 (12%) to documents of archive.

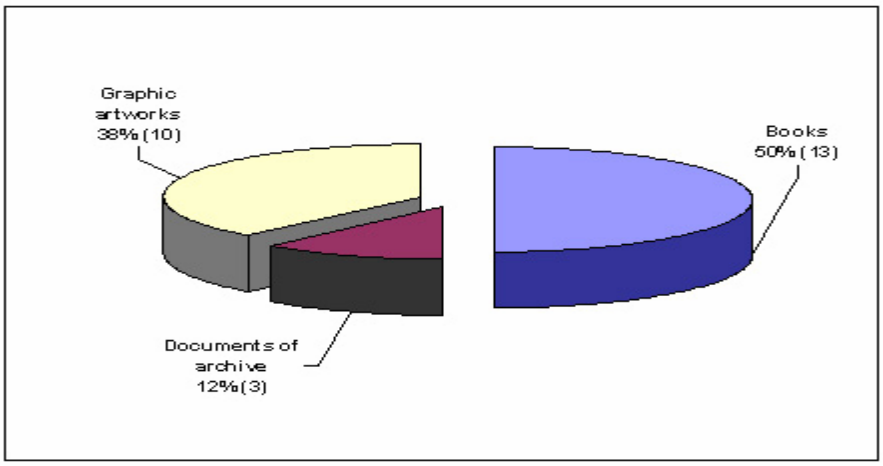

Figure 4: Distribution of projects per use function of artefacts

1.3 Distribution of RTD projects per Community Programme typology

In Figure 5 is reported the distribution of projects according to the typology of International Programme activated at Community level. Most of funds for international projects on conservation of paper artefacts of historic / artistic interest derived from the *V Framework Programme for RTD (1998-2002)*[1] [11 projects (41%) financed over a total number of 26].

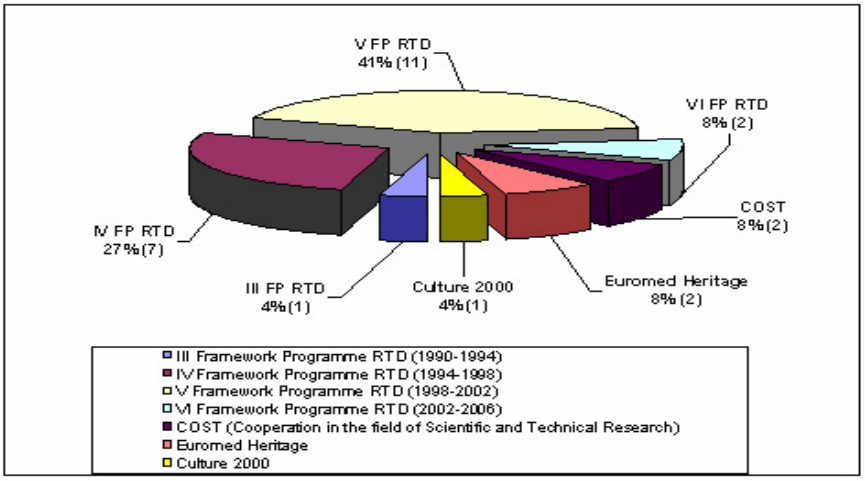

Figure 5: Distribution of projects per programme typology

[1] The *Framework Programme for RTD* is the European Union main instrument to finance multidisciplinary research and scientific cooperation in Europe. It is active since 1984. Following the principle of subsidiarity FP provides fundings to organisations of partners from different EU member States and also from third Countries.

Moreover it was calculated that the number of projects financed under the *IV Framework Programme for RTD (1994-1998)* and *the III Framework Programme for RTD (1990-1994)*, was respectively equal to 7 (27%) and 1 (4%)[2] . The other Community Programmes, namely the *6th Framework Programme for RTD (2002-2006)* – now entering its concluding phase – the *Cost Action* and *Euromed Heritage* respectively financed two projects each, which is about the 8% over the total of projects considered. Only one project (4%) was funded under the Programme *Culture 2000*.

1.4 Distribution of National Participating Legal Entities (NPLEs) per geo-political macro-area & per country

The total number of national participating legal entities (NPLEs) in the projects is 252. The distribution of NPLEs per geopolitical macro-area – namely: EU (European Union), MPCs (Mediterranean Partner Countries), NIS (New Independent States), Switzerland and Russian Federation – is illustrated in Figure 6.

From the data collected it may be inferred that the majority of NPLEs belongs to European Union countries [180 (71.4%)]; 35 (13.9%) from NIS; 27 (10.7%) from MPCs and 9 (3.6%) from Russian Federation. Only one NPLE is from Switzerland.

It should be underlined that the countries from Central Europe: Czech Republic, Hungary, Latvia, Poland; and from South Mediterranean: Cyprus and Malta, only joined the European Union in May 2004; consequently, when the work analysis was performed they were respectively assessed as part of the geo-political macro- areas NIS and MPCs.

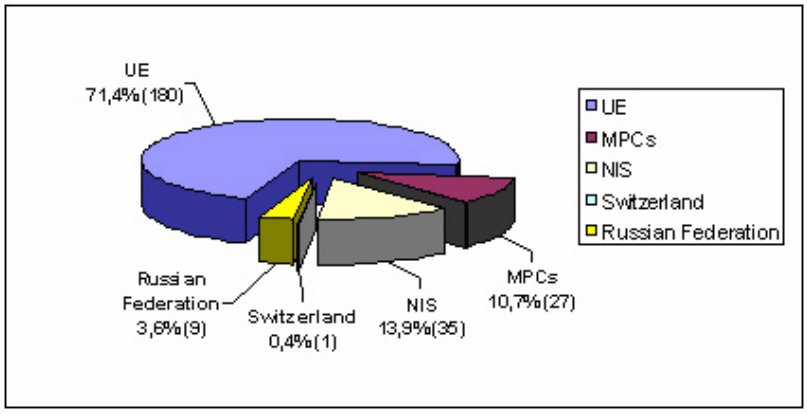

Figure 6: Distribution of NPLEs per geopolitical macro-area

The role of coordination of projects was mainly assumed by NPLEs from the European Union. Italy, indeed, coordinated 5 projects over a total number of 26, that is to say nearly the 19.2% of all projects financed, United Kingdom and the Netherlands coordinated 3 projects each (about 11.5%), Austria, Belgium, Denmark, France, Germany, Greece and Slovenia coordinated 2 projects each (about 7.7%), Norway coordinated one project (about 3.8%) [Figure 7].

The data reported in Figure 8 show how most of NPLEs belong to Netherlands (24), France (19), United Kingdom (18), Italy (17), Spain and Germany (13 each), Greece and Austria (12 each), Russian Federation (9), Slovenia (8). The other NPLEs are distributed over a large number of countries belonging to different geopolitical areas.

[2] The project financed under the *III Framework Programme for RTD (1990-1994)*, has been taken into consideration, despite out of period of analyses, as it was concluded in 1995.

It is interesting to notice that Egypt and Cyprus – with 5 NPLE each – were the Mediterranean partner Countries mostly involved in research projects, followed by Malta, with 4, Jordan and Israel with 3 NP*LE* each.

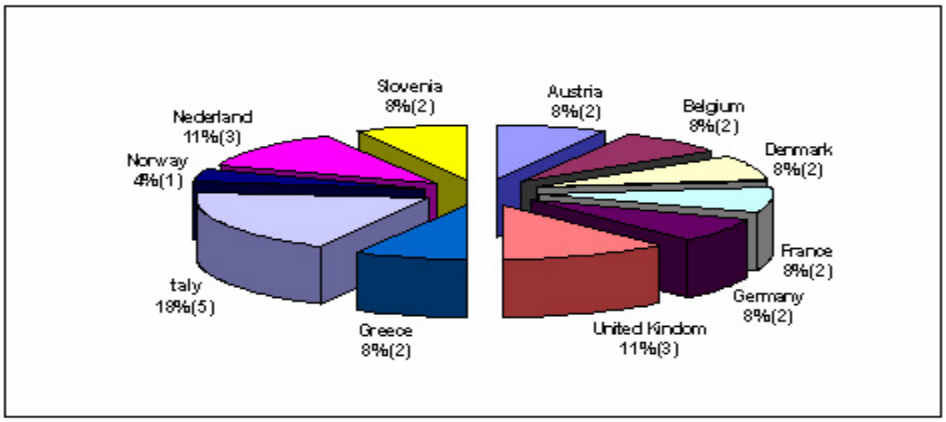

Figure 7: Distribution of coordinating NPLEs per country

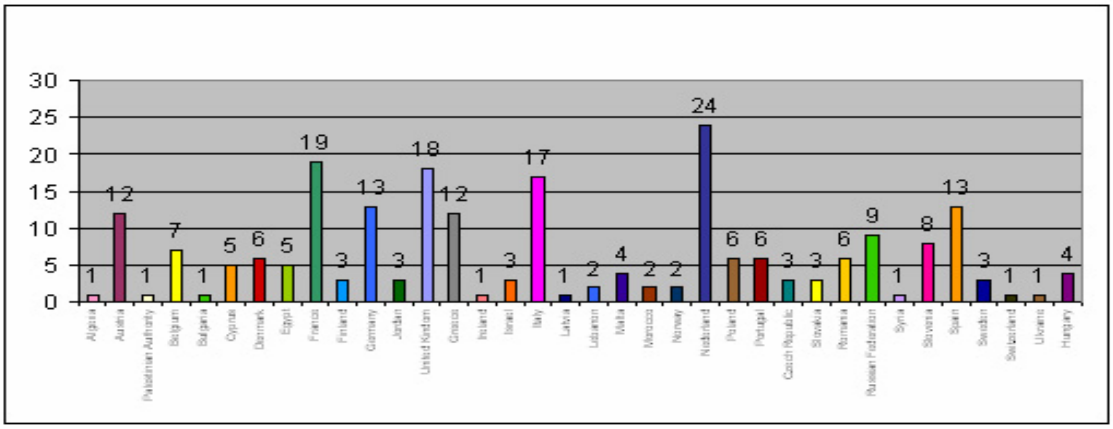

Figure 8: NPLEs per country

1.5 Distribution of NPLEs according to the typology of belonging Institution

NPLEs have been grouped according to 5 different typologies of belonging Institution: Higher Education (HES), Research Organisations (REC), Private Commercial Organization (PRC), Local, Regional or National Public or Governmental Organization (GOV), Others (OTH).

The analysis of the distribution of NPLEs per typology of belonging institution leads to the conclusion that NPLEs from REC represent the 35% of all involved participating entities (81 over a total number of 226), followed by GOV (51 participating entities, the 23% over the total), HES (48 participating entities – above all universities – corresponding to the 21% over the total), PRC (42 participating entities, the 19% over the total) and, finally, 4 participating entities under the name "Others", the 2% over the total, including in such category no-profit private organisations (Figure 9).

The distribution of coordinating NPLEs according to the typology of belonging Institution is illustrated in Figure 10. The data assessed show that 9 (34%) coordinating NPLEs are from Higher Education (HES), 8 (31%) from Research Organisations (REC), 7 (27%) from Private Commercial Organizations (PRC). These ultimate data are to be intended as a positive step towards a pro-active involvement of the private sector in international consortia of research. As

far as NPLEs from private commercial organizations are concerned, it emerged that most of them are from professional laboratories of conservation and restoration, manufactures and suppliers of products, technical tools, equipments and facilities for conservation and restoration. A governmental entity[3] and a no profit organization were also involved as coordinators of projects.

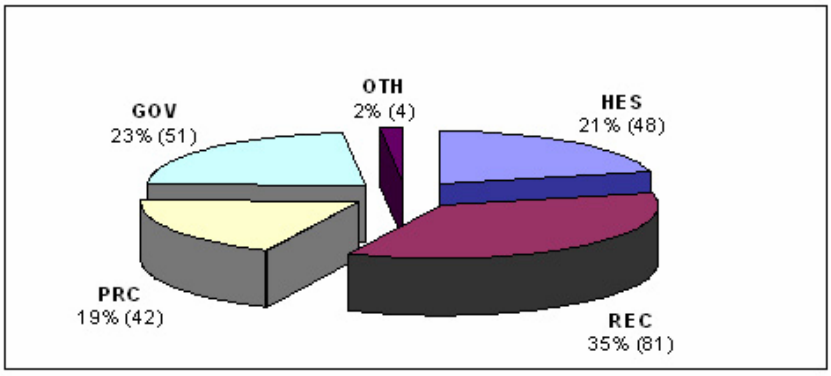

Figure 9: Distribution of NPLEs per typology of belonging Institution

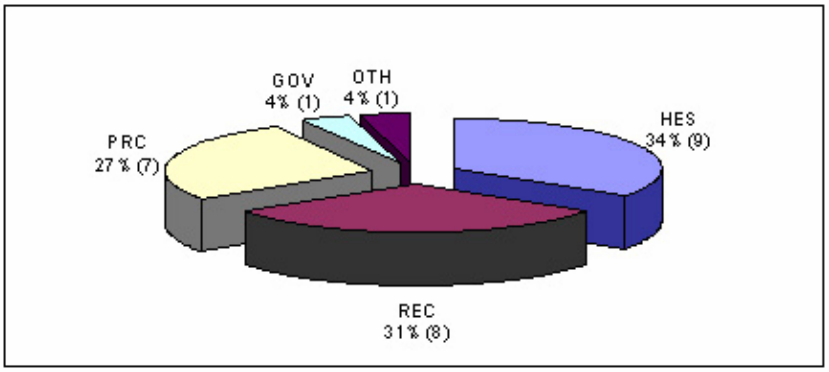

Figure 10: Distribution of coordinating NPLEs per typology of belonging Institution

2 An analyses of research projects on conservation of textiles of cultural value financed under EU Programmes

2.1 Results and Discussion

According to the analysis performed it emerges that in the period 1995-2004 the number of projects dedicated to the conservation of textile artefacts of cultural interest and financed under EU Programmes was equal to 19.

The term “textile” is applied to woven objects and also to fabrics which are products of other kinds of interlaced yarns, such as the braiding, looping, knitting, lace making, and netting. The textile category also includes materials such as felts and non-woven materials in which the fibres gain coherence by a process which is different from spinning. The textile conservation is related to the natural fibres of animal and plant origin: wool, hair, silk, cotton, flax, jute, hemp, nettle, grass, and so forth. The animal fibres consist primarily of protein while vegetable fibres are primarily composed of cellulose. All textiles are deteriorated by light, insects, micro-

[3] Governmental entities may refer, in such a contest, to ministries, libraries, archives, museums and so forth.

organisms, and air pollution which, alone or together, cause considerable loss of tensile strength and pliability. The oxygen in the atmosphere affects all organic substances which determine a variation in degrees.
As a consequence, textile artefacts require special care to be preserved and involve an understanding of light, temperature, humidity, insects, storage, display and cleaning [7].

Specific conservation projects have been financed in order to treat, restore and preserve textile artefacts in danger of damage and loss. As an example, Figures 11, 12, 13 show three fragments of textile artefacts which had undergone to chemical-physical conservation treatments within the Community research project TEXMED, *INCO-MED* activity, *V Framework Programme for RTD*.

In particular, in Figure 11 is shown a floated and brocaded taffeta with reps effects;

Figure 11: detail of stole (liturgical vestment – 1770-1780 A.D.)

in Figure 12 a double-plied "S" twisted yarn, twist is medium to tight;

Figure 12: wrapping sheet (4th millennium B.C.)

in Figure 13 a *liserè* brocaded taffeta.

Figure 13: fragment of textile (last quarter of 18th century A.D.)

2.2 Distribution of RTD projects per typology of Community programme

In Figure 14 is reported the distribution of projects according to the typology of International programme activated at Community level. The data show how the majority of international projects on conservation of textile artefacts of historic/artistic interest are under the *V Framework Programme for RTD (1998-2002)*, which financed 8 projects (41%) over a total of 19. The *IV Framework Programme for RTD (1994-1998)* and *the III Framework Programme for RTD (1990-1994)* respectively financed 3 projects each[4] (16%). The other Community programmes, namely the *Cost Action*[5] and *Euromed Heritage* financed two projects each (11%). Only one project (5%) was financed under the Programme *Culture 2000*.

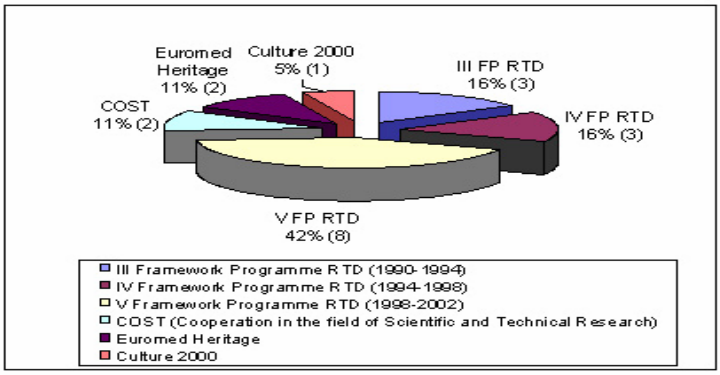

Figure 14: Distribution of projects per Community programme typology

2.3 Distribution of National Participating Legal Entities (NPLEs) per geo-political macro-area & per country

The total number of *National Participating Legal Entities* (NPLEs) in the projects is equivalent to 182. NPLEs are distributed per geopolitical macro-area – namely: EU – European Union; MPCs – Mediterranean Partners Countries; NIS – New Independent States; Switzerland, USA and Russian Federation, according to the following decreasing sequence: 120 (65.9%) from European Union; 29 (15.9%) from MPCs; 26 (14.3%) from NIS; 5 (2.7%) from Russian Federation; one respectively from Switzerland and USA (Figure 15).

The countries from Central Europe: Czech Republic, Hungary, Latvia, Poland, Slovakia, Slovenia; and from South Mediterranean: Cyprus and Malta, only entered the European Union in May 2004; consequently when the work annalyses was performed they were respectively assessed as part of the geo-political macro-areas of NIS and MPCs.

Projects were based on representative networks of countries from South Mediterranean, East Europe and EU member States. This has necessarily implied the construction of a common dialogue and the sharing of different cultural values and know how, which certainly constituted an added value and part of a strategic approach to research as intended at Community level.

The role of coordination of projects was assumed for the great majority by NPLEs from European Union, such as Italy which coordinated 6 projects over a total number of 19, that is to

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[4] The projects under the *III Framework Programme* for *RTD (1990-1994)* have been taken into consideration, despite out of period of analysis, as they concluded after 1995.

[5] *Cost (European Cooperation in the field of Scientific and Technical Research)* is an intergovernmental framework for the coordination of nationally – funded research at European level, based on a flexible institutional structure. Established in 1971, COST has developed into one of the largest frameworks of research cooperation.

say about the 31% of all projects financed; United Kingdom which coordinated 3 projects, (about the 15%); Belgium, France, Germany and Greece which coordinated 2 projects each (about 11%); Norway and the Nederlands which coordinated one project each (about 5%) [Figure 16].

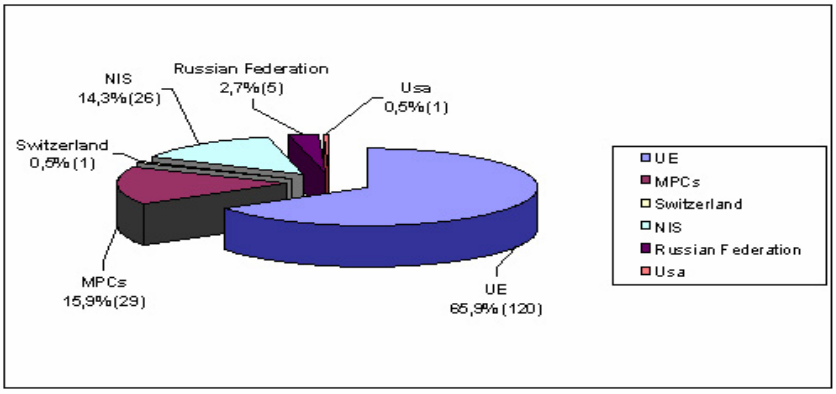

Figure 15: Distribution of NPLEs per geopolitical macro-area

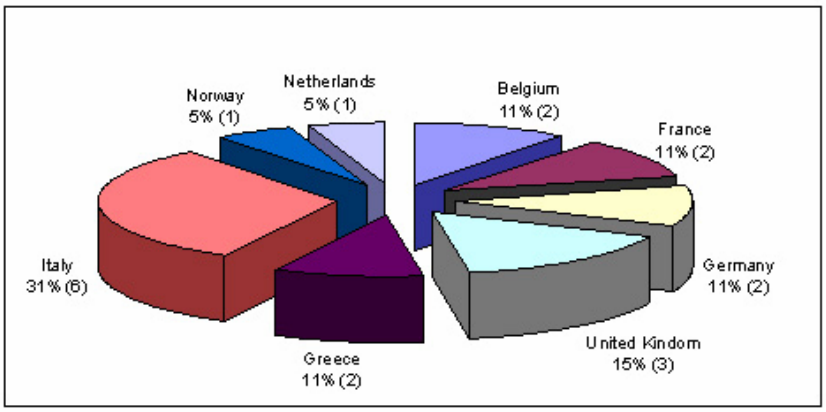

Figure 16: Distribution of coordinating NPLEs per country

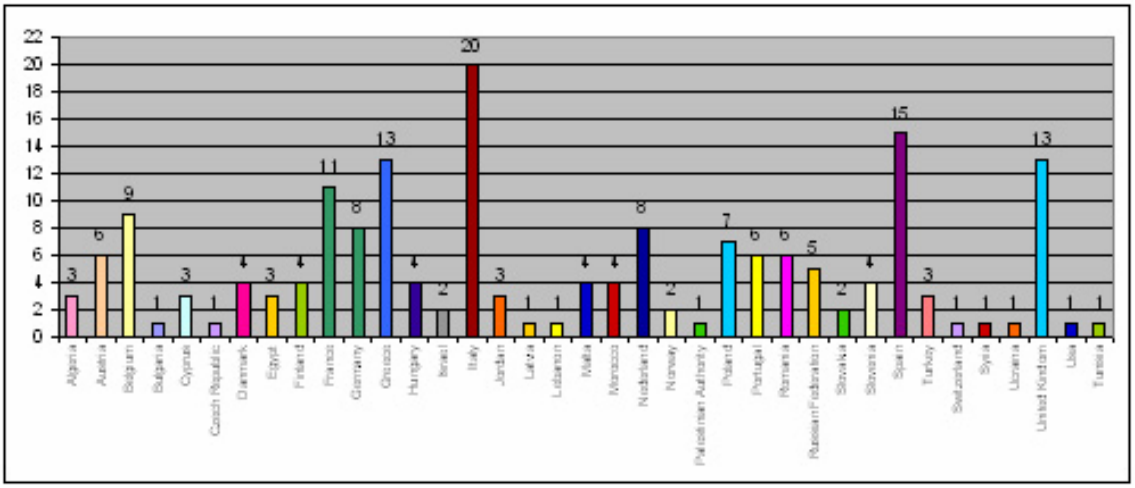

Figure 17: NPLEs per country

The data reported in Figure 17 show how Italy, Spain, United Kingdom, Greece and France most actively participated in the projects in the number of legal entities. Other NPLEs are widely distributed over a large number of countries belonging to the different geo-political macro-areas identified. Furthermore, it was observed that the Mediterranean partner countries mostly involved in projects on textile conservation were Morocco and Malta with 4 NPLE each, followed by Cyprus with 3 NPLEs, Egypt and Jordan with respectively 3 NPLE each.

2.4 Distribution of NPLEs per typology of belonging Institution

NPLEs have been grouped according to 5 different typologies of belonging Institution, namely: Higher Education (HES), Research Organisations (REC), Private Commercial Organization (PRC), Local, Regional or National Public or Governmental Organization (GOV), Others (OTH).

The analysis of the distribution of NPLEs per typology of belonging institution leads to the conclusion that NPLEs from REC represent the 34% of all involved participating entities (62 over a total number of 182), followed by HES, (58 participating entities – above all universities – corresponding to the 32% over the total); GOV, (34 participating entities the 19% over the total); PRC (18 participating entities, the 10% over the total), and, finally, 10 participating entities under the name "Others", the 5% over the total, including in such category no-profit private organisations (Figure 18).

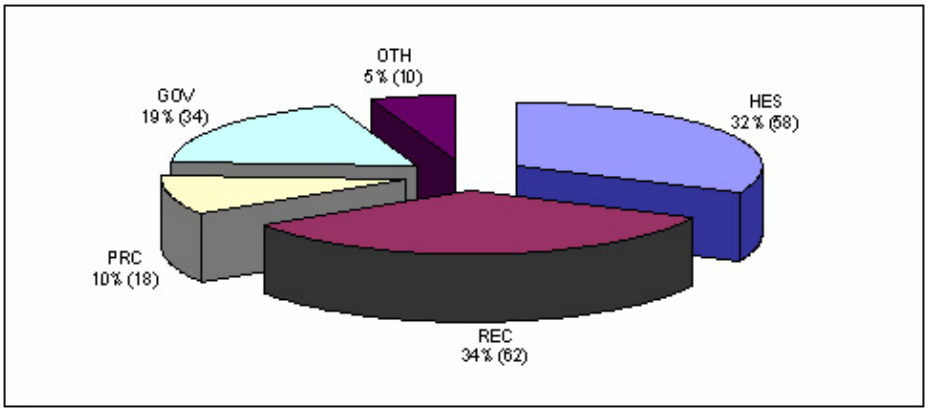

Figure 18: Distribution of NPLEs per typology of belonging Institution

The distribution of coordinating NPLEs according to the typology of belonging Institution is shown in Figure 9. From the data collected it emerges that 9 (47%) coordinating-NPLEs are from Higher Education (HES), 6 (32%) from Research Organisations (REC), 2 (11%) from Private Commercial Organizations (PRC) and 1 (5%) respectively each from Governmental Organizations (GOV) and no-profit private organisations (OTH). The data reported are to be intended as a positive step towards a pro-active involvement of the private sector in international consortia of research. As far as NPLEs from Private Commercial Organizations are concerned, it emerged that most of them are from professional laboratories of conservation and restoration, manufactures and suppliers of products, technical tools, equipments and facilities for conservation and restoration. A governmental entity[6] and a no profit organization were also involved as coordinators of projects.

[6] Governmental entities may refer, in such a contest, to ministries, libraries, archives, museums and so forth.

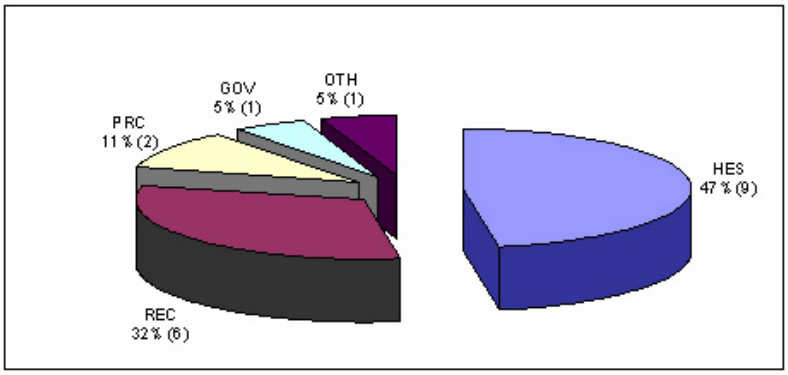

Figure 19: Distribution of coordinating NPLEs by typology of belonging Institution

3 Conclusions

From the performed analysis it may be inferred that the conservation of paper and textile artefacts of cultural, historical and artistic value represents a relevant issue of concern for many countries belonging to different macro-regional areas – in which – the high participation of NPLEs belonging to private commercial organizations, together with those from higher education institutions, research organizations and public / governmental bodies strongly supports the idea that the results could be easily transferred favouring their exploitation towards innovation. In the examined projects, financed by the European Union, the majority of NPLEs belongs to European Union member States. Nevertheless it is interesting to point out that a significant number of NPLEs come from non European countries, especially from NIS and MPCs. The actions activated, tanks to the specific instruments of international cooperation adopted at Community level, permitted the creation of a large number of trans-national thematic networks where competences and enabling technologies have been developed as outcome of north-south-east cooperation [8].

The composition of two international consortiums, established for the specific research projects "New materials and eco-sustainable technologies for the conservation and restoration of textiles" (TEXMED) and "Innovative Materials and Technologies for the Conservation of Paper of Historical, Artistic and Archaeological Value" (PAPERTECH), respectively financed under the EU INCO-MED 5th and 6th-Framework Programmes, is illustrated in Figure 20 and 21 as examples of trans-national thematic networks operating in fields of interest.

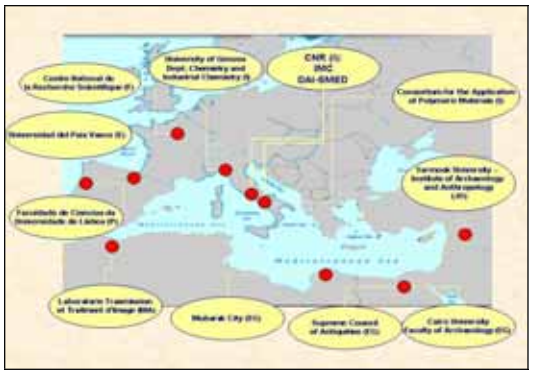

Figure 20: PAPERTECH trans-national thematic network

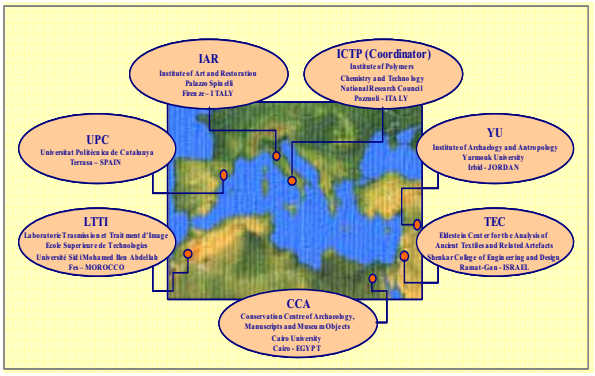

Figure 21: TEXMED trans-national thematic network

Establishing the thematic networks it allowed to satisfy a lack of information and knowledge on international cooperation activities particularly in the Mediterranean partner countries. Moreover, this has given the opportunity to many scientists (especially young) to share research infrastructures and make profit of training-through-research initiatives, thus greatly contributing to the enhancement of human resources in the participating countries. The institutions participating with their groups to the above illustrated thematic research networks implemented their background of knowledge on several aspects of conservation of textile and paper artefacts. All this represents a patrimony that should be consolidated through the implementation of actions finalized to the dissemination and transfer of know-how, the exploitation and spin-off of results with the active involvement and participation of end users, SMEs, owners, managers, restorers and conservators of paper artefacts of cultural value.

Towards this objective and with reference to the above mentioned network constituted within the research project on paper, *PAPERTECH*, the CNR- Office for Mediterranean and Middle East is presently carrying out a work of identification of stakeholders according to the following categories identified:

- *Public and private research centres and universities* working on conservation of paper items;
- *Archives, libraries and museums* in which are active laboratories of conservation of paper items;
- *Private restorers and conservators*;
- *Industries* which produce materials for the conservation of paper items;
- *Paper industries and related additives*.

The data acquired and related to the activity of identification of stakeholders, although still provisional as the activity is still ongoing, are illustrated in Figures 22 and 23. The distribution of stakeholders per sector typology is respectively illustrated for Mediterranean partner countries and for European Union countries.

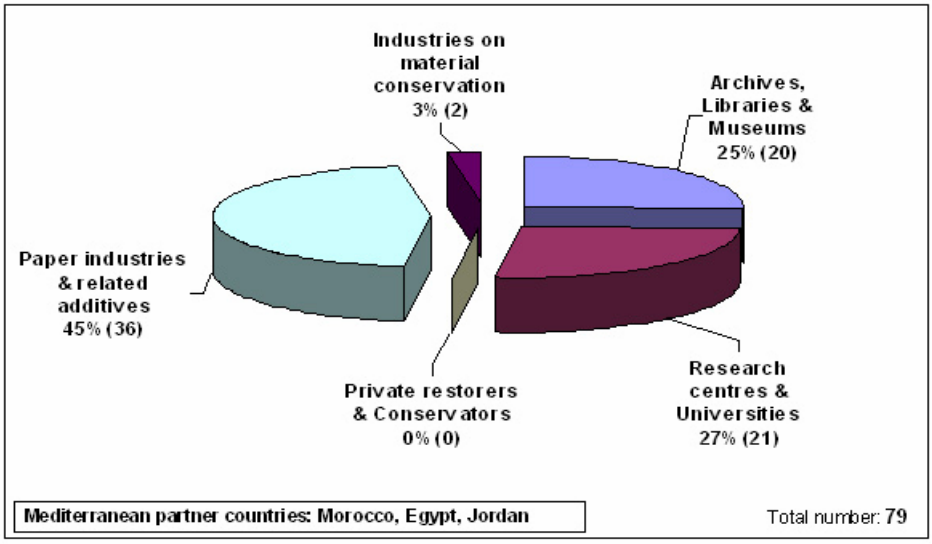

Figure 22: Mediterranean partner countries – distribution of stakeholders per sector typology. Activity ongoing. Data assessed up to may 2006

The objective is, indeed, that of further transferring project results in the Euro- Mediterranean area and creating a background to be utilised for the constitution of new networks. These networks should more actively involve typologies of stakeholders – such as suppliers of raw

materials, utilisers and end users – so far almost marginally involved in research projects, in order to comply with the new opportunities and instruments offered for European research in the shortcoming 7th Framework programme for RTD [9].

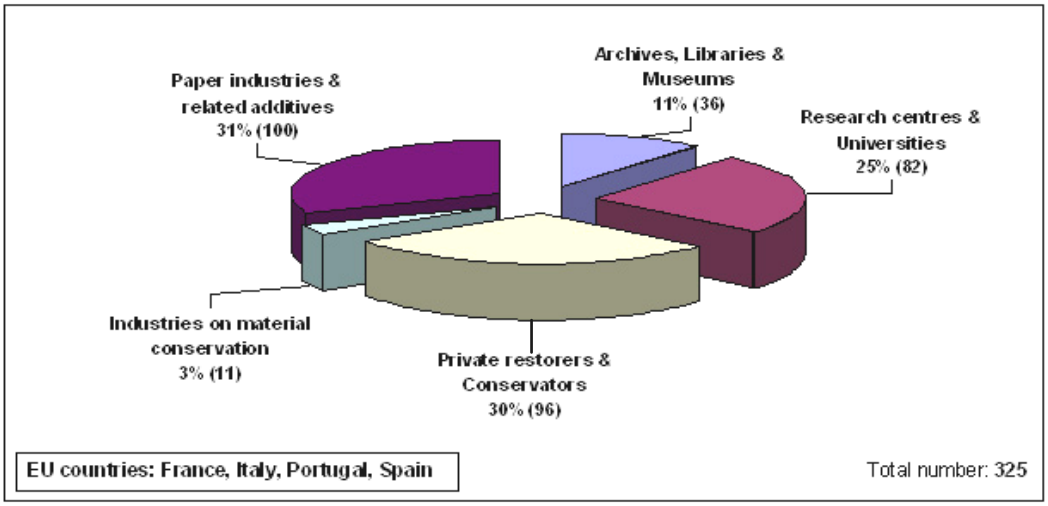

Figure 23: EU countries – distribution of stakeholders per sector typology. Activity ongoing. Data assessed up to may 2006

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Applying research results into practice in the field of repairing masonry monuments

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Key words: research results, practice, reapair materials, monuments

1 Introduction

Masonry monuments constitute the greatest part of European Monumental Heritage, since they cover a long historical period from Roman ages up to the domination of concrete in the beginning of the 20th century. They are different type of structures of excellent beauty which attract the interest of civilians and constitute "meeting points" of human civilizations - Monumental Heritage seems to be the secret treasure of Europeans that can boost competitiveness since it has been widely recognized that "Cultural production will become one of the leading sectors in the post industrial economy" [1].

The EC has been investing on research for conservation and protection of monumental heritage since 1986 [1] through EUROMED Heritage and Environment Research Program. Apart from European Community other Organizations have also supported the research for protection of monuments. For example, the NATO Scientific Affairs Division through the programs: Science for Stability and Science for Peace [2].

Most of the relevant research projects addressed documentation problems of the masonry considering it as structural element or focusing on the materials.

- During the last 20 years a critical mass of knowledge has been accumulated.
- The awareness of citizens about the monuments has been significantly increased.
- However, there is still a gap between knowledge and practice in the field of repairing monuments.

Regarding knowledge promotion in Europe, it has been widely recognized that: "Europe is weak in translating the results of research into innovative products…" (Europa Growth and Jobs, 7/02/2006) In the sector of conservation of monumental heritage there has been adequate production of knowledge and a strategy must be developed for pushing research results into practice.

2 Problems and failures in restoration

It is worth mentioning some of the encountered difficulties, according to restores opinion:

- Lack of adequate documentation due to a limited budget for the project (Documentation report is not usually obligatory)
- Lack of contractors or construction companies specialized in restoration. The competition for undertaking the restoration work is often based on the lower price not on qualifications. Lack of technicians who can manipulate soft materials, (such as lime and pozzolan), as well as cement materials
- Difficulty in finding proper materials and reliable supplier at local market
- Lack of instructions about the use of materials and techniques that could be followed for

better application (Manual of practice).
- Relatively high cost of "traditional" materials which are not used in modern constructions
- Testing the quality of materials and work done in the field is difficult and the cost for that is not foreseen in the budget.

3 Damages of historic masonries after repairing due to inappropriate materials

Use of strong binders such as cement for repairing lime-based mortar joints intervenes into the behavior of the old structure. The "free breathing" is blocked and secondary problems appeared (salt, concentration, detachments, moisture migration etc):

- Rich in soluble salts soils are often used for manufacturing 'traditional bricks'. This creates later efflorescence phenomena and destroys bricks and mortars recently applied.
- Early cracking of repointing mortars or renderings due to wrong proportioning and lack of right curing period of fresh mortar.
- Frost damage of mortars and bricks due to their low resistance to freezing.
- Loss of the mortar of the repaired joints due to unsuitable binding system (for example: air hydrated lime for places suffered from moisture presence) is often happened.
- Another obvious problem often anticipated in restored monuments is the aesthetic harmonization of the new repair mortar with the existing masonry.

4 Development of a strategy for transferring scientific issues into practice.

Restoration is a wide scientific field of multidisciplinary character. Relevant knowledge is produced at: 1. Universities, 2. Research institutes or centers, 3. by expertise coming from implementation of restoration projects.

The main axis on which a strategy should be based are:

- Education**,** in particular short term education, orientated to professionals who work on restoration field. This type of upgrading should be covering not only theory but practice as well. The fact that there is a central directorate responsible for monuments allows a better plan of this type of training. The decision makers for restoration are the directors of the Depts of Antiquities of Ministry of Culture. They also should be aware of advanced knowledge and have opportunities for further more education.
- The directly involved in the field works are contractors and technicians. Their training is of first priority. A catalogue with the specialized ones should be formed. Material scientists are often involved or provide consultancy. They must be aware of conservation problematic. An enquiry service could be established for providing technical guidance.

5 Development of codes, regulations and manuals of practice

There are not widely accepted Regulations. Therefore, principles of the Charters (such as Venice Charter) are not easily implemented into practice. Some efforts have been made by RILEM TC-RHM on Repair mortars, by CENTC-346 or in the frame of research projects. Besides many questions concerning the reinforcement of the historic structures (in case they present stability problems or they are to be reused) are still open. How could restorers succeed in strengthening the old structure and in preserving its authenticity? The lack of Regulations and Standards for testing and applying repair materials makes restoration interventions a time consuming and costly task.

The availability of suitable raw materials for the manufacture of mortar and bricks used in repairing historical masonries is low. The long distance conveyance of them to isolated castles of monasteries is too expensive for the limited budget of the restoration projects. That is why improper materials, which are easily found at market, are often used in restoration. For example, binders must be free of soluble salts. Test of pozzolanicity index is necessary to estimate the quality of pozzolan. In addition, if superplasticizers are to be used, they must be free of sulfates In relation to Methodology for designing repair material it must be said that trial mixes are necessary before applying. The strength and porosity of the new mortars should be checked to find if they are compatible with the old existing in the structure. The repair mortars should have the right workability for each type of application (e.c. plaster, bedding mortar, subtract of floor mosaics). Plots of relationships concerning strength- water/binder or strength – porosity of lime-based mortar are very helpful for designing purpose [3].

In addition, much attention should be given on the conditions of applying repair mortars**.** Proper curing of the repaired surfaces for at least 2 weeks is necessary for these slow rate of strength development mortars. The curing conditions play an essential role for the strength of each repair mortar.

Organization of a net of certified public or private Laboratories for testing materials for monuments' repair (Equipment, personnel, testing methods). All materials should be followed by quality certifications. By this way, the possibility of using bad quality materials will be low. Standardization of repair materials. The standard quality of them is of high importance. The possibility of stakeholders' involvement for the production of certified, ready-mixed mortars will be very helpful in restoration of isolated monuments.

Establishment of a legislation, according to which the Documentation before any intervention, should be obligatory and included in the project budget. All restoration works must be written down in archives. Adequate equipment in the field, should be provided for in situ tests.

6 Conclusions

The impact of transferring research results into practice is the upgrading of the quality of repair materials and works by building a bridge between knowledge and industry. The achievements are:

- Protection of the authenticity of the old structures by limiting future interventions
- Decrease of the cost of the restoration works
- About 25% of the total cost of a restoration project concerns the materials
- Since these repair materials are produced by order and used to cover specific needs of construction sector they are of relatively high cost.

The cost of a lime-pozzolan mortar is relatively high due to specific production of the raw materials (such as grinding of pozzolan) which are widely used at market. Enhancement of conservation sector and income coming from cultural activities associated to valorization of monumental heritage.

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Towards evidence for policy development in the area of climate change and world heritage

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Key words: climate change, world heritage, methodology, human habitats, settlements

1 Global climate change initiatives

The major accomplishment of the United Nations Framework Convention for Climate Change (UNFCCC) (1992) was to recognise the problem of climate change [1]. The Framework recognised that the climate system is a shared resource whose stability can be affected by emissions of carbon dioxide and other greenhouse gases. Governments were required to gather and share information about greenhouse gas emissions and national policies. They were to launch national strategies for addressing greenhouse gas emissions with the ultimate objective of stabilising greenhouse gases 'at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system'. The heaviest burden for combating climate change was placed on developed countries, recognising that emissions in less economically developed countries would rise to ensure vital economic development. The Framework was a document that was to be amended and augmented over time, the first addition being the Kyoto Protocol (1997) [2].

The Intergovernmental Panel on Climate Change (IPCC), set up in 1988, draws on the work of experts from around the world to provide objective information on climate change for policymakers. Their Assessment Reports provide the technical, scientific and socio-economic information on climate change, possible impacts and responses. The third Assessment Report was produced in 2001 [3] and the fourth will be published in 2007. Working Group II of the IPCC is charged with assessing the impact, adaptation and vulnerability of societies to climate change. The report focuses on the effect of climate change on sectors, for example ecosystems, society and settlement and the effects regionally, usually on a continental scale [4]. Its findings from the third Assessment Report were that most warming observed over the past 50 years was due to human activities and that anthropogenic climate change will persist for many centuries [3].

The IPCC has published assessments of the impacts of climate change on biodiversity at the global and regional levels (IPCC, 2002) [4]. The Convention on Biodiversity (CBD) has identified the inter-linkages between biological diversity and climate change and has identified mitigation and adaptation measures that relate to anticipated climate change impacts on ecosystems and their constituent species [5]. The CBD seeks, through this work, to integrate biodiversity considerations into implementation of the United Nations Framework Convention on Climate Change and its Kyoto Protocol. For biodiversity, systematic assessments of risks posed by climate change are therefore available with options defined for use at global and regional level. No comparable global assessments exist for assessing risks to cultural heritage.

2 Implications of climate change for World Heritage

'*The continuing and accelerating rate of global climate change and its potentially severe impacts on nature and human society call for policy responses. These responses should mitigate climate change and its impacts as far as possible and help adaptation to the partly inevitable consequences.'* (European Environment Agency, 2004) [6]

Natural heritage (including ecosystems and physical systems such as rivers, glaciers, coastal processes, etc.) is affected by changing climate. The biodiversity of ecosystems is affected by climate change but such change is only one of a range of stress factors. Land use changes, over-exploitation, invasive species and pollution are all factors that are affecting global biodiversity. The vulnerability of biodiversity and adaptive measures to deal with the impacts of climate change on biodiversity cannot be assessed without taking these factors into account. Depending upon the rate and magnitude of climate change this factor may become the dominant stress factor in some parts of the globe.

The character of cultural heritage is closely related to the climate. The rural landscape has developed in response to the plant species that flourish in different climatic regimes. The urban landscape and the built heritage were designed with the local climate in mind. The stability of cultural heritage is therefore closely tied to its interactions with the land and the atmosphere. Where World Heritage Sites inscribed on the UNESCO World Heritage List are in use by local communities there may be pressures for significant adaptive changes to allow use and occupation to continue. Even where this is not the case, there can be very direct physical effects.

Many World Heritage Sites (WHS) are living places which depend on their communities to be sustained and maintained. Climate change has consequences for human existence and the products of human creativity. In the case of WHS these consequences will be manifest in at least two principal ways: direct physical effects on the site, building or structure and the effects on social structures and habitats that could lead to changes in societies currently sustaining WHS. The implications of both are not well understood; furthermore the nature of the impacts will vary depending on the nature of the WHS.

While it may be possible to adapt to climate change by moving moveable cultural heritage away from a site, doing so could have a negative effect on the value of that site. While WHS may be subject to severe changes in their climatic, social or cultural environment, they are by their nature immoveable and adaptation is made more difficult because it has to take place in situ.

3 Risks to cultural heritage

Changes to cultural heritage caused by climate change cannot be viewed separately from changes in society, demographics, people's behaviour, the impact of conflicting societal values and land use planning which will also need to evolve in the face of climate change. In World Heritage terms, cultural heritage is now defined very widely to include individual sites, buildings or structures as well as urban or rural landscapes which may include dynamics that are not only subject to climate change but can also enhance or even define climate change.

Climate change can be subtle and can occur over a long period of time. However, some climate change parameters such a freezing, temperature changes and relative humidity shock can change by large amounts over short periods. The most commonly recognised climate parameters, climate change risks and their impacts on cultural heritage are tabulated below (Table 1):

Table 1: Principal climate change risks and impacts on cultural heritage

Climate parameter	Climate change risk	Physical, social and cultural impacts on cultural heritage
Atmospheric moisture change	• Flooding (sea, river) • Intense rainfall • Changes in water table levels • Changes in soil chemistry • Ground water changes • Changes in humidity cycles • Increase in time of wetness • Sea salt chlorides	• pH changes to buried archaeological evidence • Loss of stratigraphic integrity due to cracking and heaving from changes in sediment moisture • Data loss preserved in waterlogged /anaerobic/ anoxic conditions • Eutrophication accelerating microbial decomposition of organics • Physical changes to building materials and finishes due to rising damp • Damage due to faulty or inadequate water disposal systems; historic rainwater goods not capable of handling heavy rain and often difficult to access, maintain, and adjust • Crystallisation and dissolution of salts affecting standing structures, archaeology, wall paintings, frescos and other decorated surfaces • Erosion of inorganic and organic materials due to flood waters • Biological attack of organic materials e.g. timbers • Subsoil instability, ground heave and subsidence • Relative humidity cycles/shock causing splitting, cracking, flaking and dusting of materials and surfaces • Corrosion of metals • Other combined effects e.g. increase in moisture combined with fertilisers and pesticides
Temperature change	• Diurnal, seasonal, extreme events (heat waves, snow loading) • Changes in freeze-thaw and ice storms, and increase in wet frost	• Deterioration of facades due to thermal stress • Freeze-thaw/frost damage • Damage inside brick, stone, ceramics that has got wet and frozen within material before drying • Biochemical deterioration • Changes in 'fitness for purpose' of some structures. For example comfort heating of the interior of buildings can lead to inappropriate alterations to the historic fabric due to the introduction of engineered solutions • Inappropriate adaptation to allow structures to remain in use
Sea level rises	• Coastal flooding • Sea water incursion	• Coastal erosion/loss • Intermittent introduction of large masses of 'strange' water to the site, which may disturb the metastable equilibrium between artefacts and soil • Permanent submersion of low lying areas • Population migration • Disruption of communities and breakdown of social interactions
Wind	• Wind-driven rain • Wind-transported salt • Wind-driven sand • Winds, gusts and changes in direction	• Penetrative moisture into porous cultural heritage materials • Static and dynamic loading of historic or archaeological structures • Structural damage and collapse • Deterioration of surfaces due to erosion

Desertification	• Drought • Heat waves • Fall in water table • Dust storms	• Erosion of buildings and settlement • Salt weathering • Impact on health of population • Abandonment and collapse • Population migration • Loss of cultural memory
Climate and pollution acting together	• pH precipitation • Changes in deposition of pollutants	• Stone recession by dissolution of carbonates • Blackening of materials • Corrosion of metals • Influence of bio-colonialisation
Climate and biological effects	• Proliferation of invasive species • Spread of existing and new species of insects (e.g. termites) • Increase in mould growth • Changes to lichen colonies on buildings • Decline of original plant materials	• Collapse of structural timber and timber finishes • Reduction in availability of native species for repair and maintenance of buildings • Changes in the natural heritage values of cultural heritage sites • Changes in appearance of landscapes • Transformation of communities • Changes the livelihood of traditional settlements • Changes in family structures as sources of livelihoods become more dispersed and distant

Climate change and the resulting socio-economic changes might have a greater impact on the conservation of cultural heritage than climate change alone. This combined effect needs to be explored fully, given the current gaps in scientific knowledge on the impact of climate change on cultural heritage. An approach that takes into account physical, social and cultural impacts provides an opportunity to draw on a wider pool of evidence for policy development.

4 Rationale for using human habitats and settlements as pointers for the impact of climate change on cultural heritage

The interdependence of natural and human systems has been described as The Order of Civilisation by Stewart Brand in 'The Clock of the Long Now: Time and Responsibility' (2001) [7]. Brand suggests that a robust and adaptive civilisation will operate at different levels, each moving at a different pace. Thus governance and the economy epitomised by fashion, commerce and infrastructure will change faster than nature and culture. What disruption to this order could climate change perpetuate and what will the consequences be for cultural heritage?

David Throsby in 'Cultural Capital and Sustainability Concepts in the Economics of Cultural Heritage' (de la Torre (ed.) 2002) defines and compares three notions of capital [8]:

- *Natural* capital representing renewable and non-renewable natural resources, ecosystems and biodiversity
- *Cultural* capital representing heritage with its principal cultural and economic characteristics
- *Social* capital reflecting the use of cultural heritage by social groups as a shared space and thereby adding to the historic value of cultural heritage.

Throsby adds that just as natural ecosystems support and maintain the balance in nature, cultural ecosystems, namely human habitats and settlements support and maintain cultural life and vitality in human society. Exploring these links further, there is evidence that some clear connections have already been made between cultural heritage and human habitats and settlements:

- The 15th ICOMOS General Assembly and International Scientific Symposium: 'Monuments and Sites in their Setting: Conserving Cultural Heritage in Changing Townscapes and Landscapes', 17-21 October 2005: '*increasing concerns about the impact of rapid development on the environment, is supporting the need to broaden attention from a narrow focus on individual sites or places to a more spatial approach which reflects, and works to engage with, wider cultural, social and economic forces'* and Xi'an Declaration to '*embody recommendations and guidance on ways to appraise, manage and protect settings'* [9]

- The IPCC Technical Summary (p. 44) states *'available studies have not employed a common set of climate scenarios and methods and because of uncertainties regarding the sensitivities and adaptability of natural and social systems, assessment of regional vulnerabilities is necessarily qualitative'* [4]

- The UN-Habitat and UNESCO Memorandum of Understanding, 29 March 2005, '*provides a framework for new instruments and strategies in the field of urban development and social and environmental sustainability' and 'mutual interest include the social function of the built environment as cultural heritage'* [10]

- Indigenous Peoples' Caucus Statement on the Overall Review Session, 12th United Nations Commission on Sustainable Development, 21 April 2004, United Nations, New York: *'Human settlements are cultural homes, that nurture the traditional knowledge and wisdom within our larger ecological home….Global warming, climate change and the rising sea level all pose significant threats to Indigenous and local communities from every region of the world.'* [11]

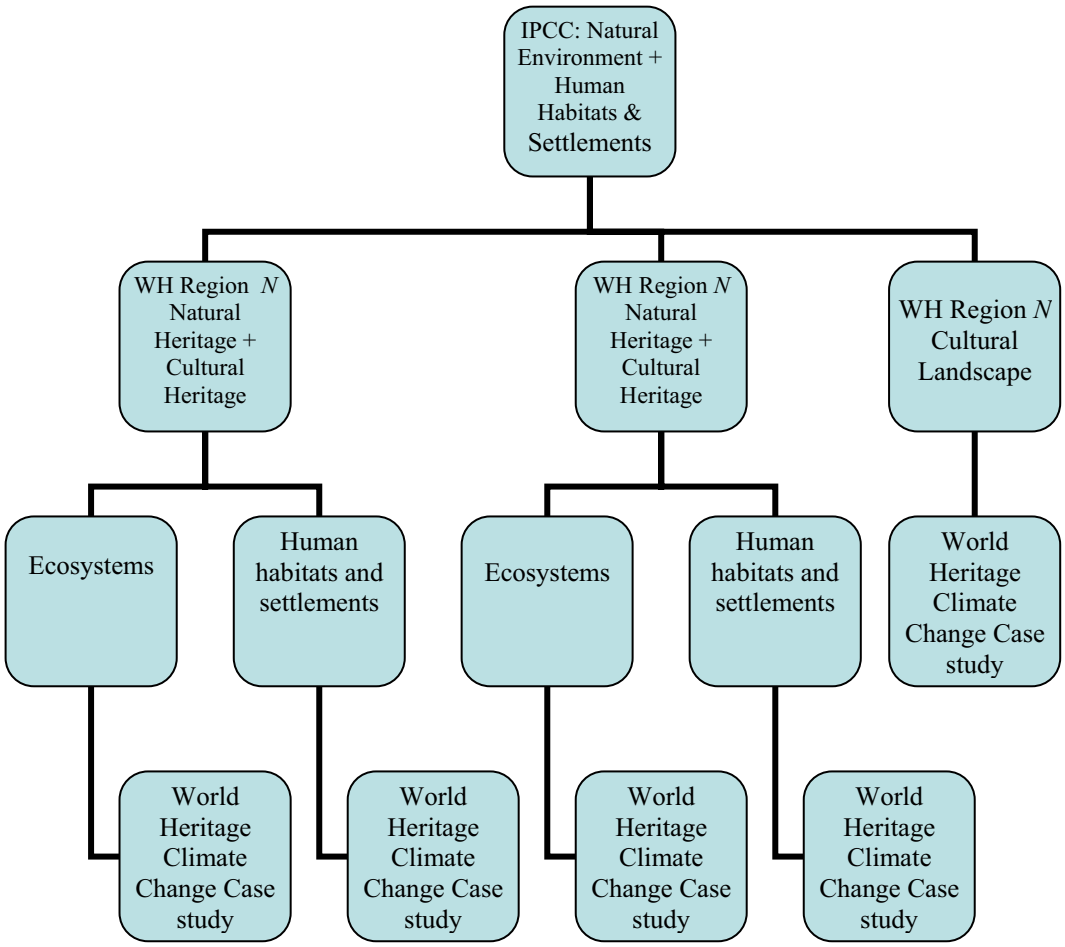
- UN-Habitat, Habitat II Conference, Istanbul, 3-14 June 1996, IV Global Plan of Action, C. Sustainable Human Settlements Development in an urbanizing world, 8. Conservation and Rehabilitation of the Historical and Cultural Heritage, states: *'Conservation, rehabilitation and culturally sensitive adaptive reuse of urban, rural and architectural heritage are also in accordance with the sustainable use of natural and human-made resources'* [12] and the Istambul Declaration states that *'To improve the quality of life within human settlements, we must combat the deterioration of conditions that in most cases, particularly in developing countries, have reached crisis proportions. To this end, we must address comprehensively…. environmental degradation; and increased vulnerability to disasters…(4), 'In order to sustain our global environment and improve the quality of living in our human settlements, ….we commit ourselves to pollution prevention; respect for the carrying capacity of ecosystems…(10)'* [13]

There is considerable common ground between the regions of UNESCO's World Heritage Convention (WHC) and the regions of the IPCC to enable the IPCC predictions for regional climate change to be used to develop regional policies to cope with climate change. The two groupings can be compared as follows:

IPCC Regions	**WHC Regions**
Africa	Africa
Asia	Asia (and the Pacific)
Australia and New Zealand	(Asia and) the Pacific
Europe	Europe (and North America)
North America	(Europe and) North America
Latin America	Latin America (and the Caribbean)
Small Island States	(Latin America and) the Caribbean

While there is no overlap between the Polar regions of the IPCC and the region of the Arab States of the WHC, they are however covered by other regions. For example, Malta while being part of the Arab States region of the WHC is located with the Small Island States region of IPCC.

In the context of World Heritage, the proposed rationale can be represented as follows:



World Heritage, as well as being divided into natural heritage and cultural heritage, also including cultural landscapes which often combine both natural and cultural heritage as well as communities that live around and within them. In assessing climate change threats to World Heritage sites information is needed on the type of site (cultural heritage, cultural landscape, natural heritage), its value and significance, assessment of damage due to climate change, proposed / managed interventions and plans for future actions to adapt to climate change. Currently the greatest gap is in the assessment of damage which is still largely based on observation by heritage managers and for which there is an urgent need for scientific research to replace observation and to support the use of complementary evidence to help policy development that is proposed in this paper.

5 New methodology

In the meantime, the development of greater knowledge and understanding of the impact of climate change on cultural heritage may be accelerated through a shared process of problem definition, solution design and examples of best practice for both cultural heritage and natural

heritage sites. If it is accepted that the impact of climate change on human habitats and settlements is a useful rationale for impact on cultural heritage, the indicators of environmental value proposed by Satterfield (2002) might be a useful starting point for the development of indicators for cultural heritage [14]. The key indicators, proposed from an ecological point of view are: system integrity, health, carrying capacity and resilience. One way of testing the usefulness of these indicators for cultural heritage is by applying them as part of a process response to climate change (Figure 1).

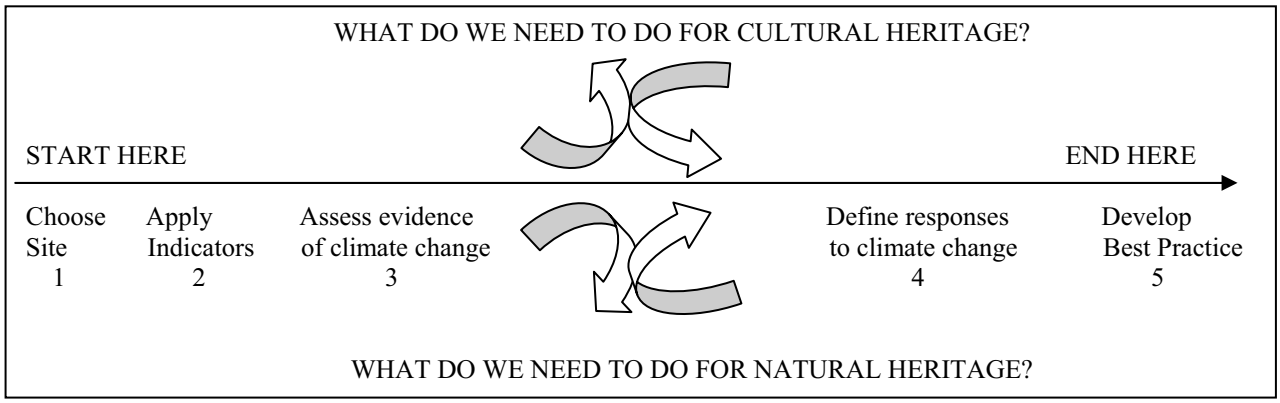


Figure 1: Process response to climate change

'Natural and social systems of different regions have varied characteristics, resources and institutions, and are subject to varied pressures that give rise to differences in sensitivity and adaptive capacity' (IPCC Technical Summary, p. 44) [4] This quotation indicates the global impact of climate change but that the challenges need to be addressed at a regional level. The corollary is that responsibility for adaptation must be taken locally.

What follows is a European example of how the rationale to link the IPCC findings and the impact of climate change on ecosystems and human habitats and settlements might be applied to cultural heritage. It also demonstrates that while scientific research on the impact of climate change on cultural heritage is in its infancy worldwide, it is in fact at its most advanced in Europe. Nevertheless the research effort in Europe is currently based on one project funded by the European Commission (EC) 6th Framework Programme for Research.

6 Europe: future condition

According to the IPCC 'Technical Summary: Impacts, Adaptation and Vulnerability' [4], present day weather conditions reveal weaknesses that can only be exacerbated by climate change. Southern Europe and the European Arctic are more vulnerable than other parts of Europe. Marginal and poorer areas will be less able to adapt, leading to important implications of equity. However, the adaptive potential of Europe should be relatively high because of well-developed political, institutional and technological support systems. In more detail, the picture looks as follows:

- Current pressures on water resources and management are likely to be exacerbated by climate change
- Flood hazard is likely to increase across much of Europe – except where snowmelt peak has been reduced
- Half of Europe's alpine glaciers could disappear by the end of the 21st century so preparations for rescue excavations will be needed
- Soil properties will deteriorate under warmer and drier climate scenarios in southern Europe leading desertification and changes in soil chemistry affecting archaeological sites

- Timber harvests are likely to decrease in the Mediterranean with increased drought and fire risk
- Some agricultural production systems in southern Europe may be threatened by the risk of water shortage
- The insurance industry faces potentially costly climate change impacts through property damage but there is great scope for adaptive measures if early measures are taken
- Human settlements concentrated on coasts exposed to sea level rises and extreme events will need protection or removal
- Heat waves are likely to reduce the traditional peak summer demand in Mediterranean holiday destinations. Less reliable snow conditions will impact adversely on winter tourism
- Risk of flooding, erosion and loss in coastal areas will increase. Southern Europe appears to be more vulnerable although the North Sea coast has a high exposure to flooding

	Flood Incidence[1]		
Region	1990 Exposed population (millions)	1990 Average number of people experiencing flooding (1000s/year)	2080's Increase due to sea-level rise, assuming no adaptation (%)
Atlantic Coast	19.0	19	50 to 9000
Baltic Coast	1.4	1	0 to 3000
Mediterranean Coast	4.1	3	260 to 120000

[1] *Estimates of flood incidences are highly sensitive to protection standards and should be interpreted in indicative terms only*

6 Europe: present response

The EC research project 'Global Climate Change Impact on Built Heritage and Cultural Landscapes' [15] is investigating the impact of climate change on various aspects of cultural heritage including:

- changes in deterioration of metals, stone and glass due to changes in precipitation, relative humidity, temperature and pollution
- the effect of climate on exposed wood in buildings particularly the prediction of the effects of changing precipitation and wetness on the potential for mould growth
- the potential for increased damage to buildings from river, coastal and other flooding and structural damage from high winds
- the impact of changing patterns of precipitation on the moisture content of porous building materials
- the growth of micro-organisms such on heritage materials and their colonisation of climate zones not currently available to them are being researched to see if their impact on heritage may change in the future.

The project is producing maps of the climate change risks that are expected to affect cultural heritage by the 2030's and 2080's, based on the current climate predictions from the Hadley CM3 model. The maps present meteorological parameters relevant to cultural heritage such as changes in freeze-thaw cycles, periods of heavy precipitation, wet frosts and temperature extremes. They will enable heritage managers to understand the likely implications of future climate change for cultural heritage buildings and to prepare for these changes. Other maps will be produced to indicate the effect of climate changes on damage to heritage materials such as exposed metalwork, glass and porous stone.

However, as the two examples below (Table 2) from European sites illustrate, greater research effort is needed to understand the adaptive capacity of cultural heritage to climate change. The proposal in this paper to use alternative sources of evidence to advance policy development is a pragmatic step but also a means of enhancing scientific research. At a world level, Europe must build on its emerging scientific research on the impact of climate change on cultural heritage, while recognising the value of linking its efforts to those of the IPCC and others, principally UNESCO in the protection of World Heritage.

Table 2: Cultural World Heritage Sites at risk from climate change

Example 1: Threat of fluvial flooding in London, United Kingdom, IPCC Region of Europe and WHC Region of Europe
• Capital city of the United Kingdom with 7.5 million inhabitants • 4 World Heritage Sites: Palace of Westminster and Westminster Abbey, Tower of London, Maritime Greenwich and the Royal Botanic Gardens in Kew • All 4 World Heritage Sites are near the River Thames • The United Kingdom Climate Impacts Programme estimates that the sea level will rise in the Thames estuary by 0.26 m to 0.86 m between 1990 and 2080. • The Thames estuary is tidal with tides being occasionally enhanced by weather conditions in the North Sea • Pressure on the flood plain of the Thames is predicted to become greater as the tidal range becomes higher • The Thames Barrier, designed to protect life, land and property from high tides and storm surges, was expected to be used 2/3 times per year. It is now being used 6/7 times per year. • 1 overtopping of the Barrier will have an indirect cost to UK economy of £30 billion. Flooding will inundate World Heritage Sites closest to the Thames. • The Thames Barrier can go to 2025 before the 1000 year return flood event is exceeded. • World Heritage Site managers need to engage in the wider planning processes for a new Thames Barrier, in flood management planning for London and in development and land use planning. The Management Plans of World Heritage Sites should incorporate climate change adaptation in their guiding principles for management over the next 25-30 years and in the quinquennial revision of the management objectives.
Example 2: Storminess, extreme rainfall and structural collapse – Prehistoric Megalithic Temples of Haġar Qim, Mnajdra, Ġgantija and Tarxien, Malta, IPCC Region of Europe and WHC Arab States Region
• Earliest free standing stone structures extant. • Constructed of a series of apsidal spaces built from limestone megaliths. • From 1994, temples suffered a number of structural collapses following sudden storms and extreme rainfall. In total 5 collapses took place over a 10-year period. Prior to the first collapse in 1994, there is no record of any collapse before 1945. The World Heritage site manager has suggested that the sites will progressively become more vulnerable to structural collapse because of the continuing loss of the finer components of the infill material • A draft Management Plan for these sites is due for completion in mid-2006 • A project to construct open-sided protective shelters over the temples has been accepted by the WHC. The shelters will protect the temple structures from direct rainfall, which appears to have been the cause of the collapses. Other benefits include protecting the stone megaliths from heating and cooling resulting in surface temperature differences of up to 30º between shady areas and areas in direct sun, from wetting and drying effects of alternating rainfall and sun causing saturation and rapid drying leading to loss of adhesion of the soil infill and salt damage to the stone megaliths, and from ponding of water inside the temples.

7 Acknowledgement

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Legal issues of the conservation restoration profession

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Key words: conservator-restorer, legal recognition, Europe, safeguarding of cultural heritage, code of conduct, free circulation and establishment of professionals

1 Presentation of E.C.C.O.

The European Confederation of Conservator-Restorers' Organisations, E.C.C.O., is the unique body currently representing the profession of conservator-restorer at a European level. E.C.C.O. seeks to influence policy on the protection and preservation of Europe's cultural heritage. To guarantee this, E.C.C.O. promotes the education and training of Conservators-Restorers, the correct exercise of the profession through a European Code of Conduct and its recognition at national and European level.

E.C.CO. was registered under the Belgian Law in 1991, individual membership of E.C.C.O. is obtained via national associations within Europe or member states of the European Free Trade Association, EFTA.

E.C.C.O. currently represents about 6000 practicing Conservators-Restorers through 20 national associations across Europe. A General Assembly, held once a year in Brussels, provides a forum for delegates from each individual association to meet, discuss and formulate policies.

Central to the work of E.C.C.O. is the promotion and regulation of the access to the profession of Conservator-Restorer in respect to the highest professional standards, articulated in the E.C.C.O.'s official documents (*Professional Guidelines, Code of Ethics and Basic Requirements for Education in Conservation-Restoration*) which each national association must formally adopt and uphold on becoming a member.

In many European countries, legislation enacted for the protection of cultural heritage does not govern or regulate for the conservation and/or restoration of this heritage.

In response to the lack of legislation specific for the field, E.C.C.O., together with ICCROM and several other partners, undertook a project to survey the 'legal frameworks regulating the preservation of cultural heritage and to explore the legal responsibilities of the Conservator-Restorer in regard to the other parties involved in the conservation–restoration process'. A document '*Recommendations and Guidelines for the adoption of common principles regarding the conservation-restoration of the Cultural Heritage in Europe*', set forth the minimum measures that national legal systems should formulate in order to recognise the precise nature of conservation-restoration activities. This document has been approved by all the participants to the project and translated into 7 languages, constituting a useful tool to improve the quality of conservation-restoration activities and guarantee the preservation of heritage.

E.C.C.O. is a member of CEPLIS (European Council of the Liberal Professions), associate member of ICCROM and has collaborated since its inception in 1991 with the main professional organisations involved in the field.

2 Principles of the code of ethics adopted by E.C.C.O.

The above mentioned official documents of E.C.C.O. are the essential reference for the Confederation. The story and the birth of these documents are totally bound to the life of the organisation and since their approval, they constitute the base for all future discussion.

The first proposal for an European organisation to represent the profession, was drafted in January 1991, and soon approved by most of the national existing associations, which, in October of the same year, signed the foundation of the organisation at its 1st General Assembly. In June 1993 the first two official documents were approved: *Professional Guidelines* and *Code of Ethics,* and in September 1994 the last one *Basic requirements for education in Conservation-Restoration*. All texts were based on previous existing acts and documents on the subject [1].

In the *Professional Guidelines* a definition of the profession was established, describing its field of application, the role of the Conservator-Restorer and the various stages for which he / her is responsible [2].

The *Code of Ethics,* is the reference for any professional in the action of his / her functions; this document "states the principles, the duties and obligations and the behaviour that any Conservator-Restorer pertaining to an organization member of E.C.C.O. will endeavour to respect in the exercise of its profession". After some general principles, the code analyses the obligations of the conservator-restorer towards the cultural heritage, towards the owner or the legal responsible, and towards the fellow-members and the ensemble of the profession. It states that the interest of the cultural object has to be considered and respected as first: "The conservator-restorer should not undertake interventions for which he / her is not qualified, nor start, nor continue a treatment which is not in the interest of the cultural object". This is a very important rule, especially in periods of recession of market.

It is requested from the conservator-restorer "to maintain a spirit of respect for the integrity and the dignity of its fellow-members", "to contribute to the development of the profession by dividing experience and information", "not to imply himself / herself in the trade of the cultural heritage". The conservator-restorer is committed to the principle of "minimal intervention". Reversibility and documentation must be assured, and constant improvement of knowledge and skill is strictly required.

It is also conferred to the conservator-restorer the intellectual property for the reports of interventions (with the limitation of attending to the terms of the contract).

In the document, *Basic Requirements for Education in Conservation-Restoration* objectives of teaching and methodology of education are analysed with reference to admission, duration and end of the studies, practical training and theoretical instruction.

After nine years of diffusion of these documents, in response to the evolution of the profession and the grown up of the Confederation, the members of E.C.C.O. decided to revise the texts in 2002 and 2003 to give more importance to:

- the responsibility for the project and for documentation;
- the intellectual responsibility and property;
- the Continuous Professional Development;
- the control of the application of the code by the members of E.C.C.O.;
- the prohibition to take part or help to the illicit trade in cultural heritage;
- the maintenance of the respect to colleagues and assistants.

The *basic education* was increased to a minimal level of 5 years, with the possibility of prolonging these studies in a doctorate (Phd).

3 The promotion of a legal statute for the conservation-restoration in Europe

The research published by E.C.C.O. in 2001, within the framework of the EU supported APEL project, is a comparative legal study on conservation-restoration in Europe. This study concentrated on the principles of conservation-restoration and on the real professional status of the conservator-restorer in Europe. Aspects of national legislations which affect or control the practice of conservation-restoration were analysed, as well as the conditions of access and the exercise of the profession.

The law to which conservation-restoration activity in Europe is submitted, is twofold. On one hand, the principle of *Subsidiarity* [3] is upheld by each member state. This principle allows each Member State to define the norms for the protection and conservation, sufficient to preserve its own cultural heritage. The protection of the cultural heritage is therefore, a *Sovereign Principle* [4] forged in response to an understanding of the States' own national cultural inheritance, in function of their national identity. This national reality imposes itself to the conservator-restorer and directly influences the exercise of their profession. This influence is all the stronger when the cultural inheritance is public property, and/or is burdened with the constraints of protection determined by national law relating to cultural inheritance.

On the other hand, the European Community legislation produces norms or standards which act directly on the exercise of the profession by the conservator-restorer. These norms mainly relate to the systems for the recognition of educational titles and qualifications as well as to the conditions formulated by the member States for the access and exercise of the profession.

The profession of the conservator-restorer of cultural property is thus caught up in this ambivalence: access and exercise of the profession is regulated by legislation originating in the European Community, whereas status of cultural heritage, on which the conservator-restorer intervenes, and conservation-restoration standards are determined by national provision defined by the individual member States and likely for this reason, to reflect greater diversity according to countries. In other words, while the environment of the profession (professional qualifications, access and exercise of the profession) is strongly marked and determined by the European Community legislation, the conditions of intervention on the cultural material, pertaining to the cultural inheritance of the States, are largely determined by national laws.

The provisions of the Community legislation, which apply to the conservator-restorer as regards occupational qualifications, access and exercise of the profession, are only of general order. Currently there is no Community rule specific to the conservation-restoration of cultural heritage, nor to cultural heritage, except regulations on import, export and claim of cultural goods. In addition, the heterogeneous character of national principles for the protection and preservation of cultural heritage is not favourable to the adoption of Protocols of Intervention and Professional Reserves [5] which are common to those States who recognise the role, functions and the contribution of the conservator-restorer as a guarantee in the processes of safeguarding cultural heritage.

E.C.C.O. is engaged in a process of promotion and recognition of the specificity of the profession of the conservator-restorer. In addition to resolving questions of access and the exercise of the profession, whose *raison d'etre* (let us be explicit) is ultimately the safeguard and protection of the cultural heritage, E.C.C.O. is also working to articulate and to elaborate

a recommendation, so as to provide the member States with Guiding Principles which must govern all interventions by professionals in the conservation and/or restoration processes.

In time, this initiative must facilitate a professional statute for the conservator-restorer that will be recognised at European level. The adoption of such a statute implies that the Community system for the recognition of diplomas and qualifications takes account of a minimal level of education which will underwrite the title of conservator-restorer [6]. This minimum level of education should comprise a total of 5 continuous years of initial academic education [7] (cf Doc. ECCO-ENCoRE) [8], corresponding to an equivalent theoretical and practical preparation where access to such education is not yet available [9].

This requirement for a minimal educational basis and recognition of a professional title is all the more important as certain States have already adopted principles which regulate the exercise of the profession. For this reason, it is essential that the education of the conservator-restorer rests on principles common to the European States. Only from such common principles will conservator-restorer's profit from freedom to practice across the EU, while reducing and even removing the risks arising out of non-mutual recognition of professional qualifications as a result of disparity in the educational training and backgrounds.

This recognition of a professional statute is all the more indispensable because, in its own right, it is a measure of the highest value a State places in its own cultural heritage. This highest value, which contributes to the forging of national identity, ensures that the restoration or conservation of historic cultural heritage is only carried out by recognised specialists. In other terms, *the requirement for a professional qualification is part of the process of safeguarding and preserving cultural heritage, for which the guarantor is the State. Therefore the need for a competence is also part of the measurements of safeguard of cultural heritage.*

But, the establishment of a general system at European level for the recognition of a professional statute for conservator-restorer, is a necessity not only to reinforce the protection of national cultural heritage of the single States, but equally, for developing the principles of a common European culture.

4 Conclusions

E.C.C.O. wants to stress that it is important for EU to assume the responsibility to recommend to the Member States to consider a reality: the survival of their heritage extremely depends on the qualification of those who deal with, those who plan and physically intervene on the objects and monuments which constitute the patrimony of a nation.

5 References

[1] Among others, The Murray Pease Report, AIC – June 8, 1963 on Standards of Practice and Professional Relationships for Conservators.
The Code of Ethics for Art Conservators, IIC-American GroupMay 27, 1967 (both published in booklet form by the IIC-AG in May 1968 together with the Articles of Association of IIC and Bylaws of the American Group.
The Australian code of ethichs, and the Canadian code of ethichs IIC-American Group May 27, 1967 The definition of the profession – ICOM-CC Copenhagen 1984.

[2] At that time it was important to specify the difference with the related professions of *artist* and *craftsman*, in order to define the different approach and methodology.

[3] *Subsidiarity* – the principle that political power should be exercised by the smallest possible unit of government.

[4] *Sovereignty* – supreme authority of a State. Freedom from outside interference and the right to self-government.

[5] If a country agrees on the need of specific laws for the protection of its cultural heritage, and wants to guarantee the safeguarding of its heritage through the control of the professionals who deal with it, it is necessary to 'reserve' all conservation activities only to a 'specialised profession' to be defined and organized in all details (for its access and exercise).

[6] The profession is already recognised in some european countries, but with different name (e.g. – Italy: "*restorer of cultural heritage*").

[7] 5 years of education are equivalent to 300 CTS points and to 5.500 hours of full time study (in educational subjects with coexistency of integrated (50/50) theory and practice on protected cultural goods). In the evaluation of this minimal level of education kind and qualification of teachers and relation teacher/pupil (not more that 1/5) have to be strictly considered. If individual studies are considered, the amount of hours should rise to 8.000.

[8] The ECCO-ENCoRE document *'Joint statement on the education of conservator-restorers for cultural heritage'* 25/9/2002, states that the Bachelor qualification is not sufficient for working as a conservator/restorer. BA graduation qualifies for work within the field of conservation-restoration only under the supervision of a qualified conservator / restorer."….The cross-disciplinary nature of the conservation-restoration profession requires that applicants to conservation –restoration education undertake specific entrance appraisals. A graduate of conservation-restoration of cultural heritage at Bachelor's Level (Level 4) will be qualified to enter to study at Master's Level and/or work in the conservation-restoration of cultural heritage in the public or private sectors only under the direction and supervision of a conservator/restorer of cultural heritage. A graduate of conservation-restoration of cultural heritage at Master's Level (Level 5) will be qualified to register for PhD studies or to work as a conservator/restorer of cultural heritage in the public or private sectors…..".

[9] *For the future* – this is the essential and irreplaceable basis to exercise the profession. *For the past* – in order to define the position of the many existing conservator-restorers who don't fulfil the requirements, "*transitory measures"* will have to be provided in short term by the singles States (the Italian law has issued a specific regulation in the Codice dei Beni Cultural – D.L. 42/2004 art 182, recently integrated and modified with the D.L. 156/2006).

Fire loss to historic buildings

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Key words: built heritage, historic buildings, conservation, fire, COST Action C17

Abstract
In addition to existing serious levels of loss to life and contents, the number, authenticity and quality of European historic buildings is being steadily eroded through the effects of fire. In 1993 this was recognised by the Council of Europe Committee of Ministers, who in the *Protection of the Architectural Heritage Against Natural Disasters, Recommendation No R(93)9,* stated that *'the governments of the Member States adopt all legislative, administrative, financial, educational and other appropriate measures'* with the aim of reducing the levels of risk.

Then, as now, there is a need to find a balance between technological and management solutions to help achieve this aim. Across Europe the full extent of physical loss of built heritage to the effects of fire is unknown. Some suspect it to be as high as one important historic building each day, but there are no reliable statistics upon which the real degree of destruction can be easily established.

In December 2002 a new Co-operation in Science and Technology (COST) initiative was established which had the aim of addressing associated concerns. Under the heading COST Action C17 "Built Heritage: Fire Loss to Historic Buildings", this four year programme has involved a wide range of disciplines and professions from 20 countries and is due to complete its work in December 2006. This paper outlines the approach that was adopted to set up the Action and briefly summarise its work to date.

1 Historical perspective

The evidence that fire loss has been an issue of on-going concern can be found on a number of historic buildings, locations and records. In Scotland, the results of the fire at Elgin Cathedral in 1270 can still be found where solidified molten lead is still adhering to the weathering masonry above the Nave, and on the damaged masonry of the wall face of the Dorter at Dryburgh Abbey following the 1322 fire.

Although these were individual fire incidents, major conflagrations involving many properties were recorded by map and painted evidence following the Great Fire of London in 1666; the etchings published in *Old and New Edinburgh* of the 1824 major fire in the medieval part of the city; and the numerous sketched illustrations and photographs of the major incident in Chicago of 1871. Here, a large part of that city was ravaged by fire leaving scenes of total destruction, 10,000 buildings destroyed, and the need to set up major post-fire trauma centres to help the homeless and suffering. In developing America such major conflagrations occurred elsewhere – notably in Boston, 1872; Chelsea, 1908; and Salem in 1914.

Figure 1: Trondheim, Norway: Location of city block destroyed by fire December 2002

In more recent times major fires occurred in the historic Chiado district of Lisbon in 1988; Totnes, England in 1990; at the Sofiensal, Vienna in 2001; in the heart of the cities of Trondheim and Edinburgh in December 2002 *(Figure 1)*; and in the Manezh Exhibition Hall, Red Square, Moscow in 2004. Fire is no respecter of location, and colleagues in New Zealand recently published the statistic that "*about 15 heritage buildings are burnt to the ground every year"* in that country alone. Combined, these incidents demonstrate the past high level of loss, and reveal how fire routinely threatens the integrity of historic buildings.

2 The challenge

Any historic structure, or authentic fabric, lost to fire is irreplaceable. Yet the large number of high profile international heritage fire losses that have occurred over the last 25 years alone only tells part of the story. The finite nature of each country's stock of historic buildings means that any loss to fire of fabric or content has a significant and relentlessly cumulative cultural impact. The wider picture is far from clear. The lack of a centralised reporting system for culturally significant fire loss, either Europe-wide or internationally, means that statistics on the true impact on the built heritage are generally unknown, but considered significant.

During the 1990's, several international conferences addressed the topic of fire loss to the built heritage. The published proceedings offered some understanding of the issues involved, although many aspects remained unresolved in practical terms. Moreover, the events promoted few mechanisms for encouraging and coordinating research projects on heritage protection.

During the *Historic Scotland Fire Protection and Built Heritage* conference held in Duff house in October 1998 delegates were briefed on a proposed *Risk Assessment in European Historic Buildings* project. This multi-national proposal, involving Austria, Sweden and the UK, was submitted as a Raphael Project to the European Commission for funding but, unfortunately, had been unsuccessful. In consequence, a new set of criteria were established during the conference

that warranted further investigation. A number of key points were identified, including the need to *"establish a European body to provide support and advice on risk assessment for historic houses, hopefully in co-operation with the European Commission and European insurance organisations"*. This intention was developed further during subsequent international conferences in Vienna (1999); Thessaloniki (2000); Stockholm and Vienna (2001); and Rome (2003).

3 COST action C17 "Built heritage: fire loss to historic buildings"

An emerging proposal to initiate an integrated approach to the established problems was offered to the *2nd COST Urban Civil Engineering Conference: The future of the city; New Quality for Life* event in Bled, Slovenia in 2001. Follow-up activities resulted in a draft Memorandum of Understanding (MoU) being prepared and agreed. This promoted the implementation of a European concerted research approach, ultimately designated as "*COST Action C17 Built Heritage: Fire Loss to Historic Buildings",* to be formally inaugurated in Brussels in December 2002.

The agreed *modus operandi* described the intention of the programme, how it was going to be directed, and how long it would take to complete. It anticipated that over its four-year duration it would involve the collaboration and integration of a variety of related projects and partnership country interests. The document identified four work-packages, the themes of which were to be dealt with by interlinked Working Groups of relevant experts:

Working Group 1: Data, loss statistics and evaluating risks.
Working Group 2: Available and developing technology.
Working Group 3: Cultural and financial value.
Working Group 4: Property management strategies.

Figure 2: The destructive effects of fire

Combined, COST Action C17 had as its central objective the definition, at a European level, of the degree of loss to built heritage through the effects of fire *(Figure 2)*, and the promotion of remedial actions and recommendations to combat these using minimal invasive techniques. The Action also aimed to address a general lack of statistical information, and a common lack of understanding and appreciation of what measures are available and required. It sought to provide good practice guidance on how to sensitively retrofit modern day fire protection equipment into historic fabric, and to develop related management expertise in dealing with this problem in historic premises.

The operational framework of the Action therefore aimed to consider and assess the:

- *vulnerability of historic buildings to fire*
- *risk assessment methodologies*
- *protection of fabric and content*
- *prevention of fire and fire spread*
- *detection and suppression requirements*
- *training and management of staff*
- *insurance considerations*

In pursuing these intentions, there was a need to integrate and coordinate the associated factors so that a common understanding of the issues might emerge that would help combat the high levels of loss. The Action's challenge was to combine new technologies with traditional disciplines, and to develop synergies within related organisations so that loss levels could be reduced substantially. The underlying objective was to ensure the retention of the remaining cultural built heritage in an authentic state for future availability, access and enjoyment by all. This required making best use of the limited resources available, while recognising that conservation is both a cultural and a political process, with priorities not necessarily being the same in all partner countries.

To achieve meaningful results during the intended life-span of the programme, a strategic approach was adopted. This focused on:

- compiling statistical data on the extent of heritage at risk.
- promoting statistical research into the consequences and causes of fires – both major fires and more minor incidents (such as small fires to which the fire brigade are not called or false alarms) and their impact. Using risk assessment data gathered as a basis for discussion, a dialogue began to be established with insurance bodies to seek the development of insurance products more closely tailored to historic buildings.
- establishing a well-documented survey of up-to-date technical expertise to assist in influencing future developments in fire protection technology for use in historic buildings.
- defining an appropriate range of passive and active technical equipment counter-measures.
- considering alternative approaches to assist in stemming current loss levels.
- organising a series of conferences and/or workshops to develop thinking for effective risk assessment techniques and risk mapping using insurance company and other data.
- promoting findings and benefits of relevant risk assessment methodologies and property management support.
- effecting know-how dissemination through publishing proceedings and recommen-dations.

4 Membership countries involved

Initiated with the obligatory five membership signatory countries in 2002, that number has since risen to 20 involving Austria, Belgium, Bulgaria, Denmark, Finland, France, Hungary, Israel, Italy, Macedonia, Netherlands, Norway, Poland, Serbia and Montenegro, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. In addition, corresponding membership interests have been established with other organisations and networks, including:

Baltic Countries:
- *Association of Castles and Museums around the Baltic Sea*
- *Federation of Finnish Insurance Companies*

Europe:
- *Comité technique international de prévention et d'extinction du feu (CTIF)*

Russia:
- *Russian Civil Defence and Disaster Management Research Institute*
- *International Informatization Academy*
- *WORLD Academy of Sciences for Complex Security*
- *Academy of State Fire Service of Emercom of Russia*

United States of America:
- *NFPA Cultural Resources Committee*

United Kingdom:
- *Scottish Historic Buildings Fire Liaison Group*
- *Scottish Building Standards Agency*
- *Historic Buildings Fire Research Coordinating Committee*

5 Technical programme

The first full meeting of the Action was hosted in Edinburgh, Scotland during September 2003. It was held as a joint Scientific Session with the Scottish Historic Buildings Fire Liaison Group, with representatives of the Historic Buildings Fire Research Coordinating Committee, led by English Heritage, also in attendance. In addition to being brought up to speed with a variety of Scottish initiatives, associated study visits occurred to inspect sensitive retrofit fire detection and suppression measures at the National Library of Scotland, the National Archives of Scotland and Newhailes, a late 17th Century property in Musselburgh, owned by the National Trust of Scotland *(Figure 3)*.

The second meeting during December 2003 in Schloss Schönbrunn, Vienna, focused on the varied research activities of the attending members. It also included a research seminar on fire modelling in historic buildings and a study visit to view the fire suppression and detection systems in operation at Schönbrunn Palace. This included the innovative “plug-in” service pillars which incorporated water sprinkler heads, and a variety of other service needs.

The third full meeting of the Action was held in the Archbishops Palace, Trondheim during April 2004. Incorporating a joint workshop arranged by Norwegian colleagues, members were informed of recent developments in Norway, and visited the wood-built World Heritage Site of Røros to view the installation of a trace wire detection system, and to Bardshaug Mansion to assess a surface mounted sprinkler system. In addition, a monitored field experiment to fire test the efficacy of a water mist system on a typical Norwegian wooden dwelling in nearby Melhus was also arranged in conjunction with the equipment suppliers and the local fire authorities.

Focusing on risk assessment and evaluation, a Working Group 3 meeting was hosted in the headquarters of the Swedish National Property Board, Stockholm during June 2004. A variety of presentations shared new knowledge on risk analysis, the approach of insurance companies to

cultural heritage, the ethical aspects of loss recovery and its impact on authenticity. A study visit was arranged to Drottningholm Royal Palace Court Theatre to view the installation of a dry-pipe fire fighting system.

Figure 3: The complexities of sensitively retro-fitting services can be considerable (Photo: Per Rohlen)

Gathering again at Schloss Schönbrunn, Vienna, the specific aim of a Working Group 1 meeting in July 2004 was to focus on fire incident data recording methodologies in different countries and to consider establishing commonality in the adopted approaches. This led to a Short Term Scientific Mission (STSM) undertaken in October 2004. Entitled *Comparison of Data Categorisation of European Countries' Fire Reporting Statistics*, the STSM was hosted by Historic Scotland in Edinburgh and carried out by a colleague from the Finnish National Property Board in Helsinki.

The fourth full Management Committee and Working Group meeting was held in Varna Free University, Bulgaria during September 2004. This meeting was arranged in conjunction with an International Workshop, "*Built Heritage: Fire Loss to Historic Buildings"* involving colleagues from Bulgaria, Turkey and Russia. A variety of case studies were presented *(Figure 4)* and a study visit to view fire precaution measures in the Black Sea World Heritage Site of Nessebar was also arranged.

In October 2004 Working Group 3 held a workshop based in the Hôtel de Ville, Paris. This continued discussions on insurance topics previously initiated during its June meeting in Stockholm. Presentations were offered on the insurance of historic buildings in Paris, Austria, Finland, Norway, Sweden and the United Kingdom, with study visits arranged to the Chateau de Versailles and the Eiffel Tower.

Figure 4: Consequences of fire: Duchess Anna Amalia Library, Weimar, Germany: September 2004 (Photo: Per Rohlen)

In December 2004 Working Groups 2 and 4 furthered their agenda during a successful meeting in Vienna, Austria. Several topics were addressed, including the effects of fire on sandstone, portable extinguishing agents, evacuation modelling, water-mist installations, and management training issues. An associated visit to the Sisi Museum in the Hofburg Palace, Vienna was also included.

In January 2004 the Italian Ministry of Home Affairs (National Fire Services Department) and the Santa Maria della Scala Foundation (representing Siena Municipal Administration) signed an agreement aimed at improving the understanding of fire protection issues relating to the cultural and historical heritage. An associated workshop, *"Misure Antincendio e Patrimonio Culturale"*, was arranged in conjunction with the Action's fifth full meeting in Siena in April 2005. It was located in the Santa Maria della Scala museum complex, where innovative fire precaution and detection measures have been adopted. Focusing on the challenges of restoring the historic site safely and securely, the purpose was to discuss, analyse and develop safety measures and risk assessment techniques specifically tailored to meet complex cultural heritage requirements *(Figure 5)*.

The next full meeting, in the Culture Hall, Helsinki, Finland in October 2005, included International Workshop presentations on computer modelling of fire behaviour, innovative fire fighting, escape solutions and technologies. Case studies on St Michael's Mount, Cornwall; Wardington Manor, Oxfordshire, England and the Sodra Rada Church in Sweden were also presented.

Figure 5: Co-operation between fire and heritage authorities, Santa Maria della Scala, Siena, Italy

Arranged in conjunction with the Slovenian Fire Authorities the Action's penultimate meeting was held in Ljubljana, Slovenia, during May 2006. An associated joint international conference was arranged in conjunction with the Cultural Resources Committee of the American National Fire Protection Association.

6 Conclusion

Through the ready cooperation, goodwill and considerable effort by all involved, the four year COST Action C17 programme has largely met the original aims as set out in the Memorandum of Understanding. This has been economically managed in a collaborative multi-disciplinary, multi-national manner. The programme has also benefited from detailed exposure to a wide variety of related practical projects that were studied on-site.

The Action has readily, and freely, built upon members' current research initiatives. In support of the agreed intentions, this approach has also resulted in the production of an appropriate range of newly published material arising from activities in Bulgaria, the Nordic countries, Scotland and Switzerland.

The programme has served to promote the use of data, methodologies and management systems to assist a broader clientele achieve a necessary balance between fire engineering needs and conservation requirements to assist in the future preservation of the European built heritage. Such an audience, as originally intended, has included property owners; public asset managers; official bodies; fire brigades and fire authorities; fire industry equipment manufacturers and suppliers; professional and technical bodies; building and artefact conservation interests; insurance companies; heritage bodies and organisations; and the tourist industry.

Considerable national and international influence has emerged through the work of the members. They have frequently reported a widespread positive reaction by authorities in their countries on how the Action outcomes have impacted on current thinking on the topic. Whilst the original programme has been successfully achieved, the results of a good deal of associated research activity, well beyond the scope of the initial intentions, have also been gathered. The scene is set for the Action's final meeting due to be held in Rome, Italy, in December 2006. Following that, the considerable body of researched information, guidance and data emanating from the Action's work will be published.

Session VI

Coordination of national research & education

Cultural heritage related research at COST

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COST is an intergovernmental European framework for international co-operation between nationally-funded research activities, created in 1971 and funded by the EU Framework Program. COST supports coordination of scientific networks and dissemination of their results, thus enabling scientists to collaborate in a wide spectrum of activities in research and technology.

Currently COST is running several Actions that are directly related to Cultural Heritage, e.g. “Art Conservation by Laser”, “Built Heritage: Fire Loss to historic Buildings”, “3D-Monitoring of Active Tectonic Structure”, “Non-destructive Testing of Museum Objects”. Some other COST Actions in the fields such as nanotechnology or chemistry can deliver results that create new possibilities in Cultural Heritage domain.

Presented contribution will mainly focus on two aspects of COST-policy: encouragement of multidisciplinary research and stimulating involvement of countries from East Europe and The Balkans.

COST, following bottom-up principle in defining the research areas and being per definition pan-European in all activities is an ideal platform for networking multidisciplinary research required in the field of Cultural Heritage. It will be shown how strategic coordination of research can help the scientists in establishing effective networks in newly defined scientific domains.

Towards an EU-wide strategy for research into the historic environment and its sustainable management

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Key words: research, strategy, European Union, historic environment, sustainable management

Abstract
This paper proposes that European Union (EU) member states produce national research strategies on the historic environment and its sustainable management. It further proposes that once produced, the states work together to develop an EU-wide framework to focus and co-ordinate research into the most pressing issues confronting the historic environment. A recently published national research strategy (English Heritage, 2005) is offered as a model and catalyst for concerted action. The paper argues that the European Commission's Research Directorate could be assisted in its work by such means: helping to respond adequately and effectively to member states' pressing research needs in this field. Furthermore, the development of a common research strategy among interested member states would also help to raise the profile of heritage research further a field and give shape to offers of collaboration from scientists outside the European Union.

In addition, the paper introduces the concept of the EU's "historic environment" (a parallel to its "natural environment") and takes a holistic view of ways it could be studied. Many cultural assets cannot be considered in isolation, for example, because they exist in complex assemblies.

1 Introduction

Under existing EU treaties and regulations, heritage protection qualifies as a "subsidiarity issue" – a matter solely for the discretion of individual member states. But research to support heritage protection is of collective interest. Indeed, EU researchers have benefited from international collaborative actions and the support of the European Commission's Research Directorate and its 1st-6th Framework research grant programmes over 20 years. The need for international collaboration is now more pressing than ever before. With new social, economic and environmental challenges emerging to confront the historic environment and its sustainable management, it is vital to ensure that future research plans deliver the knowledge base and intelligence to evaluate and manage these new threats and opportunities, and to provide the evidence base for policy developments and concerted action.

The paper therefore suggests a means to develop national and international research strategies focused on heritage matters through which common goals can be expressed and articulated to help guide the European Commission and facilitate common actions by member states. It describes the model research strategy recently delivered by English Heritage, *Discovering the Past Shaping the Future: providing the knowledge base for the historic environment and its sustainable management* [1] and suggests it should be adopted as a model or catalyst for similar work by other national agencies on behalf of member states. Then, by sharing national strategies it is argued, common research themes and the priority needs for collaborative action can be established through the establishment of an EU-wide research strategy.

2 English Heritage

English Heritage is the lead body for the conservation of England's historic environment. Established by an Act of the United Kingdom (UK) Parliament in 1983, English Heritage advises national, regional and local government and the public on heritage issues and provides funding in the form of grants for the conservation of scheduled monuments, listed buildings, areas of special townscape interest, designed parks, gardens and landscapes, and other physical heritage assets. It employs 1,800 staff and operates on an annual budget of £165 million (Euro 241 million). The organisation also has responsibility for over 420 nationally important historic monuments in England, including the World Heritage Sites of Stonehenge, Avebury and Hadrian's Wall.

The organisation has been spending £9.8 million (Euro 14.3 million) or 6% of its annual budget on research including £6.2 million (Euro 9.06 million) on research grants and contractors' fees and expenses, and on staff costs involved in carrying out, administering and managing research. These figures do not include the cost of work that supports research ie survey, recording, data collection and evaluation which is also used for other purposes – this distinction is aligned with best practice for statistical comparisons established by the intergovernmental Organisation for Economic Co-operation and Development (OECD). Over 58 full time equivalent staff (3% of the total workforce) in as many scientific disciplines take part in English Heritage's research and they are supported in turn by 275 external research partners, consultants and contractors.

English Heritage's research encompasses a broad array of disciplines from the arts and humanities (principally architectural history and archaeology) to the sciences, engineering, technology and innovation (SETI). This span of interests and the multidisciplinary nature of its research reinforces the organisation's holistic approach to understanding the historic environment, its values and management. The applied nature of its research supports fieldwork and helps to devise practical solutions at a strategic level.

In 2001, the UK Government carried out a comprehensive review of heritage conservation functions in England. One of its recommendations published as *The Historic Environment: A Force for Our Future* [2], was that English Heritage should provide leadership for the rest of the heritage sector by organising: "a coordinated approach to research across the historic environment sector, with the aim of ensuring that needs are clearly identified, priorities established and duplication avoided" [3].

3 Development of the English Heritage research strategy

While it was generally acknowledged that much valuable research was being undertaken across the heritage sector in England, the need for a coordinated approach was also clearly evident. Among the chief criticisms directed at heritage research activity was the difficulties encountered by potential research collaborators and end-users of research in establishing precisely what research was being carried out, what was needed, what had been completed to date, or what was in the process of being commissioned. Furthermore the sector's priorities for research were not clearly stated and it was very difficult to access and evaluate the impact of the research once it had been completed.

Responding to this recommendation, and working from a national template provided by the UK Government's Office for Science and Innovation (OSI), English Heritage published its first comprehensive research strategy in October 2005. The Research Strategy entitled *Discovering the Past, Shaping the Future* [Fig. 1] specifies the organisation's research priorities for the next five years, and shapes and prioritises its research activities based on commonly perceived

threats and opportunities confronting the business and the historic environment in the years ahead – tested and validated through horizon-scanning and foresight activities.

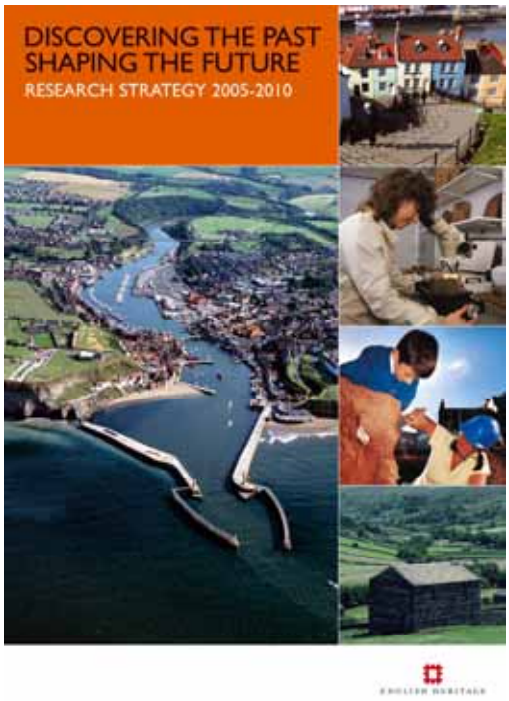

Figure 1: English heritage research strategy

3.1 Influencing and supporting corporate aims

English Heritage's Research Strategy underpins its corporate (business) aims which are expressed in the five-year plan, *Making the Past Part of Our Future* [4], namely to:

- help people develop their understanding of the historic environment
- get the historic environment on other people's agendas
- enable and promote sustainable change to England's historic environment
- help local communities to care for their historic environment
- stimulate and harness enthusiasm for England's historic environment, and
- make the most effective use of the assets in care.

Undertaking research is seen as:

- helping to develop and sustain a leadership role in the UK heritage sector
- supporting business priorities and focusing resources
- fostering high standards of research centred on the historic environment
- delivering action in support of the UK Government's historic environment policy, and
- delivering greater efficiency, effectiveness and value for money.

3.2 Horizon-scanning and foresight planning

Armed with corporate aims and objectives, the English Heritage's Research Strategy was formulated through undertaking *SWOT Analysis* – i.e. to determine the current research provision's strengths and weaknesses, and the opportunities and threats confronting the historic environment (and English Heritage's business) which helped to dictate future research needs and priorities. Focus group meetings were arranged amongst research funders, research networks, and end-users of research, and studies carried out to assess the overall research capability of the sector in England.

Comparisons were also made between the interests and concerns of different research disciplines to find common ground on concepts and terminology. Funding streams were then mapped and assessed before responsibilities for action and shared work plans were agreed.

3.3 Responding to future threats

The threats seen as confronting the historic environment in England are:

- climate change and natural erosion
- economic change in urban and rural areas
- labour and skills shortages
- social exclusion.

3.4 Seizing future opportunities

Opportunities include:

- widespread popularity of, and media interest in, the historic environment
- commitment to the sustainability agenda
- using heritage conservation as a catalyst for social and economic regeneration and as a driver for tourism.

3.5 English Heritage's research themes

By focusing on these threats and opportunities English Heritage has been able to devise Research Themes [Table 1] against which it can prioritise its research through programmes and projects – set out and described in detail in an annually published Agenda [5].

Table 1: Research Themes

THEME	
A	Discovering, studying and defining historic assets and their significance
B	Studying and establishing socio-economic and other values and needs of the historic environment and of those concerned with it
C	Engaging and developing diverse audiences
D	Studying and assessing risks to historic assets and devising responses
E	Studying historic assets and improving their presentation and interpretation
F	Studying and developing information management
G	Studying and devising ways of making English Heritage and the English historic environment sector more effective

From this table it may be seen that various themes or strands overlap and have complementarities. Themes A and E involve architectural history and archaeology; B and C involve social and economic sciences; D relates to SETI-based interests; E involves informatics and information management; and G crosses all these disciplines looking for efficiency goals.

One of the key objectives of publishing the English Heritage Research Strategy was to engage with researchers and end-users of research (ie the heritage sector) in England and test the forward plan for research against others' research needs and priorities. This process of validation or proofing for the Strategy was undertaken by means of a formal 12 week public consultation launched with a conference in London on 27th October 2005. Feedback from the consultation has generally been supportive, particularly of the proposal to establish a UK-wide strategy for research in this field [6].

4 Development of a UK-wide research strategy

English Heritage has argued that with devolved government in the UK, the four "home countries" of England, Wales, Scotland and Northern Ireland ought to pool experiences and share ideas and responses to common heritage conservation problems across geo-political boundaries. Thus, the Chief Executives of English Heritage, Cadw, Historic Scotland and the Environment & Heritage Services have agreed in principle to work towards a common research framework – though progress will understandably be slow, as the other three "home countries" need to establish their own national research frameworks first.

Of course, the historic environment of England, or of the United Kingdom as a whole, does not exist in a vacuum. It is impacted by and effects other "industries" and fields – not least the built environment and construction industries; agriculture; tourism and so on, and is studied across a very wide span by academic and other interests in research. So it makes sense then to engage with a very wide constituency of interests in assembling a UK-wide research strategy or framework for research prioritisation. And the process of engaging partners and of encouraging them to establish their own agendas and strategies has already commenced.

At the launch event for the English Heritage Research Strategy, for example, a consortium of UK public sector bodies with interests in the socio-economic aspects of the natural and built environment, the United Kingdom Historic Environment Research Group (UKHERG), was able to publish a complementary document, *A Framework for Policy Research* with a forward agenda for socio-economic studies [7] that now forms a leg of the ambitious platform building towards a UK-wide strategy for the historic environment.

Other "legs" are being assembled. English Heritage and Historic Scotland were invited to participate last year in the assembly of the conservation, repair, maintenance and improvement (CRMI) component of the UK built environment and construction industries' own national research strategy linked to the current EU Construction Technology Platform in preparation for the upcoming EC 7th Framework of research funding. Coordinated by *n*CRISP, the (UK) Construction Research and Innovation Strategy Panel [8]. Under the guidance of Professor David Fisk of London's Imperial College, the horizon-scanning / foresight work established a SETI-based plan for historic building conservation for the next 5-10 years and it will be published shortly.

In addition, as part of English Heritage's forward commitment to work more closely with academia at a strategic level, and through the establishment of a *concordat* with the UK's Arts and Humanities Research Council (AHRC), fruitful meetings have been held for the first time with the UK Government's funding agencies for research in higher education: the research councils [9]. Specialising in different areas of research based on the Frascati definitions [10], the AHRC, the Economic and Social Research Council (ESRC), the Engineering and Physical Sciences Research Council (EPSRC) and the Natural Environment Research Council (NERC) have come together to discuss mutual interests with English Heritage in historic environment research. Emanating from these meetings, the first ever UK cross-council, themed networking or cluster-forming meeting, called *Preserving our Past* took place for researchers in Birmingham, England in March 2006 [11], out of which 5 clusters or interest groups are to be funded by the research councils/English Heritage partnership to develop multidisciplinary heritage-based research projects over the next 12 months, hopefully for full three-year funding grants thereafter. If this experiment works, other research councils – notably the Biotechnology and Biological Science Research Council (BBSRC) will be invited to participate. And the research themes devised at the Birmingham meeting were found to be not too dissimilar to those in the English Heritage Research Strategy.

Finally, English Heritage's Research Strategy and its proposal to promote a UK-wide research strategy has been aired in the British Parliament, by the House of Lords Select Committee on Science and Technology's Inquiry into Science and Conservation [12]. Here the suggestion has been made that the developing research strategies for libraries and archives and for fine arts and collections conservation ought to be merged with that for the immoveable cultural heritage through UK-wide consortia interests and dialogue led by English Heritage.

Thus it can be seen that steps are being taken in the UK to create the building blocks for the establishment of a UK-wide research strategy for the historic environment. How can lessons from this practice be shared and used throughout Europe?

5 Towards an EU-wide research strategy for the historic environment

Last November 2005, the proposal to establish an EU-wide research strategy for the historic environment was promoted by the UK delegation at the General Assembly of ICCROM, the International Centre for Studies in the Conservation and Restoration of Cultural Property in Rome. A great deal of interest was shown in the idea by member states of the intergovernmental organisation both within and beyond the European Union. In particular, expressions of interest were received from the Irish Republic, Sweden and the Netherlands. Details have also been requested by the Canadian Australian and Japanese governments.

Then in April 2006, English Heritage hosted the first ever meeting of European Union member state heritage agencies to share concerns and learn from each others' activities. Future meetings of Chief Executives are planned following this experiment and various bi-lateral discussions have already been held concerning the sharing of heritage information and research results. Indeed, English Heritage is already developing bi-lateral research collaborations with EU and non-EU partners based on its own strategy and common interests – for example, on timber decay with the Office of Public Works in the Irish Republic, and on Dolomitic stone decay with the Getty Conservation Institute in Los Angeles USA.

6 Summary and conclusions

6.1 Innovation

On behalf of English Heritage, the authors' key proposal in this paper is simply to work together to establish common research priorities. English Heritage offers its own research strategy as a model vehicle to develop ideas but would be happy to see other templates used. It wishes to work with other EU member state agencies to discuss and develop the concept.

6.2 European dimension

The enlarged European Union's cultural heritage is composed of a wide range of moveable and immoveable assets including fine and decorative art collections; libraries and archives; archaeological sites; ancient monuments; historic buildings, areas, territories and cities; historic parks and gardens; cultural landscapes; battlefields and maritime wrecks. But the paper argues that these resources should be considered in a holistic sense as constituent parts of the EU's single "historic environment" and be regarded as having similar states of fragility and value, rather than dissimilar isolated objects. By such means greater synergies may ensue from wider ranging and all-encompassing study and analysis.

Under the terms of European treaties and regulations, heritage protection is classed as a "subsidiarity" issue ie excluded from pan-European strategic actions and left to the sole discretion of member states. However, research to support heritage protection is held to be a common area of interest. This means that the European Commission Research Directorate's legitimate interests in fostering concerted actions towards research involving or benefiting

European heritage are not limited. But they can be facilitated and developed with the aid of an EU-wide research strategy for the historic environment and its sustainable management. Other public / private partnerships are assembling Technology Platforms that aim to define and implement similar research agendas in their fields. They can provide new insights and direction in research and development. Why not for heritage too?

6.3 Impacts

Discussions during the 5th European Conference, *Sustaining Europe's Cultural Heritage: from research to policy* in London in September 2004 revealed that if member states produced their own common framework for research into cultural heritage matters, then the EC Research Directorate could take account of this strategy in formulating future EC Research activities.

So on behalf of English Heritage, the authors propose in this paper that EU member states undertake concerted joint action to develop a common research strategy for Europe's cultural heritage and its sustainable development. The paper describes one template that could be used in order to develop an EU-wide research framework: based on English Heritage's research strategy 2005-2010, *Discovering the Past: Shaping the Future.* Copies are available at the conference and the document can also be found on the Web.

The strategic coordination, development and resourcing of scientific, technical and other forms of research concerned with and benefiting Europe's historic environment would then follow. The EC Research Directorate would have strategic guidance to illuminate the way ahead. Member states could facilitate bi-lateral and other forms of collaborative working to common themes and programmes. Costs could be shared and common threats and opportunities addressed by prioritised joint action.

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The French national research programme on sciences and conservation of the materials of the cultural heritage: results and future

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In 2003, the Department of Research and Technology of the French Ministry of Culture has initiated a National Research Programme on Sciences and Conservation of the Materials of the Cultural Heritage.

This programme, previously presented during the 6th EC conference on Cultural Heritage hold in London 2004, is aiming to highlight research projects, to reinforce research and to breath a new synergy in the field of Sciences and Conservation of the Cultural Heritage, thanks to an annual call and financial support for projects organised in four main topics:

1 – Fundamental knowledge on materials of the Cultural Heritage;
2 – Impact of the environment on weathering and conservation of Cultural Heritage;
3 – Interpretation of weathering processes and settling of specifications for interventions;
4 – Research in conservation-restoration.

In 2003, 2004 and 2005, among 30 proposals each year, 6 were selected by the Scientific Committee and funded by the Steering Committee. They mainly deal with stone, glass, wood, metal, wall painting, canvas and ceramics.

The review of the progress of this programme, planned in a first step for 4 years (2003-2006), and its development prospects will be presented here.

The Czech national research programme on cultural heritage and European integration

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Key words: Czech national research policy, international cooperation, cultural heritage research

Research into cultural heritage in the Czech Republic has in principle been supported by four types of funding: the ministries, the grant agencies, the regional and municipal authorities, and others, e.g., NGOs and foundations. The main providers of financial grants are the first two groups, though in the last year the regions have exhibited increased interest in supporting research into cultural heritage, especially in connection with EC grant schemes. A few high-quality research projects were carried out with support from private companies, mainly SMEs working in the field of restoration.

At ministerial level, a systematic grant programme was launched ten years ago at the Ministry of Culture of the Czech Republic. This involved technological research as well as themes related to historic settlements and archaeology. This programme gradually changed its orientation toward non-scientific themes, and has been supporting cultural heritage inventories, identification and documentation. This tendency is not likely to change substantially, as will be shown below. Decreased ministerial interest in supporting research on historic technology, historic cities and conservation is also reflected in the *Czech National Research and Development Policy Plan,* in which cultural heritage and urban research has no priority for the near future.

National R&D policy is based on the major strategic documents introduced at European level, such as the Lisbon Strategy, the Action Plan for Europe, R&D Act No. 130/2002, and also at national level, such as the National Research Programme (valid until 2009). *National R&D policy* enhances all priorities set up by the documents mentioned above in the field of R&D development:

- Human resources,
- International cooperation,
- Regional aspects,
- R&D in use,
- R&D evaluation.

Accordingly, the specially supported areas in R&D are:

- Information and knowledge based society,
- Life quality and security,
- New materials and technologies.

Implementation of the *National R&D policy* comes under the responsibility of the **R&D Council**, which acts as an advisory council to the government of the Czech Republic, as stated in Article 2 of Government Resolution No. 82 (19/1/2005). The scope of its responsibilities include:

(1) The Council shall

- draw up long-term fundamental trends and schemes for the development of research and development in the Czech Republic through its advisory bodies, which have been established as expert commissions involved in the respective trends of research and development;
- process regular annual analyses and assessments of the research and development situation in the Czech Republic, compare them with foreign countries and submit the findings to the Government;
- develop a mid-term draft forecast for support for research and development, and estimate the total costs of research and development covered from individual budget chapters and propose their allocation;
- assess opinions concerning research and development documents submitted to the Government;
- conduct negotiations with the advisory bodies of the European Communities on research and development, and with the research and development councils of the individual Member States of the European Communities, and also other countries;
- act as administrator and operator and approve the rules for the operation of the Research and Development Information System;
- propose to the Government to appoint and/or remove the Chair and other members of the Board of the Czech Republic Grant Agency;
- carry out any other tasks and duties set forth in the Act on Support for Research and Development and special legal regulations, or those imposed by the Government.

The contribution of the **Ministry of Culture of the Czech Republic** is to look at national research and development programmes in the field of cultural heritage aiming to introduce interconnections and possible interrelations with the priorities of the Czech Republic and the European institutions (particularly European Commission and its programmes) within the framework of the *National Research and Development Policy 2004-2008*. Therefore, the contribution looks at the procedure for implementing it at state level (The R&D Council, Coordination Centre for R&D at the Ministry of Culture); including basic information about allocated state budget 2006 - 2011 and selected analysis related the state of R&D, with reference to funding. The Ministry of Culture introduced the *National Research and Development Policy for 2004-2008*, followed by another document *Research Programmes of the Ministry of Culture for 2006-2011*.

The Ministry of Culture of the Czech Republic established a *Coordination Centre for R&D* in the field of cultural heritage operating at the level of the Ministry of Culture as the advisory body of the R&D Council in matters of culture and cultural heritage. As such, it is responsible for:

- Drawing up and realizing a departmental conception,
- Setting up departmental programmes,
- Fulfilling sector priorities,
- Acting as administrator and operator,
- Approving the operational rules.

In order to fulfill all the above-mentioned policies, in 2006 the Ministry of Culture launched *Research Programmes of the Ministry of Culture 2006 – 2011,* opening funding opportunities through the four following programmes:

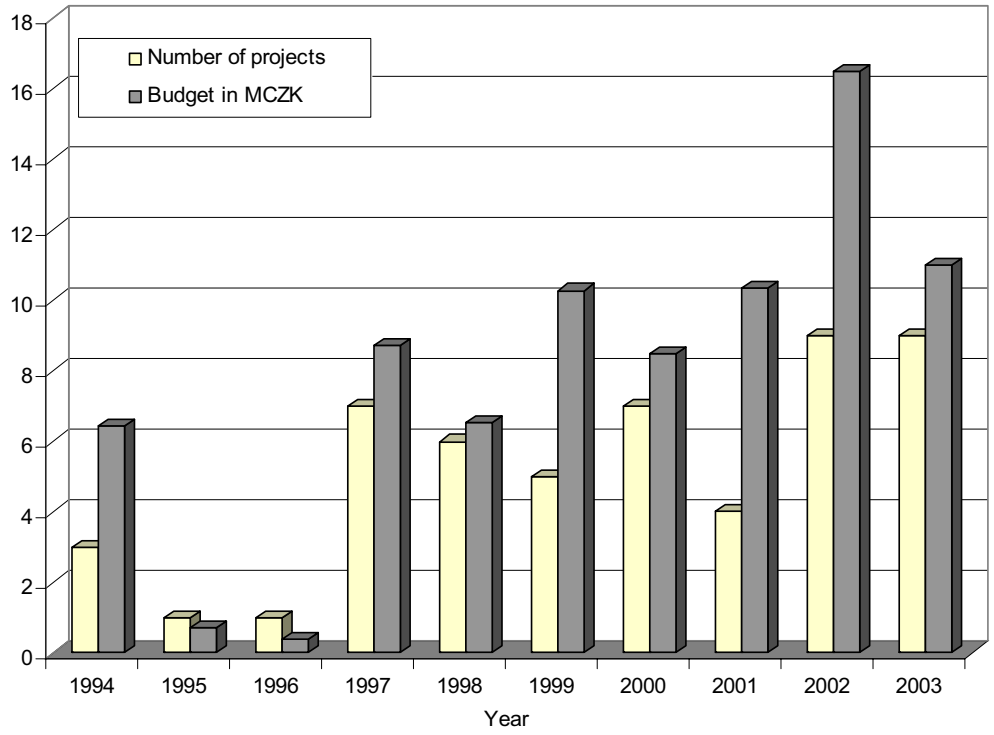
- Research and evaluation of cultural and historical values, sustainability tools and research on traditional culture as an integral part of intangible cultural heritage,
- Access to and preservation of cultural heritage resources,

- Research and documentation of musical, theater and artistic resources, literature history, theory and critics, analytical and social circumstances of culture and audiovisual mass media,
- Testimony of Czech, Moravian and Silesian museums and galleries.

The Table below gives details related to the funding allocated for each programme:

Year / programme	2006 In ths. CZK	2007 In ths. CZK	2008 In ths. CZK	2009 In ths. CZK	2010 In ths. CZK	2011 In ths. CZK	∑ In ths. CZK
1	2,494	3,854	8,446	10,545	11,335	2,929	**39,603**
2	2,046	3,545	9,000	15,000	12,000	2,495	**44,086**
3	2,046	3,545	3,573	3,873	3,873	3,376	**20,286**
4	2,046	6,150	8,231	9,282	9,442	9,200	**44,351**
∑	**8,632**	**17,094**	**29,250**	**38,700**	**36,650**	**18,000**	**148,326**

Fundamental and applied research into a wide range of tangible heritage issues has been carried out mainly with support from the grant agencies, the most important of which is the Czech Grant Agency. The graph in the Figure below presents simple statistics on completed research projects supported by the Czech Grant Agency on cultural heritage issues involving the architectural heritage, historic cities and villages, archaeology, historic materials and conservation technologies, environmental problems in museums and threats to cultural heritage from disasters. The figures do not include projects on history and similar issues related to cultural heritage, though numerous projects on such themes are also supported by the Czech Grant Agency.



The national research experience and a very long tradition of scientific support for interventions to safeguard the rich cultural heritage of Central Europe, which was necessary not only in order

to maintain the heritage assets but also to repair damage due to wars and to carry out specific tasks related to the intensive development of heavy industry after the second World War have established a well prepared scientific community ready to participate in international research projects.

The Czech Republic was involved in joint European research before accession to the European Union, and this engagement has been growing. In the 4th Framework Programme (further FP) we cooperated in only one project (REACH), but in the 5th FP seven projects focused on cultural heritage included partners from the Czech Republic (ARCCHIP, HISTOCLEAN, IDAP, LiDO, MULTIASSESS, ONSITEFORMASONRY, ROCEM). Czech scientists were also involved as external advisors or individual lecturing contributors in other four EC supported RTD or SSA projects (SUIT, two CHEPRISS projects, 5th EC Conference).

This tendency continued in the 6th FP, with participation in eight projects: CULTSTRAT, CHEF, I-SAMCO, NOAH'S ARK, PICTURE, SALTCONTROL, SAUVEUR, Culture 2000 "European roofs", and some other activities in the field of research planning, organization and evaluation (6th EC Conference, participation in research planning panels, evaluation of projects, co-organization of research events, e.g. the Prague Conference on EC supported Urban Research in 2005, etc.) Czech researchers applied successfully for cultural heritage oriented research grants provided within the programmes providing access to major facilities, e.g. the Jules Verne Climatic Wind Tunnel in Nantes.

The Institute of Theoretical and Applied Mechanics was established under the Academy of Sciences of the Czech Republic and supported under the 5th FP as the European Centre of Excellence ARCCHIP (Advanced Research Centre for Cultural Heritage Interdisciplinary Projects). It has participated in 69% of these projects, and has organized 18 specialized workshops, focused on well-defined problems related to cultural heritage research. The presentations of these workshops, together with conclusions identifying future European research needed in the field, have been published in five volumes available from Miloš Drdácký, the second author of this article. In addition to projects supported under the EC research framework, ARCCHIP has been involved in other multinational projects, e.g. COST projects, as well as bilateral research projects, including cooperation with the National Science Foundation (USA), the Getty Conservation Institute and several European partners.

ITAM ARCCHIP also coordinates the national group FACH (Focus Area of Cultural Heritage) of the Czech Construction Technological Platform, and co-coordinates one Working Group (WG6 Cities and Territorial Problems) of FACH within the European Construction Technology Platform (ECTP).

The Czech Republic authorities support the idea of establishing an ERA NET project aimed at coordinating research on European cultural heritage.

From national to European and international research and education programmes

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Key words: cultural heritage, protection of monuments, postgraduate education, advanced study course, European master of science and engineering for the protection of monuments, European network for the protection of cultural heritage

1 Introduction

The safeguarding of our Cultural Heritage is of major concern to the European community as it is an important part of our living environment, of our past, and of our future. A major effort is being made by several national and EU research projects and educational programmes that develop innovative technologies and materials for the conservation and restoration of movable and immovable cultural heritage.

The research priorities in European Cultural Heritage are focused on two fields:
a. The preservation of Cultural Heritage:
- Assessment, monitoring, diagnosis
- Materials
- Intervention Techniques.

b. The sustainability and added value of Cultural Heritage:
- Energy and Environment
- Management, Exploitation and Maintenance
- City and Territorial Aspects.

The means of meeting these goals are (a) sustainability, (b) directives, guidelines and technical recommendations, (c) socio-economic aspects and strategies, (d) disaster prevention and risk management, (e) information communication technology, and (f) education and training.

Education and training in particular, plays a crucial role in the field of Cultural Heritage protection. Continuous education and training is required to train conservators, restorers and technicians aiming at:
- Training and incentives for workers in traditional building trades
- Continuous training of public servants for the preservation, enhancement and management of cultural heritage
- Fostering local traditional materials and building techniques within the building trades
- Specialized training for professionals for the preservation and management of cultural heritage.

Throughout Europe, a large number of interdisciplinary educational programmes on the protection of cultural heritage are offered at a national level, effectively based on the experience and research needs of each individual country. Several educational programs are focusing on postgraduate studies, and offer specialization in the field of cultural heritage protection to scientists of different backgrounds. Undergraduate programmes, instead, are focusing on

a limited array of subjects related to the protection and management of cultural heritage, and are basically offering education for the development of a profession, e.g. conservators, or architects. Generally, most undergraduate programmes cannot thoroughly cover the wide spectrum of knowledge needed for the effective development of the professional interdisciplinary profile of scientists dealing with the protection of cultural heritage. This can only be accomplished at a postgraduate level, with the aid of advanced study courses and seminars.

Postgraduate curricula that provide competence for the new multidisciplinary professional profile to serve integrated protection of Cultural Heritage have recently been developed and mainstream their efforts in the international ambience. Architectural restoration, structural repair and recuperation, materials and conservation interventions, environmental management and strategical planning become issues of multidisciplinary scientific planning.

In this framework two characteristic educational tools are presented:

- The postgraduate program "Protection of Monuments"
- The Advanced Study Course "ITECOM – Innovative Technologies and Materials for the Protection of Monuments".

2 The experience from the interdisciplinary postgraduate program "Protection of Monuments", National Technical University of Athens, Greece

At a national level, in Greece, one of the two postgraduate programmes offered in the field of cultural heritage protection is the interdisciplinary postgraduate program *"Protection of Monuments"* offered by the National Technical University of Athens (NTUA), Greece. This postgraduate program (MSE) is offered continually for 10 years at NTUA with the objective to provide advanced education and specialization in the field of the protection of monuments to engineers and other scientists relevant to the field. The program consists of two directions: (a) conservation and restoration of historic buildings and sites, and (b) conservation interventions – techniques and materials.

2.1 General structure

The postgraduate program is organized at NTUA with the *School of architecture* being responsible for the administration of the program and for the first direction. The *School of chemical engineering* is responsible for the second direction. Further educational support is provided by the *School of civil engineering* and the *School of rural and surveying engineering*. The lecturers, in their vast majority, are members of the faculty of the participating schools of NTUA. In addition, selected professors from other Universities of Greece as well as European Universities are invited to give lectures on specific subjects. Specialized lectures are also provided by distinguished scientists from other national or European educational institutions, research and development bodies, and relevant industry.

2.2 Eligibility

Students are selected through an open call and a selection procedure that includes a written test on basic issues for the protection of monuments and an interview. Eligible students are required to have graduated either from: (a) the NTUA or other Technical Universities of Greece, (b) the remaining Universities of Greece with studies focusing on science, (c) from foreign Universities at M.Sc., M.Eng, or equivalent level, (d) archaeologists and art historians. The prerequisite is 4 to 5 years University studies from a broad range of disciplines (engineers, archaeologists etc.).

2.3 Syllabus structure

Courses are offered from early October each year until end of September of the next year. The duration of studies is at a minimum one year and at a maximum of two years. The normal duration of studies is divided into three four-month semesters per academic year. For the

completion of studies, it is required that each graduate student attends and successfully passes examination in nine (9) *courses* that are distributed as follows:

- Three (3) mandatory basic courses (67 hours: October) common to both directions
- Three (3) mandatory courses for each direction (225 hours: November – January)
- Three (3) optional courses (choice of three out of six offered) (51 hours: March – May).

In the case of the second direction "conservation interventions – techniques and materials" it is mandatory for the graduate students to attend a set of *laboratory experiments - demonstrations* and prepare 2-3 laboratory project reports (December – February). The syllabus structure for the direction "conservation interventions – techniques and materials" is shown in Table 1.

For both directions it is mandatory for each student to prepare and successfully pass the examination for a *Graduate Thesis*. The thesis is typically assigned after the completion of at least half of the courses. The *Thesis committee* comprises of five members, mostly professors from NTUA with experience relevant to each thesis. Often external members of the scientific community are included in the thesis committee, such as distinguished scientists from industry and the ministry of culture. The theses are examined during one of the three examination periods available (September, February, June).

2.4 Graduate thesis

For both directions it is mandatory for each student to prepare and successfully pass the examination for a Graduate Thesis. The thesis is typically assigned after the completion of at least half of the courses. The Thesis committee comprises of five members, mostly professors from NTUA with experience relevant to each thesis. Often external members of the scientific community are included in the thesis committee, such as distinguished scientists from industry and the ministry of culture. The theses are examined during one of the three examination periods available (September, February, June).

The deliverables from the students' research dissertation are:

- 35%: Continued as PhD
- 30%: Publications in International Journals and Scientific Books
- 47%: Publications in Greek and International Conferences
- 53%: Research and Applied Projects.

2.5 Characteristics of the program

The main characteristic of the program is its interdisciplinary character. As it is evident in Figure 1, the students of the program, and in particular direction (b), originate from a wide range of disciplines. Regarding the lectures in the program, 66 are from the NTUA, 44 are from other institutions, including European ones, and 8 are educational staff – researchers. The lecturers from NTUA belong to various Schools of the University (Chemical Engineering, Architecture, Civil Engineering, ect.) reflecting the interdisciplinary character of the program

In addition, the program ensures diffusion, application and evaluation of advanced research topics and professional best practices and in particular in advanced diagnostics, non-destructive techniques, strategic planning of conservation interventions, compatibility evaluation of repair/restoration materials, integrated environmental management, knowledge based decision making. This is accomplished through various educational tools, such as lectures, laboratory exercises, fieldwork, and MSE Thesis.

Table 1: Syllabus structure for the direction "conservation interventions – techniques and materials" of the interdisciplinary postgraduate program "Protection of Monuments", NTUA

1.	Mandatory courses common to both directions
1.1	Theoretical and historical approach of restoration
1.2	Introduction to the pathology and restoration of monuments and building materials
1.3	Legislation and management
2.	Mandatory courses for the direction "conservation interventions - techniques and materials"
2.1	Science and engineering of building materials and architectural surfaces
2.2	Science and engineering of conservation-restoration-protection interventions
2.3	Monuments protection – environmental management
3.	Optional courses (choice of three out of six offered)
3.1	Specific topics of materials science and engineering
3.2	Monuments conservation and protection specific techniques
3.3	Pilot applications of conservation interventions in monuments
3.4	Specific topics of planning the environmental management for historic complexes
3.5	Specific techniques and technologies on conservation and preservation of cultural heritage
3.6	Specific topics of techniques and methods for materials characterization
4.	Laboratory experiments - demonstrations
4.1	Techniques and methods for materials characterization and decay diagnosis
4.2	Techniques and methods for cleaning interventions on laboratory and monument scales
4.3	Techniques and methods for consolidation interventions on laboratory and monument scales
4.4	Study of the behaviour of structural materials to humidity transport phenomena
4.5	Characterization and synthesis of compatible restoration mortars – characterization of historic mortars
4.6	Behaviour of structural systems to static and dynamic stresses
4.7	Monuments protection - environmental management

In particular, the program syllabus places particular emphasis on computational and mathematical methods of analysis (GIS, GIS fuzzy logic, finite elements modelling, multicriteria analysis, discriminant analysis), seismic risk assessment and development of fracture curves, instrumental laboratory techniques (mercury intrusion porosimetry, sorption analysis, differential thermal analysis, thermogravimetric analysis, thermal mechanical analysis, dynamic mechanical analysis, fourier transform infrared thermography, ultraviolet-infrared-visible spectrometry) and semi – industrial scale units (aging test chambers, repair mortars testing laboratory).

The above know-how is applied in the field – in situ educational visits. These include the Acropolis of Athens, the Archaeological Site of Eleusis, the Hagia Sophia Basilica in Istanbul, the National Archaeological Museum, the Academy of Athens, the National Library of Greece, the Medieval City of Rhodes, the Osios Loukas Monastery in Fokida, the Unified Archaelogical Sites of Athens and others.

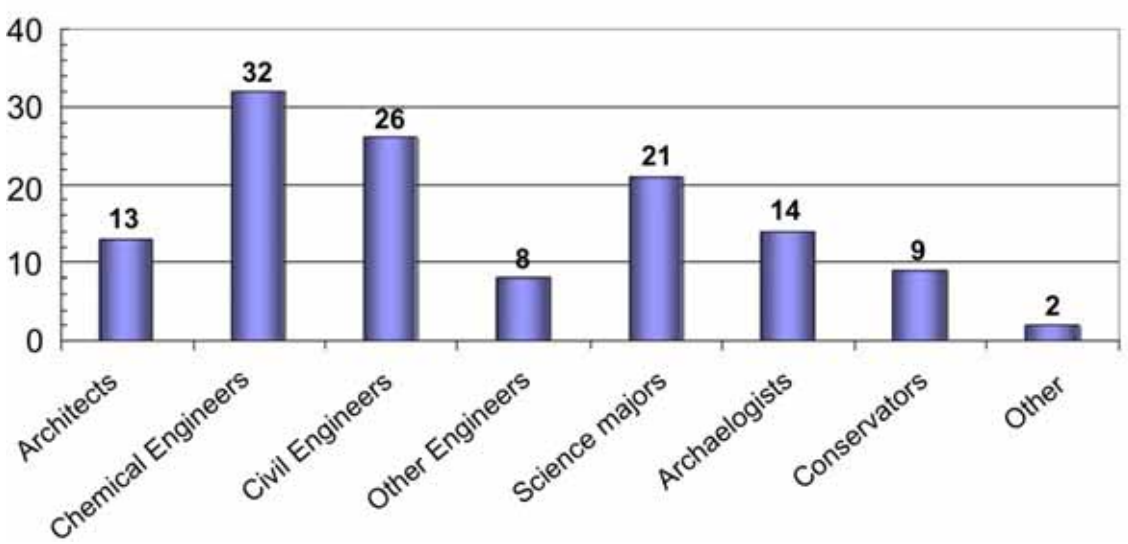

Figure 1: Distribution of students' discipline in the postgraduate course "Protection of Monuments – Direction: conservation interventions – techniques and materials", National Technical University of Athens, Greece

2.6 Evaluation of the program

The program was evaluated by NTUA Faculty, visiting Professors from other institutions and internationally acknowledged experts in the field. According to the internal and external evaluators, the program's recognition and perspectives were attributed to its multidisciplinary character, scientific level, cohesion and longevity.

The evaluation of the program in regard to employment perspectives revealed that 30% were employed at the Ministry of Culture, 40% continued as NTUA Researchers, 10% were employed in the relevant industry and the remainder were employed elsewhere. In general, the students evaluated the program experience as satisfactory.

Concluding, the reasons justifying the development-viability of the MSE program are the advanced knowledge and high level of specialized education offered by the program, its multidisciplinary character, its effective structure (combination of theory with fieldwork and exercises, orientation of MSE Thesis to real problems in the field of Protection of Monuments), the fact that it responds to issues of the scientific community's research needs, the new labor posts-opportunities based on sustainable preservation heritage and new European strategies.

2.7 The experience from the European Advanced Study Course "Innovative technologies and materials for the conservation of monuments"

With the goal of encouraging closer cooperation between education, research and industry, the Advanced Study Course "Innovative Technologies and Materials for the Conservation of Monuments" was successfully held in Athens, 8-20 December, 2003, funded by the European Commission – Research Directorate – General, contract EVK4-CT2002-65002, under the 5th Framework Programme, Energy, Environment and Sustainable Development, City of Tomorrow and Cultural Heritage. The Consortium consisted of partners from Belgium (1), Germany (1), Greece (4), Italy (5), Turkey (1).

2.8 Selection of students

The selection was based on a predefined set of qualifications and criteria, the results from a database-multicriteria analysis application, and the suggestions of the Technical-Scientific Committee members. The required qualifications of the candidates were the following:

- University degree on Conservation, Architecture, Engineering (Chemical, Civil, Survey, Materials, Mineral, Land and Urban Planning, Informatics, Environmental Engineering et al.), Chemistry or any other relevant field
- European nationality
- Age less than 35
- Competence in English language
- Two references, testifying the relevant studies or expertise of the applicant to the conservation of monuments and to the protection of Cultural Heritage.

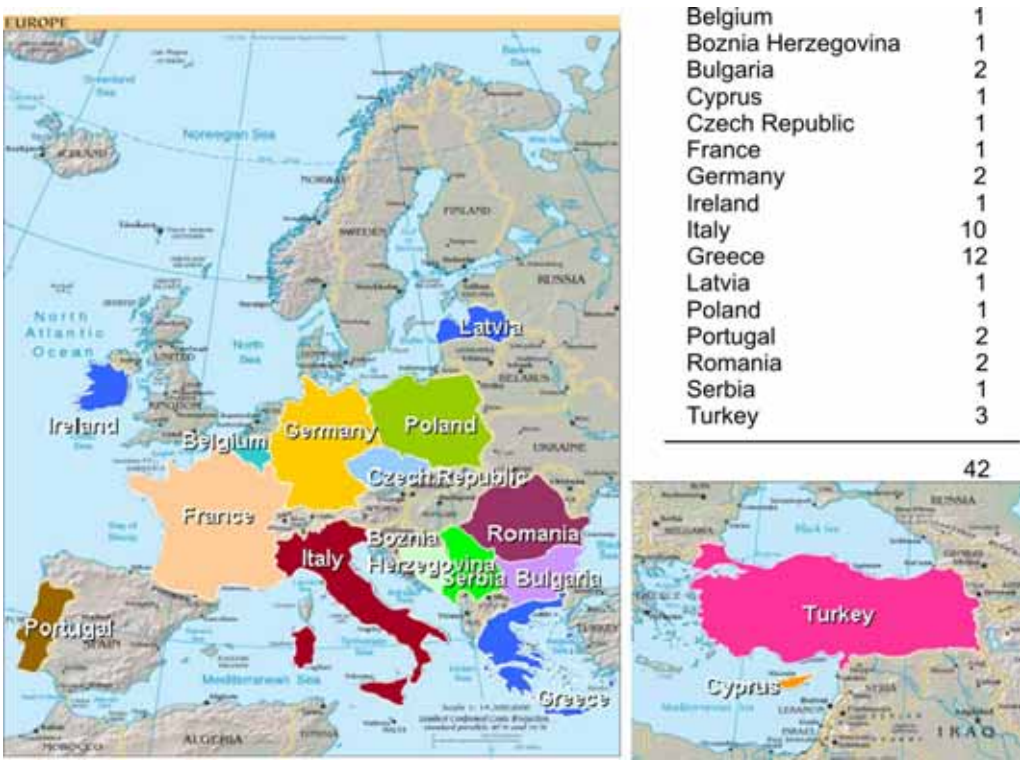

Figure 2: European profile of the ITECOM Advanced Study Course – Distribution of selected students

The criteria for the selection of candidates who complied with the above-mentioned qualifications were the following:

- Overall grade obtained in the degree or diploma
- Grades obtained during the degree or diploma in specific subjects relevant to the Course
- Performance in previous degree or diploma dissertation or other studies of theoretical nature
- Any relevant professional or research activity
- Publications in scientific journals of the relevant field
- General skills as described by the referees.

80 candidates applied for the Course. Based on a multi-criteria analysis, a total grade was obtained for every candidate, taking into consideration the undergraduate and postgraduate studies, the relevant seminars attended, the publications, the professional experience, the

nationality, the good command of English language, the references and other relevant skills or experience. Based on the above-mentioned multi-criteria analysis and after the remarks and proposals of the Selection Committee, 42 students were finally selected and 11 of them obtained a travel grant, due to their financial situation. The total grade obtained by the multi-criteria analysis was taken into account together with other parameters such as nationality (with emphasis to those regions with limited access to such programs) and discipline (in order to enhance the multidisciplinary nature of the course).

2.9 Course structure

The Advanced Study Course was attended by 42 students and lasted 14 days (see final Course timetable, Annex section), consisting of the following teaching modules:

Theoretical lectures	40 hr
Lab demonstrations	12 hr
Scientific field visits	12 hr
Total	64 hr

Conference & Exhibition of technological innovations	2 days

The course structure is shown in the following Table.

Table 2: ITECOM structure and thematic areas

THEMATIC AREA 1: ***Assessment of building materials susceptibility to decay factors - Assessment of damage caused by air pollutants***				
Theory			**Laboratory / Demonstration**	
Lecturer		***Title***	***Team***	***Title***
1.1	A. Moropoulou	*Assessment of building materials' susceptibility to decay factors. Advanced and integrated diagnostic study*	*A. Moropoulou, A. Bakolas, E. Aggelakopoulou, A. Giakoumaki, E. Delegou, M. Karoglou, S. Kouris, P. Moundoulas*	***Lab 1: Instrumental techniques*** *(Mercury Intrusion Porosimetry; Differential Thermal Analysis; Moisture Transport Phenomena: Capillary Rise Coefficient, Isotherm Absorption, Water Vapor Permeability, Total Water Content; Fourier Transform Infrared Spectroscopy)*
1.2	C. Sabbioni	*Assessment of damage caused by air pollution*		
1.3	R. Van Grieken	*Assessment of damage caused by air pollutants*		
1.4	B. Fitzner, K. Heinrichs	*Assessment of stone weathering on monuments*		

THEMATIC AREA 2: ***Non - destructive techniques for in situ assessment and innovative technologies for the protection of monuments***				
Theory			**Laboratory / Demonstration**	
Lecturer		***Title***	***Team***	***Title***
2.1	A. Moropoulou	*Non -destructive techniques: Applications*	*A. Moropoulou, A. Bakolas, E. Aggelakopoulou, E. Delegou, M. Karoglou, S. Kouris, P. Moundoulas*	***Lab 2:*** *Non-destructive techniques (Ultrasounds, Infrared Thermography, Fibre Optics Microscopy, Digital Image Processing)*
2.2	B. Fitzner, K. Heinrichs	*Damage diagnosis on stone monuments - Monument mapping and in situ measurements*		
2.3	D. Rodrigues	*Biocolonisation and biocidal monitoring by means of a portable fluorescence instrument*		
		DRMS: Drilling resistance measurement system - the instrument and some typical examples		
2.4	A. Nappi	*Numerical and experimental methods applied to the conservation of historical monuments*		
2.5	A. Ronchi	*Innovative technologies for the conservation of monuments*		

THEMATIC AREA 3: *Compatible materials - Interventions and innovative conservation strategies*				
Theory			**Laboratory / Demonstration**	
Lecturer		***Title***	***Team***	***Title***
3.1. Basic Issues				
3.1.1	A. Moropoulou	*Assessment of conservation materials and planning of interventions for the protection of monuments*		
3.2. Cleaning				
3.2.1	G. Biscontin	*Techniques and materials for cleaning interventions*		
3.2.2	A. Moropoulou	*Cleaning materials and interventions: Criteria and evaluation methodology*		

THEMATIC AREA 3: (CONTINUED) *Compatible materials - Interventions and innovative conservation strategies*				
Theory			**Laboratory / Demonstration**	
Lecturer		***Title***	***Team***	***Title***
3.3. Rising Damp				
3.3.1	G. Biscontin	*Techniques and materials for treating rising damp*		
3.3.2	A. Moropoulou	*Rising damp: Diagnosis - Treatment*		
3.4. Consolidation				
3.4.1	A. Moropoulou	*Consolidation treatments against salt decay*	*A. Miltiadou-Fezans*	***Lab 3.4:*** *Experimental procedures to control inject ability characteristics and mechanical properties of hydraulic grouts*
		Recommendations for compatible consolidant materials		
3.4.2	A. Miltiadou-Fezans	*Design and application of hydraulic grouts for structural restoration of monuments*		

THEMATIC AREA 3: (CONTINUED) *Compatible materials - Interventions and innovative conservation strategies*				
Theory			**Laboratory / Demonstration**	
Lecturer		***Title***	***Team***	***Title***
3.5. Restoration Mortars				
3.5.1	L. Binda	*The role of mortar joints in the mechanical behavior of masonry structures*		
3.5.2	G. Driussi	*Design, application and assessment of compatible restoration mortars*	***Lab 3.5A:*** *C. Malami*	***Lab 3.5A:*** *Pozzolan testing*
3.5.3	A. Moropoulou	*Reverse engineering for compatible repair mortars*	***Lab 3.5B:*** *E. Chaniotakis*	***Lab 3.5B:*** *Compatible restoration mortars with hydraulic properties*
3.5.4	C. Malami	*Pozzolan: A natural product as binder component of in historical and restoration mortars*		
3.5.5	E. Chaniotakis	*Research for the production of compatible restoration mortars with hydraulic properties*		
3.6. Marketing Issues				
3.6.1	G. Driussi	*Marketing, finance, research aspects in conservation and restoration industry*		

THEMATIC AREA 4: *Techniques and materials for earthquake protection of monuments*				
Theory			**Laboratory / Demonstration**	
Lecturer		***Title***	***Team***	***Title***
4.1	M. Erdik	*Techniques and materials for the earthquake protection of monuments*	*P. Karydis, C. Mouzakis*	***Lab 4:*** *Earthquake Engineering*
4.2	A. Nappi	*Protection of historical monuments against seismic risks*		
4.3	K. Syrmakezis	*Finite element modeling*		
4.4	P. Karydis, C. Mouzakis	*Earthquake engineering*		
4.5	A. Moropoulou	*The role of materials in the earthquake protection of monuments - Crack ability curves an innovative tool for the earthquake protection of monuments*		

THEMATIC AREA 5: *Strategic planning for the protection of cultural heritage*				
Theory			**Laboratory / Demonstration**	
Lecturer		***Title***	***Team***	***Title***
5.1	A. Moropoulou	*Strategic planning for the protection of cultural heritage – GIS management of data*	*A, Moropoulou, E. Delegou*	***Lab 5:*** *GIS management of data*
5.2	E. Maistrou	*Urban planning and management aspects for the safeguarding of cultural heritage. The case of historic cities*		
5.3	S. Kyvelou	*Tourism, urban planning and environmental management aspects concerning cultural heritage*		
5.4	A. Moropoulou	*System for quality control and conservation management of historic buildings*		
5.5	A. Moropoulou	*Directives for keeping Historic Cities alive*		

IN SITU INVESTIGATIONS AND SCIENTIFIC FIELD VISITS IN INTEGRATED PROJECTS		
Coordinator	**Position**	**Scientific Field Visit**
D. Galanis	Director - Technical Director, Unification of Athens Archaeological Sites S.A.	*Unification of the Archaeological Sites of Athens*
T. Tanoulas	Architect responsible for the anastylosis of Propylaia; Acropolis Restoration Service	*Acropolis of Athens*
A. Miltiadou-Fezans	Ministry of Culture, 1st Ephorate of Byzantine Antiquities	*Daphni Monastery*
	Ministry of Culture, 2nd Ephorate of Prehistoric and Classical Antiquities	*Sounion - Sanctuary of Poseidon and Athena*
A. Moropoulou	National Technical University of Athens	*Lavrio Technology & Cultural Park*

Conference: ***Innovative Technologies and Materials for the Protection of Cultural Heritage. Industry, Research, Education: European Acts and Perspectives***
Advanced European research results within the 5th Framework Programme *Research needs according to the construction and materials industry in Europe*

2.10 The ITECOM conference

The dissemination and exploitation of results was accomplished through the realization of the two – days European Conference – Industrial & Research Exhibition of Technological Innovation titled *"Innovative technologies and materials for the protection of cultural heritage. Industry, research, education: European acts and perspectives".* Aim of the Conference was the creation of a platform for the integration of research, industry and education in the field of Cultural Heritage protection. The Conference focused on the European industry, the small and medium enterprises and the construction companies – their products and their needs – for a successful competition in the market.

The topics discussed covered the following thematic areas:

- New fields and new roles for engineers in research and construction field
- Education, research, technology and industry achievements in the field of cultural heritage protection
- Integrated assessment of building materials' susceptibility to decay factors
- Non destructive techniques for in situ damage assessment and quality control of materials and conservation interventions
- Design, application and assessment of compatible restoration materials
- Innovative techniques and materials for conservation materials
- Marketing, finance and research aspects in conservation and restoration industry
- Tourism, urban planning and environmental management aspects concerning Cultural Heritage.

2.11 ITECOM evaluation

The ITECOM Course was evaluated by the Quality Assurance Committee, consisting of the Consortium partners, one external evaluator representing ICCROM, one external evaluator representing ICOMOS and the students. The evaluation results were very positive and were reported to the EC, consisting the proposals for innovation strategies for the protection of Cultural Heritage regarding the applications of the 6th Framework Programme and the proposals for the 7th Framework Programme.

3 Conclusions

As described above, the experience gained at national level through the interdisciplinary postgraduate program "Protection of Monuments" was successfully upgraded to an Advanced Study Course at a European level. Both courses as well as the European priorities indicate the need for the creation of a European Master of Science and Engineering in Materials Techniques and Conservation Interventions for the Protection of Monuments.

The experience from the postgraduate course "Protection of Monuments" and the ITECOM Advanced Study Course emphasize the need to develop an autonomous scientific field on science and engineering of materials and technologies for the protection of cultural heritage with two main thrust areas:

- Restoration and repair of historic buildings and complexes
- Conservation materials and techniques.

The new professional profile in the protection of cultural heritage responds to the following needs:

- Advanced diagnostics and monitoring of deterioration
- Environmental impact assessment and mapping on real scale-real time production
- Selection, application and evaluation of proper, i.e. effective and compatible materials and techniques for conservation interventions.

- Strategic planning of conservation interventions, environmental management for the protection of monuments, complexes and sites, preservation management of monuments, complexes and sites.

This new profile will be supported by the following prerequisites:

- European Directives for Cultural Heritage
- European Chart for professional rights and obligations of scientists and “engineers” in the field of cultural heritage protection
- European network of innovative concepts, strategies, materials & techniques for the protection of cultural heritage.

At a higher level, a European network of innovative concepts, strategies, materials & techniques for the protection of cultural heritage should be developed, consisting of Centres of Excellence linked with industrial partners & stakeholders. Such a Network will ensure the reproduction of knowledge, the development of innovations, the creation of links with industry & stakeholders and the dissemination of know-how. It is evident that education and training will play a crucial role.

Research on cultural heritage – based communication and creation models

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Key words: database, communication, ancient Asia knowledge models, education, creation

Abstract
This paper will present several projects that we have completed during the last few years on the digitization of China's cultural heritage. In so doing, it will describe the interface design and graphics that we have promoted in the re-creation of cultural heritage. It will then discuss the new cultural heritage-based communication and education models that have been inspired by the ideas and arts of ancient Asia. In addition, it will also discuss ways in which to share our knowledge of world culture through the benefits of digital technology. Our goal is to provide a new data-based inter-museum system that can be used in communication and creation models for global background education.

1 The digital museums

Since the late 80's, museums all over the world have made extraordinary progress in the use of digital technology to record, preserve, and present world cultural heritage and museum collections. In recent years, with the support of government and non-government sources in Europe and Japan, a number of large museums have constructed database. It is anticipated that these will be used for such purposes as education, tourism, entertainment, etc. When I worked for a short time at C2RMF in 2003, I was surprised to see the European Open System is now available in thirteen different languages. The web-based project Minerva is a comprehensive platform that provides information about Europe and the EC's plans for expanding its digital cultural heritage.

In China, the digitization of that country's cultural heritage began in the late 1990's with a series of museum archive projects sponsored by the State Administration of Cultural Relics and the Ministry of Education. At present, however, the digitization of China's entire museum system is just beginning. Major related projects from recent years are as follows:

In 2000, four provincial museums in Gansu, Shanxi, Henan, Liaoning were listed as trial projects for "Cultural Relics Research and the Systematic Construction of Database Management" by the State Administration of Cultural Relics. Initially, however, these projects focused primarily on hardware systems and on the setting up of equipment; it was not until later that attention turned to the actual contents being stored. Although some museums have now begun to work on their archive, others are still in the process of constructing their hardware system infrastructure.

In 2001, the Ministry of Education in China initiated a project of "Museum Construction in Universities," part of a program known as the "Revitalizing Program for 21st Century Education. This project sponsored the digitization of 18 museums in tertiary schools such as the

Geological Museum in Beijing Geology University, the Humanitarian Museum in Sichuan University, the Anthropology Museum in Fudan University, and the Archaeology Museum in Shandong University. These museums successfully presented such historical sites as ancient tombs by using virtual reality technology. The Ministry of Education has agreed to increase funding for museum digitization over the next few years and has stated that it wishes to establish a system for resource-sharing among university museums.

The Grottos and Frescos at Dunhuang are a rare and important cultural treasure. There are 492 grottos in all and these hold 45,000 square meters of frescos and approximately 3,000 colored sculptures that date from the Wei and Jin dynasties. This vast repository of art is now a major resource for historical research into the culture of China, mid-Asia, west-Asia and the Indian sub-continent. With the passage of time, however, Dunhuang's frescos and colored sculptures have shown signs of deterioration. Hence, the preservation of Dunhuang's heritage by means of digital technology has become an urgent task. In 1998, the Dunhuang Research Academy, in collaboration with the Mellon Foundation in the US, set about the task of recording and digitizing the Dunhuang grottos. To date, the recording and cataloguing of 22 grottos. The digitization of Dunhuang can be separated into two distinct parts: one is the establishment of a Dunhuang database system using digital technology and on site relics; the other is the collecting and documentation of those Dunhuang artifacts and documents that are scattered all over the world.

In 2002, sponsored by the scientific committee of the City of Beijing, the Beijing University of Aeronautics and Astronautics, Qinghua University, the Beijing Physical Education University, and CAPINFOR jointly initiated a project known as the "Virtual Olympic Museum". As part of this project, two prototypes; the digital recreation of an ancient archery competition in the West Zhou dynasty, as well as the recreation of the five-animal exercises from the Han dynasty have been completed. The aim of this project is display Olympic history, to exhibit artwork relating to the Olympics, and to create a virtual and interactive space, in which people can experience ancient sports and cultures.

In 2005, we began a network-based project supported by the Chinese Ministry of Education; this is now known as the China Cultural Heritage Network (CCHN). CCHN is an international platform, and its goal is to provide and exchange information about Chinese culture and other cultures around the world and to share knowledge of world culture and the benefits of media technology. At the same time, CCHN is also a platform for the promotion of China's cultural heritage in a variety of interactive media formats. It explains how to transform cultural heritage into a visual language and to develop a new creative approach to the education of children.

2 Database & communication

The second purpose of the museum archive is to apply digitized resources. So far, the database in most museums is used chiefly for information retrieval, management, museum organization, education, etc. The ways adopted are basically unilateral and fixed. The problem to be addressed in heritage communication, education and entertainment remains as follows: how can the museum's data can be brought into play at the global level and be used for communication and educational proposes?

The museum information system supported by computer and network technology is presented in a variety of forms such as simple images, 2D, 3D and moves. At present, most museum information systems are independent and dispersed. Like the physical museums themselves, a museum's digital resources have their own space. Indeed, it could be said that invisible walls now divide most digital museums.

Since old copyright policies, access systems, and security technology do not address digital databases such as movies, copyrights are now becoming a major problem in the sharing of databases and resources. As a result, while some museums have made the choice to open their digital doors completely to the public, others have decided to close them. Nonetheless, there are some positive examples in Europe, like Gallery Uffizi in Italy, which has divided its database according to pixels to accommodate a variety of needs. To make the world's heritage-sharing possible, a multimedia database and information management system must first be developed.

At the present time, WWW-based platform has made it possible to integrate museum resources beyond the limits of the physical environment. The interconnection of digital museums in different countries and areas can transform a small museum into a large one and a unilateral museum into a multilateral one. Given this capability, a multilateral museum could freely combine and exchange any cultural heritage information located in a variety of museum archives. A multilateral or interconnected museum can also exchange data and help to construct a distributed museum in the future, thereby overcoming physical obstacles and virtual separation and making it possible to share humanity's historic heritage and arts.

In the course of our research on database communication and creative educational models, we have found that a common ground exists between today's network-based databases and the prevailing philosophy of ancient Asia, namely the idea that all things in the world are integrated and connected to each other. Our research has led us to ancient oriental art patterns that reflect this idea, patterns like *Indra's Net* in India and the multiple viewpoints of early Japanese space constructions known as *Rakutyuurakugai*, as well as the famous *Mandalas* of Tibet. Indeed, we have come to regard these reflections of ancient knowledge patterns as an underlying framework for the construction of a virtual heritage information space characterized by dispersal, interactive communication, and sharing. As previously stated, the construction of such a virtual space is now possible and can be realized by means of internet and communication technologies.

3 The historical models of knowledge mining

There was a time in the early 1970's when the "new science" reached a point at which it began to close the gap between Western technology and Eastern ideology. Physicists found that the universe was not, as had been previously believed, a mechanical construction with fundamental building blocks. Instead, it seemed to be made up of networks and interrelationships. There were no separate parts to be found in all the vast array of interconnected webs. This brought Western thought much closer to that of the East.

The beginnings of the ensuing dialogue among physicists, biologists, physiologists, and artists can be traced back to the 1960's. It was at that time that Dr. Suzuki first translated his *Zen Buddhism* into English, and the appearance of that Zen philosophy strongly influenced the Western world. Physicists began to apply modern physics and systems theories to Buddhism and Taoism. Artists like John Cage created a *music of silence* based on the teachings of Zen, and the very popular work by Fritjof Capra, *The Tao of Physics,* appeared. This book explored existing parallels between modern physics and Eastern mysticism.

One of the first pioneers in this Western technology and Eastern dialogue was Stanford neurosurgeon Karl Pribram, the author of "The Languages of the Brain". Pribram's studies in brain memory and function led him to the conclusion that the brain operates, in many ways, like a hologram. He accumulated convincing evidence that the brain's "deep structure" was essentially holographic. Pribram participated in this research with Karl Lashley and then began to perform experiments to see whether or not memory was stored in any one part of the brain or distributed throughout it. Benefiting from developing technologies, Pribram was able to confirm

the traditional theory that "higher centers" of the brain controlled the lower ones. He found, however, that the existing theory was in need of modification.

At about the same time, English physicist David Bohm, who had worked with Einstein, suggested that the organization of the universe itself might be holographic. According to Bohm, beneath the explicate realm of separate things and events lay an implicate realm of undivided wholeness, which was simultaneously available to each explicate part. In other words, the physical universe itself functioned like a gigantic hologram; each part of which contained the whole.

We can also find this same idea of networked knowledge models in Tibetan Mandalas and similar examples exist in the traditional garden designs of China, India and Japan. In Sanskrit, the word "Mandala" means a circle or a polygon. It is often conceived as a place with four gates, each of which faces in one of the four directions. As a symbolic representation of the universe, it is most commonly associated with Indian tantra, the Vajrayana school of Buddhism in Tibet, and Shingon in Japan. Mandala is a perfect example of the way in which a single aspect of life can represent all of life itself. In that sense, a Mandala can be said to be an undivided holographic picture.

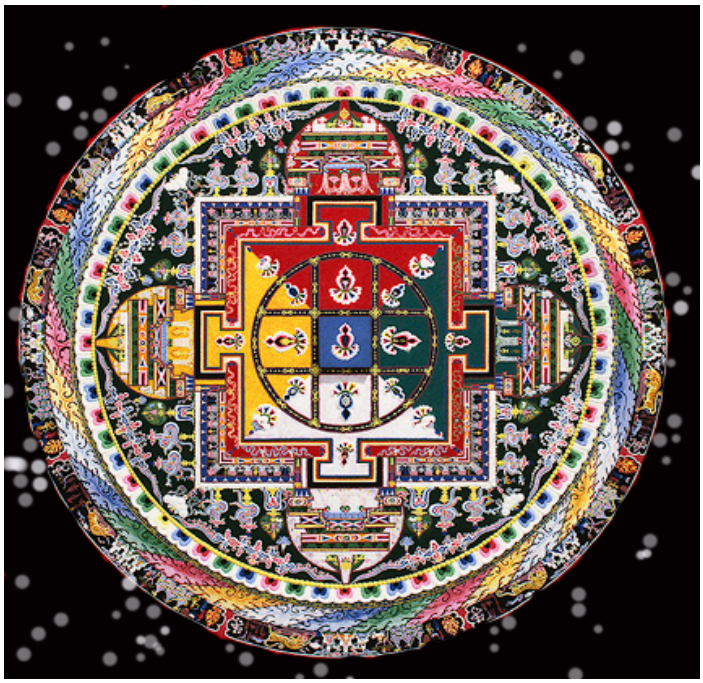


Figure 1: The image of Mandala

A most extraordinary ancient description of a network of interconnections is found in certain Indian Buddhist sutras. As Fritjof Capra explains in his *Tao of Physics,* "...particles are dynamically composed of one another in a self-consistent way, and in that sense can be said to 'contain' one another. In Mahayana Buddhism, a very similar notion is applied to the whole universe. This cosmic network of interpenetrating things is illustrated in the Buddhist Sutra by the metaphor of Indra's net".

The image of Indra's net is similar to concepts found in the "bootstrap philosophy" of Geoffrey Chew, a professor of physics at the University of California. As Fritjof Capra describes it in his *The Tao of Physics.*

"In the new paradigm, the relationship between the part and the whole is more symmetrical. We believe that while the properties of the parts certainly contribute to our understanding of the whole, at the same time the properties of the parts can only be fully understood through the dynamics of the whole."

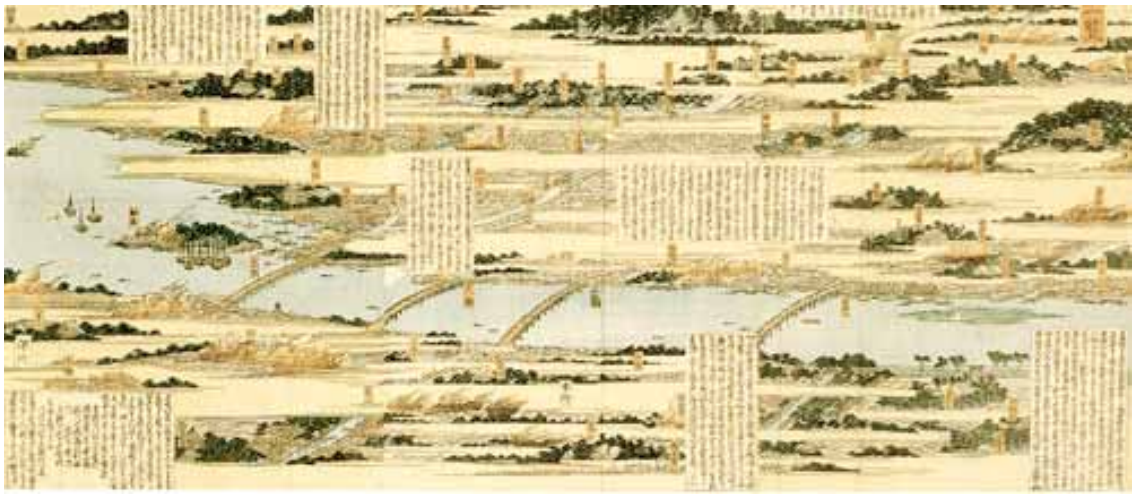


Figure 2: The Painting of Rakutyuurakugai

A style of painting known as *Rakutyuurakugai* that we often associate with the "cubism"of the 1890's in the West appeared in the Late Momoyama and early Edo Periods in Japan. Typically, it was used to decorate screens with scenes from the capital. These pictures portrayed the life of the common people and in the streets and shops of Edo. The way these scenes were portrayed was indeed uncommon before the invention of airplanes and aerial photography or even the experience of living in high buildings. It is beyond dispute that the pictures imply an excellent command of the city's geography and the artist's own interpretation thereof. Unlike the use of perspective in the West, the artists of the Edo Period integrated information about the city in plan form by means of full-orientation construction.

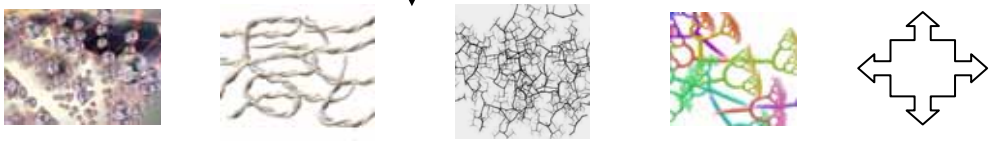
The ancient Asian ideas art mentioned above all demonstrate the same concept, namely that was the world is a undivided space, and all knowledge therein is interconnected and associated with all its multifarious parts. This is and will be the ideal model for today's inter-museum information system.

4 A new database – based communication paradigm

I would now like to give some examples and discuss the new database-based communication models we have designed. Let us first take a look those models that focus on character-search engines, such as google, yahoo and/or museum information systems. If, for example; we enter the key word "Francisco Goya", we will get innumerable results that contain the word "Francisco Goya", but there will be little if any relationship between the items listed, whether it be date, life story, or works of art. To find relevant relationships takes a lot of search time and perhaps two or three returns to the original results. What's more, in the course of searching, one of the items found may even take us to a website that has nothing to do with "Francisco Goya", deviating entirely from the original search. By contrast, the new models that we have designed as follows:

Users can use a PC, a PDA, or a mobile phone, etc as tools to make a connection with the Inter-Museum System; Users will also need to select their own models before start the research.

The Inter-Museum Information System



An Inter-Museum Model; 1-A Time and Space Combination Model; 2- bootstrap; 3-A Free Association Model; 4-A Tree Model; 5-A Multi-View Point Model

The Purposes: Education; Research; Entertainment; Arts Creation; Tourism; Presentation

Through keyword retrieving / searching, users can, by choosing any one of the above patterns, get the data they require from the museum database and freely combine it in virtual space in accordance with such different categories as "history", "biography", "aesthetics", and "works",and then they can construct a new virtual knowledge space that centers around vision. For example, if we choose the "Time and Space Combination Model," – which is also called Indra's net – for the term "Francisco Goya" the following results will appear:

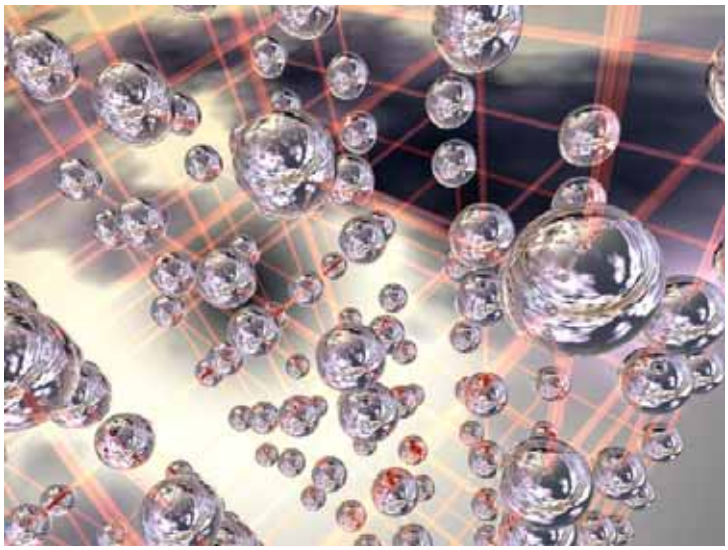


Figure 3: The term of "Francisco Goya" in the Time and Space Combination Model

Figure 3 shows how all the results for “Francisco Goya” in the database appear in the form of a net in virtual space; each result contains a link to another and shows its associations and connections in the word’s knowledge bank.

Meanwhile, an interactive heritage communication can transfer museum data (used mainly to save and retrieve) into an active space for spreading knowledge and creating art. In virtual space, students, according to their own needs, can choose the corresponding knowledge construction pattern to construct their own space from a variety of museum data information systems. They can then reconstruct the database resources in time and space by means of transfiguring, copying and interpreting the original heritage resources by means of their own creative activity.

Figures 4, 5: The image of Kabuki, before and after

The Center for Media Esthetics in Koyto Zoukei University is a place in which people are now working on database creation activities. By accessing Koyto’s network-based database, which includes ancient paintings, architecture, and handcrafts, students can freely copy and download the images and, if they wish, combine new images with old ones to make original works of art. By means of the process of copying and digitizing, they can derive the different values of ancient Koyto. Without digital technology, this would not be possible. For example, one can enlarge an ancient silk fabric, combine new information with the old pattern and create a new work of art. Figure 4 and 5 shows how to digitize an original Kabuki drawing and make it to a new image by means of the digital image system, correcting the colors and clearing up the lines in the picture. In the connected museum system, the world is an open space in which traditional cultural can be transformed into a myriad of hybrid formats.

5 Conclusion

Digital technology that is centered around a network provides us with reliable human knowledge, while oriental ideas – i.e. those of space construction in the traditional arts – offer us rich patterns from our cultural heritage that we can acquire, apply, and integrate. Whatever in ancient and in modern times, East or West, has been regarded as a culture’s soul and identifies humanity’s upward movement toward civilization can be sought out and used. In all digitization centered around Western technology with the introduction of oriental ideologies, the most important goal is the integration and activation of human knowledge. This is the best way to integrate the technology of the West and the ancient wisdom of the East, the union of which can play an important role in the creative education of young people who will share an international perspective and a global cultural background.

As Vannevar Bush, the inventor of the network, said in 1954 in his paper “As we may think”, “The human mind does not work that way. It operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain. It has other characteristics, of course; trails that are not frequently followed are prone to fade; items are not fully permanent; memory is transitory. Yet the speed of action, the intricacy of trails, the detail of mental

pictures, is awe-inspiring beyond all else in nature." From this point of view, the Inter-Museum Information System is nothing less than the dream of the internet world.

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Training and research at the foundation Centro "La Venaria Reale"

O. Chiantore and M. Filippi

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In the surroundings of the town of Torino (Italy) a new institution devoted to training of conservators and to development of conservation research programmes has been recently established and is now operating. The Center for Conservation and Restoration of Cultural Heritage *La Venaria Reale* has been organized as a Foundation with participation of the national and the regional governments, of the University, and of local bank foundations. The conservation laboratories, together with the connected scientific department, the library and technical services, is located in the outstanding historical set constituted by the former Stables and Riding School of the 18th century Royal Grounds *La Venaria Reale*, which is part of the largest restoration project of historical buildings in Europe so far realized.

The ancient buildings have been recently restored and equipped with modern facilities, resulting in a 8000 square meters complex containing 8 conservation laboratories, 5 scientific sections, library, archive and workshops, together with 15 classrooms, one great hall and study rooms and offices for the staff.

The safeguard of cultural heritage is the Center's mission, which will be realized through:

- the coordinated and planned monitoring, prevention, maintenance and restoration of artistic manufacts;
- the analytical support to the conservation activity of the scientific department, and the research projects herein developed;
- the "School for Advanced Studies" where the University of Torino will establish a graduate curriculum in Conservation and Restoration of Cultural Heritage, in the framework of the European credit systems and according to the quality standards of the Italian conservation school, internationally recognized;
- the systematic documentation of every conservation activity, with dissemination of results and open discussion of methods employed;
- the organization of training courses, workshops and meetings for professionals involved in conservation activities;
- the promotion and realization of studies and research projects, also in cooperation with the University and the Politecnico of Torino, on artists' materials and techniques and on conservation methods and technologies;
- the promotion and support of small enterprises involved with conservation activities, on technical innovation or technology transfer in the field;
- the participation in international heritage research and conservation programmes.

Laser multitask non-destructive system for conservation diagnostic procedures

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[1] FORTH/IESL (Foundation for Research and Technology – Hellas/Institute of Electronic Structure and Laser, Heraklion, Crete, Greece), [2] BIAS, [3] UNIVPM, [4] NILPRP, [5] Envirocoustics S.A., [6] Art Innovation b.v, [7] LRMH, [8] Malta Ministry of Environment, [9] ProOptica

1 Introduction

Laser metrology provides complementary capabilities to Cultural Heritage field to encounter a great variety of diagnostic problems. Those ranging from periodic assessment of movable museum objects to routine evaluation of immovable wall-paintings, statues and wood carvings to preventive deterioration strategies of monumental constructions and outdoor cultural heritage sites are explored to be met by a user-friendly transportable instrument equipped with a standardised diagnostic procedure. Diverse Optical Coherent Techniques (OCT) uniquely suited to adaptation for each of the mentioned diagnostic problem categories allowing alternate use of advantages and similar procedures to generate informative signals with essential diagnostic complementarity have been suggested and adjustably developed during the EC project LaserACT.

In particular, the critical invisible defects of structure and distinct mechanical condition of the inspected cultural item are obtained in the visual form of distorted output signal/s interrupting the ordered input one. The objective of direct visual information is to serve to a restorer as an immediate qualitative tool for prioritising the restoration strategy. Costly, ambiguous and time-consuming manual investigation or full scaffolding installations may be replaced by remote non-contact and non-destructive standardised optical inspection which can be periodically or routinely repeated in later times.

The aim of the presented research project is based equally on the development of instrumentation allowing complementary operation of inspection capabilities as well as on the development of integrated diagnostic methodology. The aim to classify the variety of conservation problems of movable and immovable cultural heritage in one main database which drive a multifunctional user-friendly interactive device has achieved the critical feasibility proof and further explorative plans are foreseen by the consortium committee.

1.1 Partner contribution

The consortium is based on the close collaboration of complementary know-how ranging from optical coherent metrology techniques to laser design, optomechanical and software construction to art conservation stake holders. Each partner profile describes a specific and non-overlapping role in the task distribution described in the project workpackages. In table I the project partnership is presented indicating the complementary expertise and potential interaction necessary for the accomplishment of multitask system integration which forms the final output of the project.

Table 1: Laseract project partnership

1. CO. Institute Electronic Structure and Laser / Foundation for Research and Technology – Hellas, (GR), Heraklion – Crete, Greece, REC
2. CR Bremen Institute of Applied Beam Technology / Optical Metrology, BIAS (D) Klagenfurter Strasse, 228359 Bremen, Germany, REC
3. CR Universita Politechnica Delle Marche / Department of Mechanical Engineering UNIVPM (I), Via Brecce Bianche, 60131 Ancona Italy, REC
4. CR National Institute for Laser Plasma and Radiation Physics / Solid-State Laser Laboratory, NILPRP(RO), Atomistilor 111, 76900 Bucharest-Magurele Romania, REC
5. CR Envirocoustics, S.AEnvirocoustics (GR), EL. Venizelou 7 & Delfon ,4452 Athens, Greece, IND/OTH
6. CR Art Innovation b.v (NL), Westermaatsweg BW Hengelo, Netherlands, IND
7. CR Laboratoire de Recherche des Monuments Historique, LRMH (FR), 29 rue de Paris, F-77420 Champs sur Marne, France, OTH
8. CR Ministry of Resources and Infrastructure / Works Division-Restoration Unit, EM/WD (MT), CMR02 Floriana, Malta, OTH
9. CR Societatea Comerciala PRO OPTICA S.A / Research and Development Department, ProOptica (RO), Aleea Gh. Petrascu, Bucharest Romania, IND

CO: coordinator, CR: contractor, REC: Research center, IND: Industry/SME, OTH: Enduser

The above partnership was divided in three main groups:

- Partners 1-3: Laser metrology group: to perform the investigation on functional module for complementary software / hardware (SW/HW) integration.
- Partners 4, 6, 9: SW/HW construction group: to develop the optics, laser, hardware and software components.
- Partners 5, 7, 8: End users group: industry and conservation institutes to provide artwork classification, reference samples, study cases and assess the use of laser technology for art conservation structural diagnosis.

2 Project implementation

The investigation on functional module followed the ethical criteria set by the end users of the consortium. Primal requirements for the optimum features of the functional inspection were to be non destructive, non contacting, non invasive, not requiring sample removal. The choice of laser-based non destructive technology obeying the principles of interferometry is implemented and the relevant optical techniques used satisfy the above criteria [1-5]. The operational inspection methodology records the artwork of interest during an equilibrium process induced by acoustical or thermal excess of energy deposit. The frequency response used for vibration measurements and the optical phase change for interference fringe generation resolve the artwork responses in high accuracy and resolution. In either case the procedure assumes presence of hidden structural discontinuities. As the second set of criteria the performance according to selected complex diagnostic problems put by the end-users was dependent on the variety of problem-solving capabilities. These exemplary proof-of-feasibility results are mostly of interest in this publication.

2.1 Routine inspection of movable museum objects

Sets of samples simulating representative construction methods and materials of museum objects were constructed by the end-users of the consortium and were distributed to the developers of the investigation. The fabrication has been completed by specialists with representative defects of detachment in various cases of typology, according to that can be

found in the actual cases. Detailed reports about the fabrication were provided and characteristic examples are shown.

Veneered woods – description and fabrication

From the appearance of these pieces of furniture in the early 17th century with ebony cabinets, veneers were saw lumbered, and this until the middle of the 19th century approximately. As time passed, veneers were thinner and thinner and sawing more and more precise. During the industrial age, machines were fitted to lumber veneer sheets with a thickness of six tenth of a millimetre. (Nicolas Boucher, furniture restorer). For that, logs were left in a steaming pit during several weeks. Hence, there are strong differences in the veneer structures themselves (regarding porosity, flexibility), and their hygroscopic property may vary. Thus, the cabinetmaker must "balance" the support when manufacturing furniture with sliced veneer; which means that he must stick veneers with the same thickness on recto and verso (fig. 1). An unbalanced sliced veneer will tend to deform the support when drying because its crawling is much quicker and spectacular.

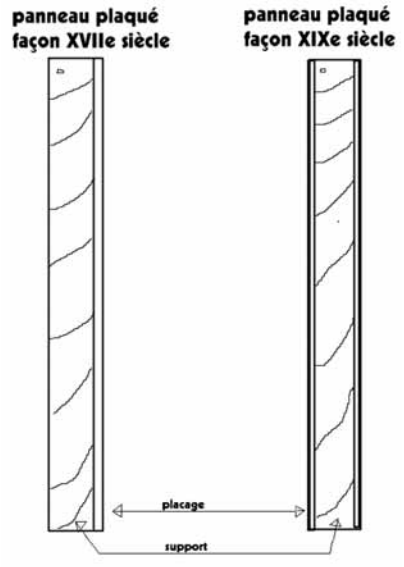


Figure 1: Veneer construction for sample preparation

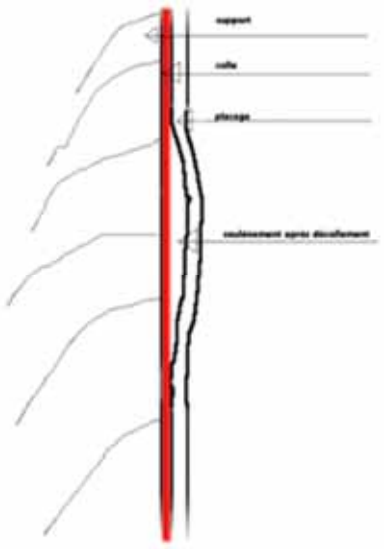


Figure 2: Typical delamination of veneer

Wood variation and defects

Furniture makers soon realized that wood could expand and crawl according to the relative dampness of its environment. They invented matching methods that respected the wood variations; they didn't use glue. On the contrary, veneering techniques tend to subject this unstable material. The problems faced by the cabinetmakers, apart from natural predators (insects, fungus, restorers), are often related to gluing. The adhesive used is of animal origin; it dries out with time and loses its adherence power. Sliced veneers often lift after delaminating; this lift can be called "bubble" (in French, "cloche", that means "bell" because of the shape of the profile) due to the significant noise it makes when tapping on it with the finger. (Fig. 2). However, sawed veneers lift quite less often after delamination, due to their higher thickness, but, overall, because they are not steamed, which make "bubble" impossible to detect sometimes.

Protocol programme
After these comments, two kinds of parameters stand out:

I : constitution parameters:
1) a support, a sawed faced veneer
2) identical with "brass cutting-off"
3) identical with composites (18th century marquetry)
4) a support, a sliced faced veneer and another one to balance.

II : evolution parameters:
1) without defects
2) lifts (bell)
3) xylophages' attacks (Coelostethus pertinax).

For sample making, in order to stick to the techniques of these periods, the glue used will be MC2 (animal glue made of oxen bones and nerves). The contact surfaces will toothing planed, except sliced veneers. Tests have shown, with removing veneering, that the sound given by knocking with finger is the same on the film or on the glue; that means the film can correctly represent the defect of detachment, since when sounding, it seems as if the veneering was stuck on the support. In this examplary constructions, various types of veneer and detachment were made. It must be noted that the fabrication of these type of samples is somewhat long, because it needs a very meticulous work, as if it was an actual furniture fabrication, some of them in 18th century style, in order to get very representative samples of actual artefacts. The realisation of defects showed some problems that have taken some time to be resolved, as explained above.

Investigation results
Characteristic examples of the resulted inspection follow in figure 3, is shown the topography of the defect and an interferometric result visualising the exact topography given. All samples provided were successfully investigated and the relevant defects detected.

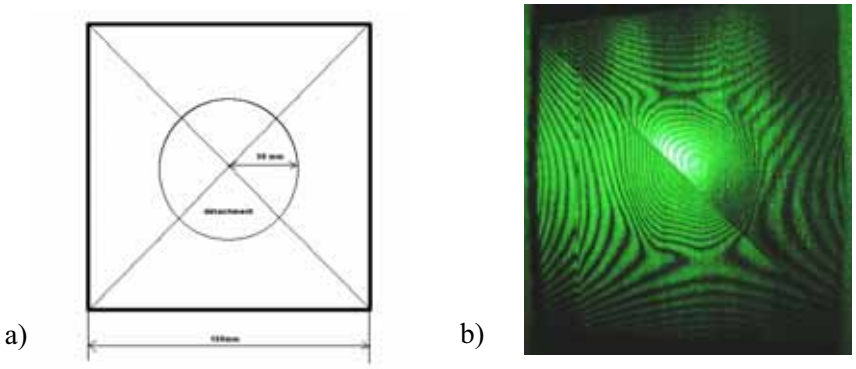


Figure 3: In a) Topography of the defect and in b) defect 500 mm deep successfully detected

2.2 Routine inspection of immovable wall paintings
Wall-paintings represent another broad category of interesting application.

Wall painting samples – description and fabrication
That concerns a set of samples built from the most common typologies of painted layers detachment in wall painting. The selected reference technique is that of so called *buon fresco*, for it's the most encountered as classical conception. Most of wall paintings are technically close to *fresco* regarding the way of recovering wall surfaces. Baked brick as been chosen as sample support material, same as that used in traditional way for soil coating. It's lighter than

stone and should give wished conditions as compact and resistant material. Sizes of support are 19.7 × 19.7 × 1.5 cm (industrial fabrication size). Mortars are made by one *arriccio* and one *intonaco*, applied by traditional way, that means *arriccio* is made of lime mixed with cleaned and sifted sand with average size of 1-2 mm, and with a maximum thickness of 1 cm (ratio lime/sand: 1/3) and an *intonaco* also made of lime mixed with smallest size sand (ratio 1/2.5) and 0.5 cm thick. This *intonaco* will be painted a *fresco* with background and geometrical motives. Pigments are chosen from panels of natural earth. Final thickness of support together with the two layers is about 3 cm maximum (fig. 4).

Edges of each sample are protected by a mobile frame in order to protect it during the transport and handling in laboratory. This frame can be removed while making tests.

Each set of samples includes 4 items:

0) check sample without any alteration

1) sample with detachment between *arriccio* and support

2) sample with detachment between *intonaco* and arricio

3) sample with partially recovering detachments

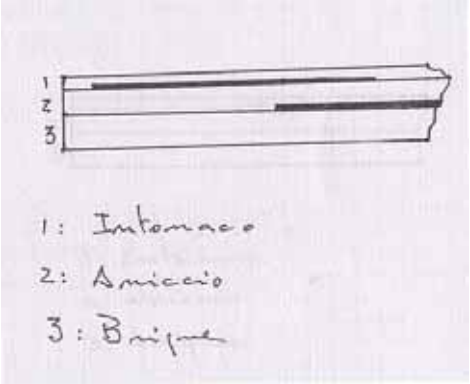


Figure 4: Defected sample schematic

Detachments are made by applying a circle of organic material that should be soluble in water, size 8-10 cm. Contact of this material with water will cause its almost complete disappearing. Remaining part is small enough and cannot perturb observations, as few amount of dust generally found in actual detachment. The whole process is documented by drawing and photos, in order to deliver a copy for each participant laboratory.

Fabrication of samples

Impregnation of brick-support with water in order to make easier the adhesion of the 1st layer of mortar (arricio). After applying that 1st layer is covered by a plastic film in order to avoid too quick drying that might cause retraction and cracking. As usual in buon *fresco*, just at the beginning of carbonatation of this layer, the next layer (*intonaco*) is applied and painted.

The whole process is realised in very moist environment, with often humidifying surfaces so that avoiding cracking. That is obtained by spraying water and covering the sample by a film of plastic as far as it completely dries. Various detachments be planed between support and layers.

The samples are very fragile, for little sizes (under 20 cm) give very friable-edge surfaces, then the edges have been lightly consolidated with Paraloïd B-72 at 5% in toluene and sections with PVA at 50% in water.

Investigation results
All samples provided were successfully investigated and the relevant defects detected.

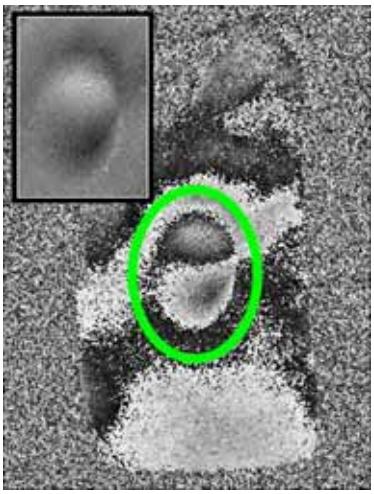
a)  b) 

Figure 5: In a) Fresco with inclusions and b) Inclusion in Intonaco layer detected

2.3 Statues and monuments
The sculpture shown in fig. 6a is made from sandstone. It has a rough, opaque surface with crust on it. The layer of crust has a thickness of approx. 1 *mm* covering several voids / delaminations.

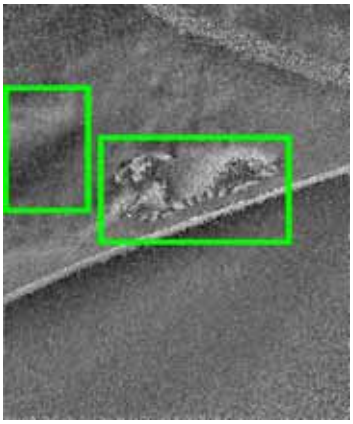
a)  b) 

Figure 6: In a) Sandstone sculpture, b) delaminations detected

2.4 Maltese stone: quality differentiation
The layer of Globigerina limestone, locally referred to as *tal- Franka,* found immediately below the Blue Clay strata, has, for thousands of years been considered as the ideal building material for the Maltese Islands. Much harder than Blue Clay, but softer than the Upper Coralline Limestone, the Globigerina limestone can be easily quarried and shaped into virtually any form. Although this stone can be quarried from practically the whole of the Southern part of Malta, the quality of the limestone obtained varies significantly from one area to another. Due to its importance, Globigerina limestone has been categorised by the local building industry into three main classes; First quality, Second quality, and *soll.*

Most of the physical problems found on stone building can be classified as:

1. Flaking	2. Cracking	3. Voids	4. Detachment	5. Crusts	6. Missing parts

Many of these pathologies especially flaking and detachment are directly related to the quality of the stone, explaining the importance of differentiating between *good* quality limestone and "*soll*".

Investigation results
For the Maltese stone samples were extracted the characteristics linked to their vibrations after excitation that could be suitably used to distinguish among different quality types, characteristic results are shown in figure 7.

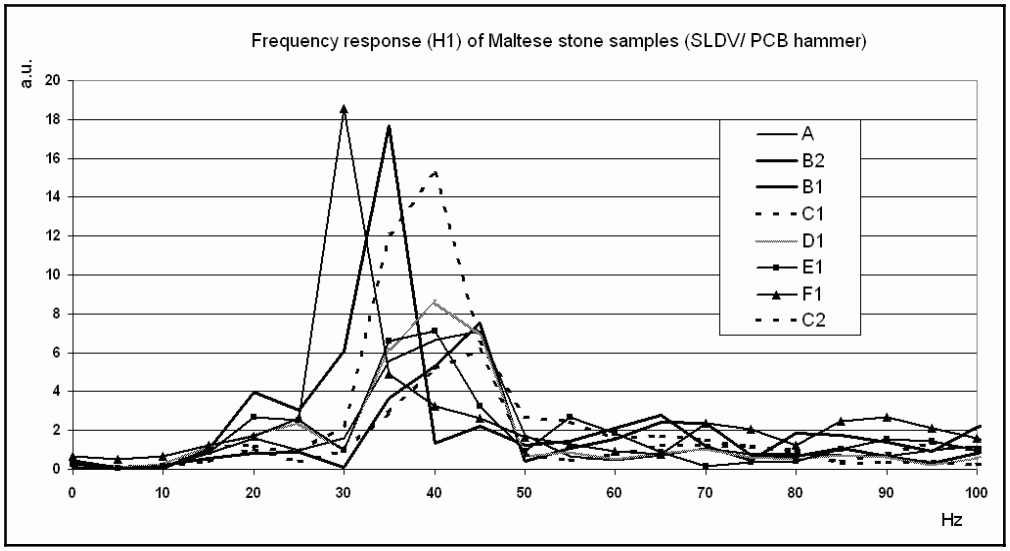


Figure 7: Frequency response of Maltese stone samples (numbers identify impacting points on the sample)

The "*Good*" stones showed a higher value of pulse propagating velocity (around 3600 m/s), with the 'Bad' positioned at about 2600 m/s, table II, and the results confirmed with other sources in literature.

Table 2: Pulse propagation velocity in Maltese stone

Sample	Stone quality (as indicated by the producer)	Observations	Velocity (P waves, m/s)	Average vel. value
A	Good	Arrived broken	2289	3618
B	Good		3636	
C	Good		3600	
D	Bad		2286	2671
E	Bad		3057	
F	50%		2500	2500

2.5 Maltese fortification: onfield application

The developed transportable device was carried to Malta for on field feasibility investigation on Valletta fortifications, in front of the fortification walls and some examples shown in figure 8.

Defect detection achieved from representative aged regions dating from 50-400 years old constructions. By development of a uniquely suited methodology age differentiation seems

matter of system calibration. The investigation approaches used were based on structural features differentiation under acoustical or thermal load. Therefore the scale of resolution of the surface displacement is of the order of few microns. Even if the surface displacement may seem minute the revealed deformation of the structural feature is evident in either cases.

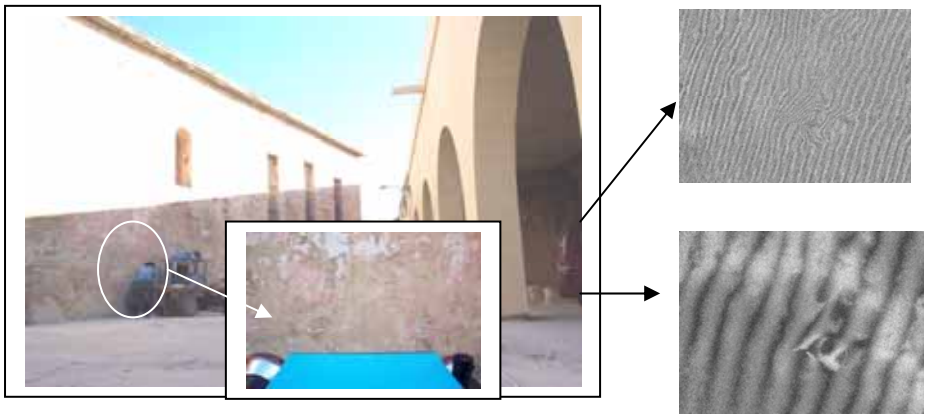


Figure 8: On-field application in Valletta. Defects revealed in aged and new stones

3 Conclusions

The development of integrated optical laser-based non-destructive technology for application on critical aspects of conservation diagnostic interest is proven to be feasible and of remarkable range. By suitable development in operational and diagnostic methodology a complementary logic for advantageous properties provided by relevant ND laser techniques can be chosen and adjusted to the most complex conservation problems. Further exploration in standardised artwork type of specific construction or according to case studies of interest as was provided by the Maltese stone quality and age differentiation can be performed at will.

4 Acknowledgement

The EC funded project LaserACT EVK4-CT-2002-00096 is acknowledged for the implementation of the research as well as all the affiliated institutes involved in the project partnership for the fruitful collaboration during the project realisation.

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European Network for Conservation-Restoration Education – ENCoRE: the role of education in the implementation of European cultural heritage research

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Key words: ENCoRE, conservation-restoration, education, cultural heritage, implementation, EC Framework research

1 Introduction

ENCoRE is a network organisation of higher educational institutions in the field of conservation-restoration. A main objective of ENCoRE is to promote research and education in the field of conservation and restoration of cultural heritage [1, 2]. Currently ENCoRE has 34 members from among the leading conservation-restoration study programmes in Europe. In addition 24 leading institutions and organisations working in the field of cultural heritage protection and research are partners of the network. ENCoRE supports contacts and the exchange of information and ideas between its members and partners and other interested institutions to improve co-operation within Europe. This includes initiatives in connection with the implementation of the Bologna system for higher education institutions in Europe, the definition and recognition of the conservator-restorer's profile in Europe, PhD networking and the mobility of students and teachers. As an academic discipline conservation-restoration is by definition based on the highest level of research. However, in order to obtain sufficient critical mass for high level research and to achieve research-based education within a small discipline like conservation-restoration, resources are required that can only be made available through continued European co-operation supported by external funding. Till now the EC Framework Programmes and other initiatives of the Community within cultural heritage have been the major sources for international research and development in this area. A survey among members and partners of ENCoRE shows that this and other networks are active platforms for the dissemination of the results of the European joint research. However, there are good possibilities for developing dissemination activities e.g. through wider co-operation with other research networks and greater involvement of the ENCoRE members as partners in the European Framework research projects.

2 Collaboration activities of ENCoRE

Since the establishment of ENCoRE, board members as well as representatives of its member institutions have been involved in many activities. They include the FULCO project resulting in "The Document of Vienna", the CON.B.E.FOR. project (Conservators-Restorers of Cultural Heritage in Europe: Education Centers and Institutes. A Comparative Research), the APEL project (Acteurs du Patrimoine Européen et Législation), the CURRIC project on developing a postgraduate curricula for conservation scientists and its present continuation, and European PhD in Science for Conservation, EPISCON. All these projects have obtained financial support from the European Commission Framework Programmes. Moreover, ENCoRE has been actively involved in the discussion of the development of the conservation-restoration education in several countries through its representations in national and European conferences and peer reviews of educational institutions. Since 2002 the E.C.C.O. working group of Education,

Qualification and Practice has been in close contact with ENCoRE, building on previous collaboration on the CON.B.E.FOR project [3]. The aims of this collaboration are to set up goals, strategies and recommendations for the development of a European conservation-restoration education programme as well as for the recognition and protection of the profession of conservators-restorers in order to meet the needs for the highest possible quality in the protection of cultural heritage [4, 5].

3 The need for research based education and applied practise in the field

Over the past decades it has become increasingly evident that the conservation of cultural heritage poses problems too complex to be solved within a system of practice based on craft skills supported by related academic disciplines, e.g. art history, science, etc. Today the leading conservation-restoration education programmes in almost all European countries are recognised at university level and several of these offer research education at PhD level. In many countries conservation-restoration education has implemented the Bologna system for higher educations in Europe [6]. The general trend in this development is so clear that the most likely forecast is that conservation-restoration education programmes in all EC countries will have adopted an education programme system with modular course structure and ECTS by 2010. This will improve the basis for mobility and cooperation also with respect to research and research education.

The need for increasing quality and professionalism in applied conservation and restoration practise became still more obvious with the growing recognition of the danger posed by commercial interests and pressures which have resulted in poor quality conservation-restoration with potentially disastrous and irreversible results. This is reflected in the creation of European standards in conservation within the framework of CEN and is clearly expressed in the comments to the work programme of this activity [7]: “A scientific approach is nowadays essential for the conservation of Cultural Heritage as a preliminary basis to guarantee a proper planning of ordinary and extraordinary maintenance works, and to assure their efficacy and durability. Only thanks to a sound scientific knowledge of the materials constituting the artefact, of its environmental and conservation conditions, can these conservation / restoration works successfully be carried out. Unfortunately, the great experience developed in this field by the different European countries for the time being cannot constitute a common background because there are too many differences, not only in the methods of analysis, but also in the terminology used. A specific European standardisation activity in the field of conservation of Cultural Heritage is essential to acquire a common unified scientific approach to the problems relevant to the preservation-conservation of the Cultural Heritage. Moreover, this common approach and the use of standardised methodologies and procedures would promote the exchange of information, avoid the risk of duplication and foster synergy between the European experts and specialists involved in the preservation activity.”

The implementation of standards in European cultural heritage conservation activities will have a huge impact on education, applied practise and research in the field and place great demands on active contribution to the continuous evaluation and development of a standard system from all parties and on their cooperation.

3.1 Cycle of interactive development of education, research and applied practise

Research is the necessary basis for both education and applied practise in conservation-restoration for both areas to be in front with respect to the state of the art of the discipline as well as for their continuous development. To ensure that the content of education meets the needs of applied practise and that the latter is given an input for development from outside, a natural link of cooperation and interaction between the two areas of the discipline is necessary. In particular, as small areas with restricted resources, they both depend on cooperation with

other scientific disciplines. Moreover, as an academic discipline strongly directed towards applied practise there is an established tradition for involving professional practitioners in the teaching of education programmes. This also includes student internships and projects at professional institutions as part of the education programmes as well as other types of collaborative activities and links. Such obvious collaboration activities are research and development. Figure 1 illustrates the global Cycle of Interactive Development of Education, Research and Applied practise, CIDERA. In this model, research forms the natural integrated basis for both areas and the links between these are illustrated by the smaller interaction link. The smaller size of this symbolises the fact that it is necessary that the independency between the two areas be respected in order to ensure that the discipline as a whole develops dynamically, and not that the degree of communication, collaboration and dissemination should be greater. The latter is without doubt needed.

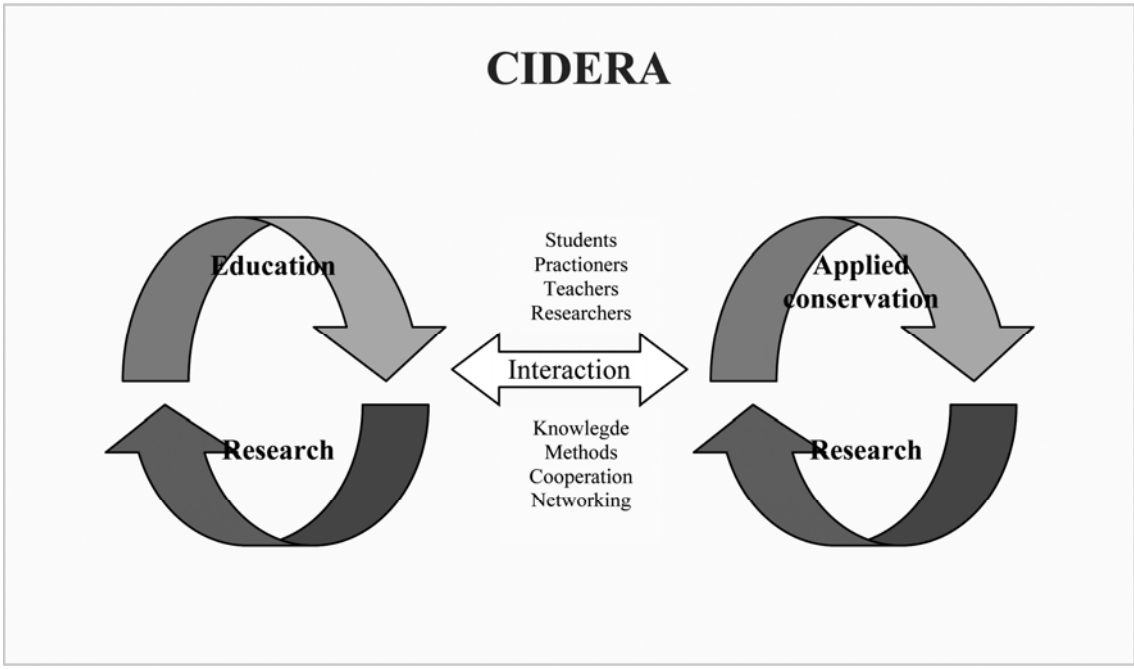

Figure 1: Cycle of Interactive Development of Education, Research and Applied practise, CIDERA. The education / research cycle produces practioners and researchers for the applied practise / research. The latter produces teachers and researchers for education / research. Knowledge and methods etc. flows between them and are developed in cooperation.

4 The role of education in the implementation of European cultural heritage research

As research based education European conservation-restoration programmes are obliged to teach and train their students on the basis of current theoretical knowledge and methods. The EC Framework Programme research projects in the field have from the start produced international results and leading knowledge and should therefore be a major reference source for education programmes. The active participation of conservation-restoration education institutions in the Framework Programme research projects and activities should be an integrated part of their research and research education activities. In addition, as the tradition for close cooperation between education and applied practise in conservation-restoration is well established, it is to be expected that the rate of implementation of the results of the European Framework Programme research should be fast in both areas. The ENCoRE network, with its

members and partners covering both education and applied practise, constitutes a good basis for surveying these questions.

4.1 Involvement in and implementation of European research in the ENCoRE network

In order to get an overview of the involvement in and the implementation of the European Framework research results within the ENCoRE network of member and partner institutions, a course survey based on a simple e-mail questionnaire has been performed for the purpose of this paper. The network institutions were asked about their involvement in EC Framework research project (FP5 or FP6) within the three-year period 2003-2005 and if this was the case, to inform about the names/acronyms of the projects and the role and type of involvement (Coordinator, Contractor, Subcontractor, End-user partner, PhD project/-s, Master project/-s, Bachelor project/-s). In addition, if their involvement was in the form of educational activities (PhD, Master, Bachelor or equivalent), they were asked to specify the number of students involved. Moreover, they were asked if their institution had in any case implemented results and methods from EC research projects during this period in their research, education and/or applied work, and, if so, to specify the type of implementation.

Of the 34 members and 24 partner institutions and organisations 15 and 6 have answered the questionnaire corresponding to 47 % and 25 %. So the information given below far from covers the real situation. On the other hand, I am aware of members and partners that have been actively involved in EC projects in the given period who have not answered the questionnaire. Thus the survey uncovers only part of the full picture of the involvement and implementation which have taken and take place.

Table 1 shows the number of replying members and partners that have been involved in EC FP projects in the period and the role and type of their involvement.

Table 1: Numbers, role and type of ENCoRE members and partners involvement in EC FP projects in the period 2003-2005

	Coordinator	Contractor	End-user	PhD project	Master project	Bachelor project
MEMBERS	2	4	2	3	2	2
PARTNERS	1	4		1		
TOTAL	3	8	2	4	2	2

The number of institutions is relatively low and especially the number of coordinating institutions is unsatisfactory low. However, these figures do not reflect the total number of projects in question. This information is given in table 2 which shows the number of involvements

Table 2: Total numbers of involvements of ENCoRE members and partners in EC FP projects 2003-2005

	Coordinator	Contractor	End-user	PhD project	Master project	Bachelor project
MEMBERS	2	6	2	3	2	4
PARTNERS	1	9		1		
TOTAL	3	15	2	4	2	4

As can be seen in this table, the number involved as contractors is almost doubled. On the other hand the numbers of linked education activities in the form of PhD, Master or Bachelor projects are relative low in both analyses. However, these numbers only reflect the activities of the institutions in question and not other institutions that have acted as partners in the projects. As

an example the IDAP project, of which I was the scientific coordinator, involved 6 PhD projects and the methods and knowledge of the projects have been and are used in several projects at Master's and Bachelor's level. Moreover, the project involved three ENCoRE partner institutions (end-users) as contractors.

Table 3 shows the acronyms of the projects and networks that the members and partners have been actively involved in during the period. Several of the projects are different for members and partners reflecting the fact that there exist different research and development interests as well as different scientific and professional networks within the fields of education and applied practise, respectively.

Table 3: The acronyms of the EC funded projects and networks that the ENCoRE members and partners were involved in during the period 2003-2005

Members		Partners	
Projects	Networks	Projects	Networks
CONNECT	COST G7	COC	COST G8
EPISCON	IDAP	EPISCON	IDAP
FAITH	MIP	GHANA'S CASTLES	
IDAP		HAEC	
LMCR*		LIDO	
MASTER		LMCR	
IMPACT		MIMIC	
InkCor		MoSS*	
PROMET		SurveNIR	
ROCEM			
VIDRIO			

* CULTURA 2000 project

A positive aspect which is not reflected directly in the numbers or information shown by the survey is that some of the projects and networks like e.g. COST actions, IDAP, InkCor, Master and MIMIC include project partners that know each other from networks like ICOM-CC. This means that cross-over implementation of results between partners in these project is not an unusual thing. Partners from these projects have communicated scientific results of their own projects at scientific meetings and at partner meetings of other projects. In several cases the same institution has been actively involved as a partner etc. in more of the aforementioned projects, typically through connections made to other scientists / projects at such meetings. Moreover, several of the projects (e.g. IDAP, InkCor and MASTER) involved end-users as project partners as well as external partners in the research, development and evaluation of the work and products during the project. Apart from the very positive effect on the outcome of these projects, this strategy lead to broad awareness of and interest in the projects among relevant end-users in general, as well as a quick implementation of the project results among them. In addition, as a result of this strategy several new projects including former external end-user partners as new internal partners have started.

A recent result of this synergistic activity is a new upcoming network between EC project groups and colleagues researching in natural organic polymers cultural heritage materials in a broad sense within the framework of the ICOM-CC working groups. In addition, the coordinators and partners of the IDAP, InkCor, MODHT and Papylum projects are active in establishing a dissemination project, Learn4movable, the aim of which is to produce high

quality mobile modular courses for the teaching and training of end-users in the methods and knowledge produced by the four projects.

Table 4 shows the type of results implemented by the members and partners from the aforementioned projects. It should be noted that many of these were put into action early during the ongoing active project period. This includes a more permanent inclusion as part of the contents of teaching courses and as methods in practical conservation activities.

Table 4: Type of output results implemented by the ENCoRE members and partners

MEMBERS	PARTNERS
Dissemination of results at conferences, training seminars and in scientific papers	Definition of prequalification standards for craft persons
Education and training in new methods of identification of composition of historic materials	New commercial product for selling
Education and training in new methods of damage assessment and conservation of historic materials	New European network for the study and documentation of restoring events
Implementation of theory of deterioration and damage assessment	New knowledge on effectiveness of dosimeters used in teaching programme on preventive conservation
Input to research education and training in conservation-restoration	New experience and results used in surveys and consultative jobs
New European international post graduate courses for PhD students	New scientific multilingual glossary in conservation-restoration
New international networks for assessment, research and applied conservation-restoration practise	New systems for monitoring, safeguarding and visualising archaeological sites
	Use of new tools and strategies for damage assessment

5 Conclusions

Experience and the present survey shows that conservation-restoration education is an important source for the quick and efficient implementation of EC Framework cultural heritage research results. Moreover, both as present end-users and coming end-users in professional applied practise, students are sources for a permanent awareness and use of the research output as well as future contributors to research itself. Although education and research activities and spin-offs in connection with the European FP research in the period 2003-2005 are far greater that those reflected in the simple ENCoRE survey, this shows that too few of our member and partner institutions are involved as research partners. This places demands on ENCoRE to work more actively to change this situation with the goal of increasing the development of research-based education and the contribution of conservation-restoration education to European research.

On the other hand, the positive synergistic effect of the implementation of research results through networking among researchers, educators and end-users is now very clear. Apart from the gain with respect to implementation of networks and active contacts between them, it creates new research groups and projects as well as new organised networks. However, the very active and well-organised society of cultural heritage has limited resources. Therefore, to avoid a slide into uncontrolled chaos that could drain the energy and dynamics from this positive

development, some overall coordination of the network activities is needed e.g. through a central communication source. The research results produced by the EC Framework research within the past years are overwhelming and impossible to overlook for the end-user, researchers and students. Organisation and coordination would be of great benefit for all parties. Central databases, e.g. organised by the networks, would improve the possibility of dissemination and access to research results. Moreover, it would provide the opportunity for using data and other information in education and follow-up research as well as helping to avoid meaningless duplicate research and development activities. Support from the coming EC Framework Programmes is necessary to help the establishment of these coordination and communication activities in order to gain as much as possible from our research activities. In addition, supporting network activities like these will greatly improve the research basis of conservation-restoration education and applied practise for the benefit of all our European cultural heritage.

6 Acknowledgement

The author is very grateful to the members and partners of ENCoRE who have devoted their time to take part in the present survey on their involvement in the EC Framework research. Moreover, I am grateful to Christina Lund and Karen Borchersen, School of Conservation, Copenhagen for proofreading the manuscript and editorial help, respectively. I would also like to thank the Members of the Board of ENCoRE for their comments etc. on this manuscript.

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The SAHC (Structural Analysis of Historic Constructions) International Master Course

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Key words: master course, cultural heritage, historic materials, historic structures, conservation, restoration, non-destructive testing

1 Partners

The Advanced Masters in Structural Analysis of Monuments and Historical Constructions (MSc) is a Joint European Master Programme on conservation of architectural heritage structures, aiming at producing an international platform of top level competence. The higher education institutions involved in the MSc (consortium institutions) are: University of the Minho (Guimarães, Portugal), Czech Technical University in Prague and the Institute of Theoretical and Applied Mechanics of the Academy of Sciences of the Czech Republic, (Prague, Czech Republic), Technical University of Catalonia (Barcelona, Spain), University of Padova (Padova, Italy).

The relationship of the partners with the ICOMOS International Scientific Committee for Analysis and Restoration of Structures of Architectural Heritage ensures the opportunity to contact and collaborate with experts from over the world with experience of dealing with international and regional conservation problems and practices. The partnership includes the editors of the International Journal of Architectural Heritage: Conservation, Analysis, and Restoration, the Organizers of the series of conferences on Structural Analysis of Historical Constructions (1995-2006). The partners are also involved in relevant technical committees and enjoy a proven record of R&D&I external funding and top professional experience in fields such as inspection, diagnosis, monitoring, structural analysis and restoration of world architectural heritage.

2 Motivation and objectives

The building industry and tourism represent about 15-20% of GNP in Europe. As the built environment ages, conservation of existing buildings and infrastructure is receiving more and more attention, reaching an average value of 1/3 of the market in Europe. The MSc programme will address the issue of existing buildings, but with a focus on buildings with cultural value. Since monuments and historical centres are major attractions for tourism, their conservation is not only a societal requirement but also an economic issue. Europe is a world leader in generating knowledge, a methodology and technologies applicable to conservation and restoration of the architectural heritage. The large investment made in recent years has led to significant advances in experimental and numerical techniques applied to the conservation of architectural heritage structures.

The objective of the MSc programme is to offer an advanced education programme on engineering aspects of conservation of structures, with a focus on architectural heritage. The

Master programme combines the diverse expertise available at leading European universities in the field, and offers education oriented to a multidisciplinary understanding of structural conservation through the involvement of experts from complementary fields (engineers, architects, materials scientists and others). Students deal with top level structural analysis in a research-oriented environment, in close cooperation with industry and with a focus on problem solving. The Master programme will provide a cross-disciplinary education comprising engineering-oriented issues (experimental techniques, computer modelling, structural analysis, seismic behaviour and structural dynamics, repairing and strengthening techniques, surveying, monitoring, etc.) together with more general methodological and philosophical concepts (history of construction and restoration, principles and methodology of conservation, etc.). The main focus of this education is the application of scientific principles in analysis, innovation and practice of conservation of monuments and historical structures worldwide. The programme will combine very recent advances in research and development with activities oriented to practical applications. The programme will pay significant attention to regional differences in architectural heritage and historical construction techniques within Europe and worldwide.

3 Programme structures, content and admission requirement

The MSc programme takes 12 months and is held on a rotating basis among the partners. Coursework is concentrated in two countries each year and dissertation work is divided among all involved institutions. The students carry out the entire coursework in one location and the dissertation in another location. For 2007/08, and in odd years, the coursework will be held in Portugal and the Czech Republic. For 2008/09, and in even years, the coursework will be held in Italy and Spain. The study programme comprises eight units, with six sequential units, one project-based unit and one dissertation. The units are as follows:

SA 1: History of Construction and of Conservation
SA 2: Structural Analysis Techniques
SA 3: Seismic Behaviour and Structural Dynamics
SA 4: Inspection and Diagnosis
SA 5: Repairing and Strengthening Techniques
SA 6: Restoration and Conservation of Materials
SA 7: Integrated Project
SA 8: Dissertation

Units SA 1 to SA 6 are arranged as a mix of theory and application, in the context of project-led education. The Integrated Project is a truly project-based course that includes a mini group project to solve a real engineering problem, with site visits, and the preparation of a proposed work plan for the dissertation. The Dissertation aims at developing research and/or professional competences in the field of conservation and restoration of architectural heritage structures.

The degree awarded is a Master's degree, provided as a double degree from the institutions involved. The admission requirements for students wishing to enrol in the Master Course are a good quality degree in Civil Engineering, or equivalent qualifications. Typically, students are expected to have a four- or five-year higher education degree. Admission is subject to the approval of the Master Committee, and is based upon the applicant's abilities, letters of recommendation, and language skills.

Session VII

Challenges of European cultural heritage research

Report on Session VII

"Challenges of European cultural heritage research"

Michel Chapuis

European Commission, Directorate General Research, Belgium

Chairperson of the Session VII: Andrea Tilche, EC DG Research

Session VII dealt with the new research initiative of the European Technology Platforms, and with the international context of Cultural Heritage: 10 papers were presented in the course of the session (one contribution about "Iraq's research needs and future cooperation with the EU" was withdrawn).

The first three first papers were about the European Construction Technology Platform (ECTP) and its FACH Focus Area, which aim to stimulate and provide a better structure for CH research through public / private partnerships (PPPs) in the field of construction and the related cultural heritage, plus one paper on "how to bridge the gap between research and industry".

Six papers covered a broad European and worldwide canvas: Europa Nostra, which expresses the idea of setting up a European strategy for cultural heritage; the European Network on Structural Assessment Monitoring and Control of Natural Hazards, stressing the increased intensity and number of such events; ICOMOS which deals with "evaluating the world heritage" and the main challenges raised in current conservation; a paper from ICCROM in conservation and research, and two papers on historic cities, one of them by OWHC (Organisation of World Heritage Cities). All contributions called for greater cooperation and exchange of information through their numerous networks and case studies, experts and the involvement of local authorities.

An additional specific communication was about existing cooperation of the Getty Institute with Europe, especially in conservation science.

We took note of several requests made more specifically to the EU regarding the need for increased cooperation and for exchange of expertise, with some support - such as that expressed by ICCROM - for research and training in cultural heritage. There were calls for more involvement of the EU in the context of natural hazards during the 7th Framework Programme, and for the definition of multi-criterion analyses and common indicators for historic cities.

As a provisional conclusion, we would like to stress a few common issues raised by these contributions:

- the need to strengthen interdisciplinary approaches
- the need to transform the knowledge that is generated into practically implementable solutions, and not only to disseminate research results and data
- the need for more complementarity and synergies between the various frameworks, in order to avoid duplication of efforts in joint common activities.

historic cities .

Cultural heritage related research and the European construction technology platform

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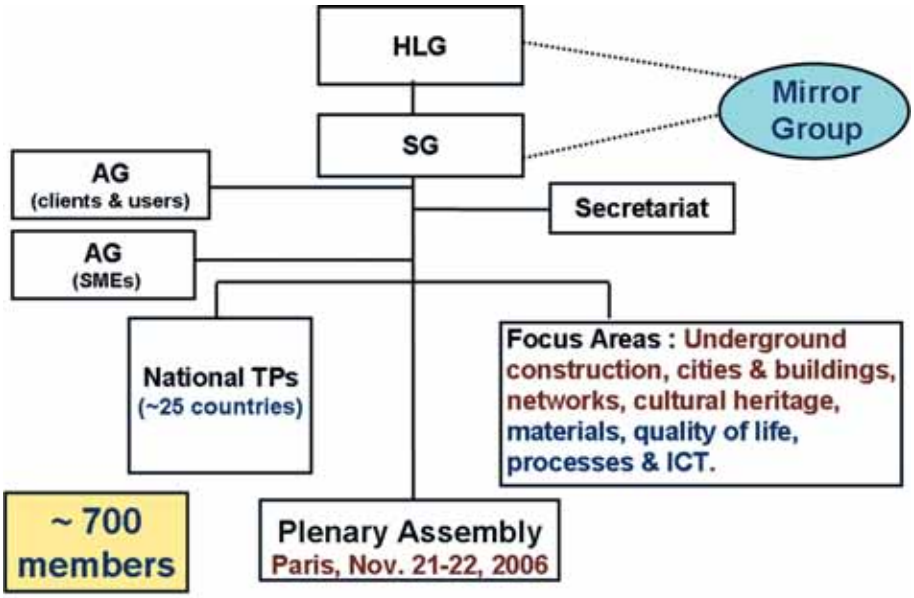
ECTP is an *industrial driven platform* with the contribution of all the stakeholders to mobilise the construction sector.

A new way to achieve *Lisbon's goals* put forward by the European construction stakeholders and fully supported by the Commission.

New strategies on *R&D&I* are being developed to improve the *competitiveness* of the sector and to satisfy the *societal needs*.

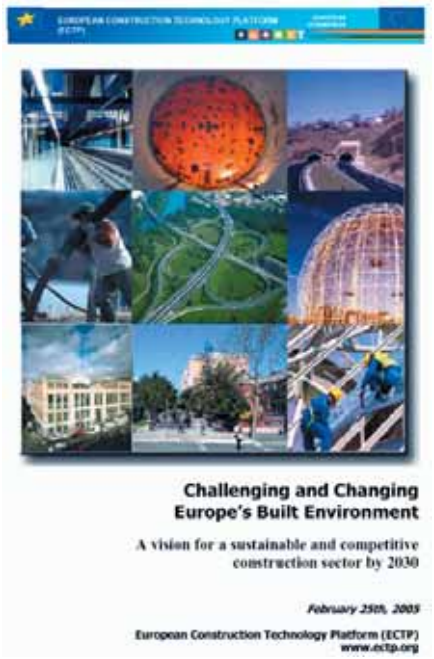


ECTP

Stage 1: getting together
- ToR
- Vision 2030

Stage 2: define SRA
- SRA

Stage 3: Implementation Plan



Strategic Research Agenda (SRA)

Research priorities

- Meeting client / users requirements
- Becoming sustainable
- Transformation the construction sector

Implementation Plan 2006

- Selecting research priorities
- Research actions
- Dissemination
- Networking
- Other:
  Training and education
  Standardization
  ….

Groups of research priorities

1. Technologies for healthy, safe, accessible and stimulating indoor environment for all
2. Underground innovative construction technologies
3. New technologies, concepts and high tech materials for efficient and clean buildings
4. Reduce environmental and man-made impacts of build environment and cities
5. Sustainable management of transports and utilities networks
6. *A living cultural heritage for an attractive Europe*
7. Improve safety and security within the construction sector
8. New integrated processes for the construction sector
9. High added value construction materials.

A living cultural heritage for an attractive Europe

Reaching the European citizen involvement through the development of an integrated approach to the natural and man-made environment to maintain natural resources; improve quality of life and social cohesion and to create a sustainable balance between cultural heritage and economic benefits.

Foreseeing and managing changes through:

- Development of models for disaster prevention and risk management in historic materials and structures.
- Prediction of long-term behaviour of materials and structure in order to establish reliable maintenance plans.
- Development of understanding of mechanisms of degradation.
- Introduction of the principles of rational use of energy in planning and execution of interventions as well as in management of heritage sites and buildings.

Developing assessments and controls:

- Integrated quality control system.
- Science of monitoring from on-site applied technologies to the satellite technologies to assess harming processes and their consequences.

Innovating in the creation of materials and structural components for cultural heritage:

- Materials adapted to better preservation of historic materials applying nano and other emerging technologies.
- Understanding the historic materials and technologies.

- Introduction of innovative and low intrusive intervention techniques including introduction of replicable additional or supplemental structural components.

Preserving urban and built environment:

- Understanding of thematic and spatial governance interactions in cities.
- Development of innovative integrated analysis and planning mechanism taking into account climate and demographic changes.

Research initiatives (JTIs)

- BEE- Building Energy Efficiency (Acciona).
- Jules Verne- Underground Innovative Construction Technologies (Bouygues).

NTPs & Eureka

ECTP through most of NTPs is promoting an Eureka umbrella in construction related projects.

June 7: Presentation of Eurekabuild at Eureka NPC meeting in Prague.
Sept. 26: Meeting with NTPs to promote projects.

Eurekabuild

Eureka umbrella on construction:

- Belgium
- Croatia
- Czech Rep.
- Denmark
- Finland
- France
- Greece
- Lithuania
- Netherlands
- Norway
- Poland
- Portugal
- Slovenia
- Spain
- Sweden
- UK

2006-2009

Action Plan
WP1 Promotion and Dissemination
Leaders: *Poland and Croatia*

WP2 RDI project portfolio preparation
Leaders: *Netherlands and Norway*

WP3 Management
Leaders:
Dragados, *Spain* (chairman of the umbrella)
CSTB, *France*, (Secretariat of the umbrella)

Dissemination
www.ectp.org

Nanocem: April 25, 2006 (Copenhagen)
NTP conference: May 4-5 (Vienna)
Eco-server seminar, May 18-19, Varsaw
Underground const. workshop: May 22-2006 (Madrid)
Cultural Heritage: May 31-June 1-3 (Prague)
TRA conference: June 12-15, 2006 (Gothenburg)
Eccredi: June 16, 2006 (Brussels)
eBusiness and eWork in AEC, Valencia, Sep 13-15
Cultural Heritage brokerage: Sep.14-17 (Croatia)
ECTP conference: Nov. 21-22, 2006 (Paris)

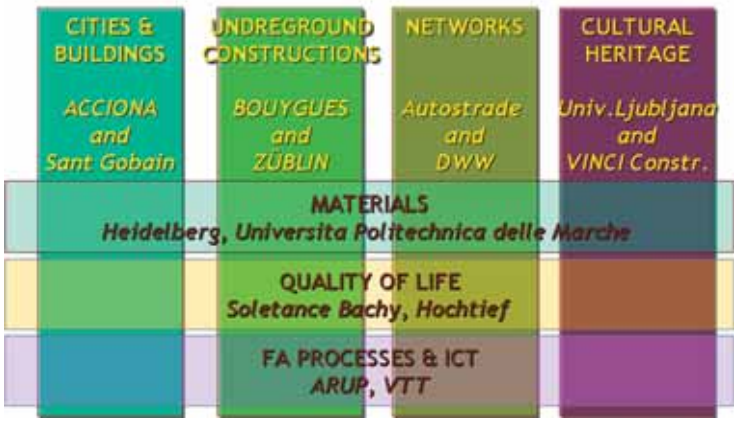
ECTP conference (Nov. 21-22, 2006)

- To enlarge the number of stakeholders contributing to the change of the construction sector through new strategies on R&D&I.
- To promote research proposals for FP7, Eurekabuild, ….
- To identify synergies with other ETPs.

Past, present and future on research in construction

- Research projects and networks
- ECTP & NTPs
- SMEs involvement in R&D&I
- Clients and users views.

Focus Areas



NTPs (~ 25 countries)

Austria	Netherlands	*Starting:*
Belgium	Norway	Cyprus
Croatia	Poland	Estonia
Czech Republic	Slovenia	Ireland
Denmark	Spain	Italy
Finland	Sweden	Portugal
France	UK	Slovakia
Germany		Switzerland
Greece		Turkey
Lithuania		....

Workshops

Paris, January 31, 2006
Multinational research initiatives:

- Eureka
- Eranet, ….

Paris, May 11, 2006

- Eurekabuild
- Involvement of SMEs

Brussels, September 26, 2006

- Project proposals (Eurekabuild, Erabuild, …)

Advisory Group

Clients and users

Leaders:

- SBi (Denmark)
- Eurocities

Meetings:

- January 25th, 2006
- March 30th, 2006
- June 22&23, 2006

SMEs

Leaders:

- BBRI (Belgium)
- Labein (Spain)

Meetings:

- April 4: WG meeting
- May 11: ECTP & NTPs workshop
- June 15: 1st AG meeting
- June 16: Eccredi conference

Focus Area Cultural Heritage as a part of the European construction technology platform

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1 Brief history of the ECTP and FACH

The first ideas about the establishing of the European Construction Technology Platform (ECTP) originate from year 2003 [1]. They were launched among the members of the industrial associations in construction sector in connection with the representatives of the European Commission. The issue of ECTP was initially discussed during the E-CORE (European Construction Research Network) Workshop on "FP6 & Construction Research in the Enlarged European Union" in Warsaw on November 6/7, 2003. In the beginning of the year 2004 ECCREDI (The European Council for Construction Research, Development and Innovation) established a working group that has prepared the detailed proposal for creation of a construction technology platform. The development of platform has been reported on several professional and scientific events until the E-CORE B4E Conference held in Maastricht on October 14/15, 2004. This Conference was an event where the European Construction Technology Platform was for the first time introduced to the wider professional and scientific audience. Therefore, this introduction is to be considered as an official start of ECTP activities in an entirely organized form. However, the months before the Conference the first four National Construction Technology Platforms were established in Poland, the Netherlands, Spain and Slovenia.

Among the initial six Focus Areas that started their activities from the beginning of the ECTP is also the Focus Area Cultural Heritage (FACH) that is established to cover the aspects of immovable cultural heritage that is affected by the construction activities. The process of organizational constitution of FACH started by the initial meeting of the ad hoc organizing group held in Padua, Italy on November 11, 2004. The main outcome of the meeting has been an outline of the organization scheme consisting of the six working groups and establishing of the coordination body consisting of working group coordinators and coordinators of FACH as whole. These first working groups become known later as vertical ones or 'pillars' of FACH. During the third meeting of FACH Coordinators held in Cavtat, Croatia on October 12, 2005 the additional six working groups has been formed as horizontal ones or 'belts'. Their role was to link together the vertical groups in relation to the common issues of all vertical groups. Including the issue of movable heritage among the horizontal groups the step forward of the FACH development was achieved. Thus the concern with the interaction between the immovable and movable heritage has been set as one of important issues to be covered by FACH.

The development of the ECTP and FACH can be tracked through the development of their official documents starting from their Terms of References, Visions, Strategic Research Agendas and the currently developing Road Maps. Documents are still developing and improving but the results of the ECTP activities clearly reflects in the latest official documents

of European Commission [2]. It means that the research proposed by ECTP and FACH itself will be addressed in the forthcoming call for proposals.

The future activities of ECTP and FACH will be very much oriented to stimulation of ECTP members and other stakeholders interested in activities related to construction sector and specifically to heritage preservation for the preparation of high quality project proposals. Therefore the FACH Conference in Cavtat on October 14/17, 2006 and ECTP Conference in Paris on 21/22 November, 2006 will also encompass special Brokerage events to assist the formation of research teams and preparation of project ideas to be in near future developed in project proposals.

2 European construction technology platform

2.1 European Construction Sector and ECTP

European Construction Sector produces more than 10% of the EU25 total GDP and 50% of the Gross Fixed Formation and is a huge industrial employer. In recent years it is constantly growing sector acting both on the EU and external markets. The first ten construction company on the global level achieved in the year 2004 in total 142.6 billion $. First four and the sixth in the world are the European companies (Vinci, Bouygues, Hochtief AG, Grupo ACS and Skanska AB). The revenue of these five European companies was 62% of the total revenue of the first ten construction companies in the world. But 95% of all companies that are active in European construction sector are SMEs where many of them have less then ten employees. Typically, the SMEs are engaged in the interventions in existing structures including heritage buildings. The contemporary market is driven by the customers' demands and satisfaction. Therefore construction industry tends toward the fast response on customer expectations. It can be achieved on the long term only by investment in knowledge and by fast and elastic response on the customers' demands by the large spectrum of innovative solutions of the emerging problems.

European Technology Platforms, and ECTP is the typical one, were set up in the fields where Europe's competitiveness, economic growth and welfare depend on important research and technological progress in the medium to long term. Platforms bring together stakeholders, under industrial leadership, to define and implement a Strategic Research Agenda. The 7th framework programme will contribute to the realization of these Strategic Research Agendas where these present true European added value. Platforms can play a role to facilitate and organize the participation of industry, including SMEs, in research projects relating to their specific field, including projects eligible for funding under the Framework Programme.

Specifically, the aim of the European Construction Technology Platform is to support the European construction sector and help him to remain the world leader, to increase its competitiveness, to create new jobs, to become sustainable and to transform from traditional to modern, high-tech sector. These ambitious goals can be reached by development of the strong research, development and innovation environment where the European Construction Technology Platform together with the National can have the decisive role obtaining the support of European Commission, Member State authorities and industry itself.

The Vision of the ECTP [4] can be briefly summarized in several lines:

- In year 2030 the built environment of Europe is designed, built and maintained by a successful knowledge and demand driven sector.
- Construction sector is well known for its ability to satisfy all the needs of its clients and society, providing a high quality of life and demonstrating its long-term responsibility to the mankind's environment.

- Diversity in age, ability and culture is embraced. Equalization of opportunities for all is an overarching principle.
- Construction sector has a good reputation of an attractive sector to work in.
- It is deeply involved in research and development, the companies are well known for their competitiveness on the local, regional and global level.

2.2 Organization and strategy of the ECTP

Vision of the ECTP can be reached in the next decades and construction sector can become sustainable and competitive. The ECTP organized itself in the way that enables wide cooperation of representatives of its almost 600 members through the 25 national platforms and seven Focus Areas (Figure 1). The main documents as the Terms of Reference [3], Vision 2030 [4] and Strategic Research Agenda [5] were proposed by the Support Group and approved by the High Level Group. The documents itself were prepared in the cooperation with the members of National platforms, Focus Areas and Advisory Groups.

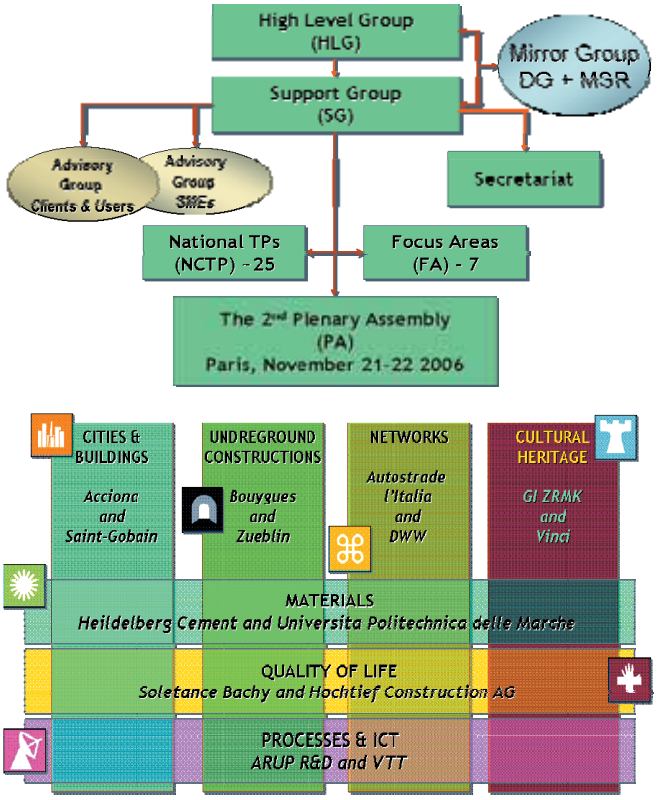

Figure 1: The scheme of ECTP' organization and seven Focus Areas of ECTP

The brief presentation of the SRA [5] is given by HLG Chairman Mr. Michel Cote, Deputy Chief Executive Officer of Bouygues Construction in his letter [6]:

"The Strategic Research Agenda (SRA) presents, for the first time ever, a broad consensus at European level on the main objectives and research areas that must be addressed and coordinated to turn the ECTP Vision into reality. The wide range of activities and impact of the Construction Sector on all aspects of European Society is reflected in the SRA. In parallel with the three main criteria for sustainability – Society, Environment and Economy, they are classified as follows:

- *Meeting Clients / User Requirements*: providing a healthy and comfortable habitat for all, promoting a new image of European cities, developing underground transport to free surface space, developing mobility and supply through efficient networks;
- *Becoming Sustainable*: reducing resources consumption (energy, materials, water), reducing the environmental impact of human activities, maintaining efficient transport and utility networks, enhancing our cultural heritage, improving safety and security;
- *Transforming the Construction Sector*: developing a knowledge-based, client driven construction process, supported by ICT, automation, high added value construction materials and making construction workplaces attractive".

Following the SRA the ECTP members have been widely engaged by an extensive questionnaire to help in the selection of the priorities for the first phase of the research activities supported by the ECTP. Priorities are as follows, where the order of listing is not the order of importance:

- Technologies for healthy, safe, accessible and stimulating indoor environment for all
- Innovative use of the underground space
- New technologies, concepts and high tech materials for efficient and clean buildings
- Reduce environmental and man-made impacts of build environment and cities
- Sustainable management of transports and utilities networks
- A living cultural heritage for an attractive Europe
- Improve safety and security within the construction sector
- New integrated processes for the construction sector
- High added value construction materials.

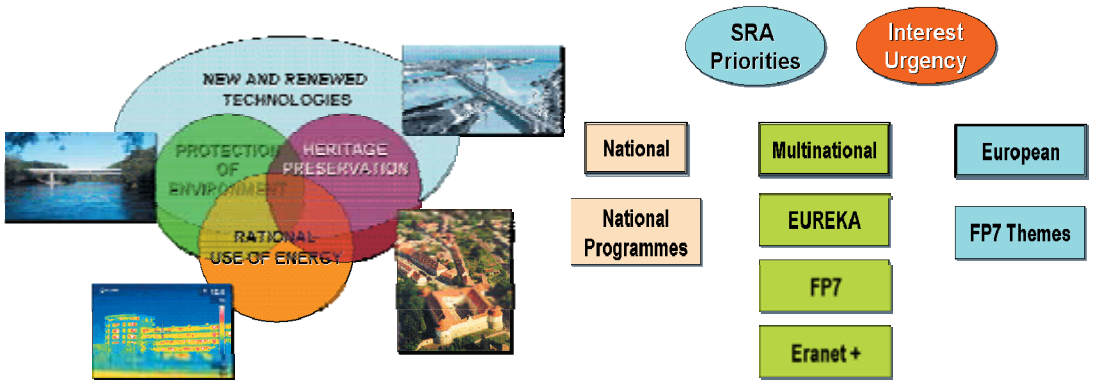

Figure 2: The interaction of technology development and environmental demands and possibilities for realization of SRA and other research priorities

The partners of ECTP will search for the different sources for the research founding, depending on the character of projects (national, multinational, European – Figure 2). Since the European Technology Platform is a tool to enhance collaboration with international initiatives the Eureka is a typical one. ECTP is able to promote generation of the Eureka projects through national Platforms. Therefore it was decided to establish a Eureka umbrella for the construction related projects. The newly established Eureka umbrella project has been launched by the ECTP and approved at Eureka NPC meeting in Prague on June 7, 2006 for the period from 2006 to 2009. The new umbrella is entitled E! 3790 EurekaBuild: Technologies for a Sustainable and Competitive Construction Sector and gather 19 countries. The evolution of a Eureka project under the EurekaBuild is illustrated in Figure 3. This shame can be applied with necessary modifications also to the development of other ECTP supported projects.

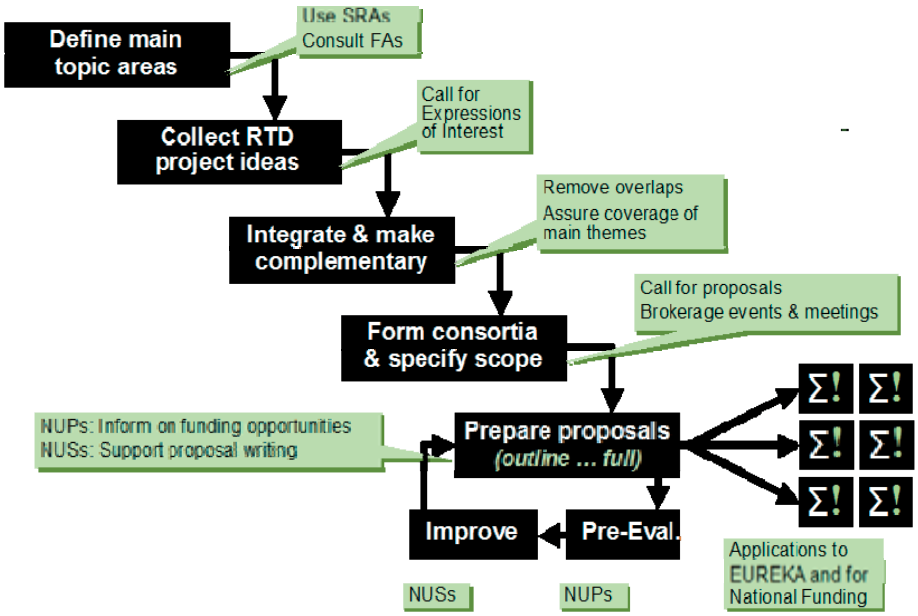

Figure 3: The evolution of the EurekaBuild project proposal

3 Focus area cultural heritage

3.1 A living European cultural heritage

A living cultural heritage makes Europe attractive for its inhabitants and visitors, and stimulates economic competitiveness and a better quality of life. European cultural heritage is the testimony of our shared past and the root of our identity. It enriches the collective memory, which will make the future of Europe more humane and civil for its population, so it needs to be conserved with great care.

The importance of this cultural wealth can be measured in economic and social terms, such as growth in employment, job creation and unified communities, and it has a considerable impact in many areas such as the environment, construction, tourism and regional development to enhance European competitiveness and skills through technical innovation and traditional skills. The European construction industry will achieve greater competitiveness and the ability to satisfy societal needs through research, development and innovations oriented towards protecting and enhancing cultural heritage, and adaptive re-use of existing buildings. Today, about 40 % of construction activities are devoted to adaptive re-use, repair and maintenance. Beyond that, Cultural Heritage is the key issue to enhance the sustainability of the Construction Sector, ensuring that Cultural Heritage is added to the three basic pillars of sustainability: Environment, Society and Economy. We are now building for the cultural heritage of future European generations: a strong knowledge-based approach must be used to protect and promote our cultural heritage to keep it alive in an attractive Europe.

3.2 The objective and vision of FACH

The global objective of the FACH is to promote new sustainable and preventive strategies, concepts, methodologies and techniques for conservation and restoration of cultural heritage in order to improve the quality of life of citizens and the attractiveness of Europe, particularly its cities, buildings, monuments and landscapes.

The interventions of the European Construction Sector in cultural heritage must take a knowledge-based and interdisciplinary approach for the sustainable protection of cultural heritage underpinned by the principles of safety, authenticity and compatibility to ensure

minimal intervention to avoid damage to cultural heritage and to enable it to be protected from environmental and human causes of destruction. This includes in particular the implementation of ambitious programmes of adaptive re-use and energy-efficient and sustainable retrofits of existing buildings. These imply appropriate use of knowledge-based advanced technologies and the active participation of all stakeholders, practitioners, industry and SMEs. The challenge of the application of special techniques, materials and processes to maintain Europe's rich cultural heritage is of great importance for all players involved in these vital activities for the maintenance and preservation of European cultural identity in today's globalize processes. In addition, new strategies for management are needed to reinforce and recognize the added value Cultural Heritage gives to cities and landscapes.

There are six main topics of interest for the Focus Area Cultural Heritage, selected to address the challenges facing the preservation and sustainability of Cultural Heritage (Figure 4): Assessment, Monitoring & Diagnosis, Materials, Intervention Techniques, Environment & Energy, Management, Exploitation & Maintenance and City & Territorial Aspects. They are horizontally linked by the permanent need for development of knowledge and its transfer through education and training to all educational levels; constant attention to socio-economic strategies for interaction with interventions for cultural heritage; promoting the development of relevant European directives, codes and standards; response preparedness against natural hazards such as earthquakes, strong winds, fire and floods and the use of ICT for communication and dissemination. Furthermore moveable works of art are an integral part of the immovable heritage and as such must be preserved as a valuable part of cultural heritage. Finally, strong dissemination and communication activities are needed to transmit information on the activities being carried out within the FACH group and ECTP and beyond to ensure their adequate implementation within Construction Sector.

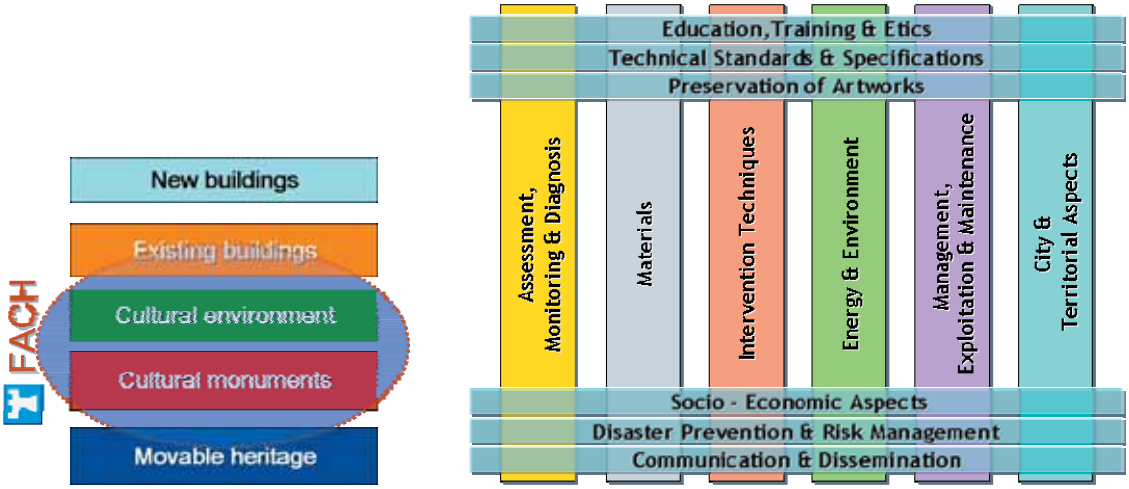

Figure 4: The areas of FACH interest and FACH vertical and horizontal working groups

The Vision 2030 of Focus Area Cultural Heritage may be summarized as:
"Holistic protection of living Cultural Heritage and its territorial setting by appropriate understanding; planning and management; monitoring, conservation and restoration, maintenance; encouragement of its sustainability and added value for Society and the Construction Sector; recognition of integration and diversity of cultural assets in relation to all citizens."

If the input of cultural heritage activities is significant and brings more social and cultural acceptance for the whole ECTP, it can also be expected that the initiatives taken by the ECTP

and the other Focus Areas will take into account cultural heritage when implementing various initiatives and projects resulting from the ECTP Strategic Research Agenda.

However, the specificity of the Cultural Heritage Sector and therefore of this Focus Area must also be recognized, as it is quite different from the other Focus Areas. In particular it must be emphasized that some standards, codes and principles used in construction may not apply directly to cultural heritage (otherwise, for example, demolition might become a serious consideration for whole or parts of ancient buildings; or generic building systems appropriate to domestic, commercial and industrial buildings might risk being applied to Cultural Heritage). Moreover, conservation principles, whether of Cultural Heritage, the Environment or Energy can differ in their application? More focused management can create synergies that can achieve all three: saving energy, improving the environment and indoor air quality, and safeguarding human health and Cultural Heritage. This Sector needs to develop appropriate guidelines that consider other aspects such as security. In addition, even if public funding progressively decreases in the tangible cultural heritage research field in many European countries, it still depends largely on the public sector as the private sector in this field is still characterized by a large number of small companies.

3.3 The research priorities

Cultural Heritage is a clear priority for Construction sector in order to found a development of the sector based on knowledge and sustainability. ECTP Focus Areas Quality of life and Cities and Buildings are obviously concerned by cultural heritage which has a real impact on the "discerned-quality" for a territory or a city, also Focus Areas Materials and Processes & ICT interact with cultural heritage.

The aim of research activities is to establish systems for the integrated management of cultural heritage in Europe. These would ensure the safeguarding, regeneration and development of the Historic European Urbanized and Vernacular Environment, based on research-supported development and implementation of standardized modular hard and soft tools. These include strategies, technologies and systems for rational management, monitoring, surveying, documentation, evaluation, sustainable maintenance, public participation, communication and networking of units with cultural and natural heritage territorial values. Six main research topics of FACH must be developed to support this aim. In the medium term, the research has to be focused on new assessment and management tools, new safeguarding and maintenance projects. In the long term, new applications should ensure implementation of the research results.

The research efforts should help to achieve the following targets:

- Make cultural heritage accessible for all.
- The service life of Cultural Heritage materials and structures can be predicted with 20% error and is the base of predictive maintenance plans.
- Reducing the decay of Cultural Heritage by 95%.
- Improved safeguarding and consolidation of Cultural Heritage values in risk territories.
- All information generated during the study, restoration and maintenance process will be available and used for appropriate management.
- 25 important EU cultural heritage sites should be assessed using new specifications between 2010 and 2030.
- Cultural Heritage considered as an added-value for economical, social and environmental aspects and not only because of tourism impact.
- The safeguarding of Cultural Heritage as a pillar of sustainable development.
- Application of technologies and materials that do not impose the conflict between the various disciplines engaged in heritage preservation and that do not induce long term harmful effects.

There is the common opinion of FACH members that the above listed targets can be achieved with the several groups of interlinked projects. The European citizen involvement can be reached through the development of an integrated approach to the natural and man-made environment to maintain natural and cultural resources; improve quality of life for all and social cohesion and to create a sustainable balance between cultural heritage and economic benefits.

The changes of cultural heritage can be foreseen and managed through:

- Development of models for disaster prevention and risk management in historic materials and structures (climatic changes, earthquakes, fire, strong wind, landslides, flood, pollution, urban development, terrorist attack …).
- Prediction of long-term behavior of materials and structure in order to establish reliable maintenance plans.
- Development of understanding of mechanisms of degradation and deterioration of materials.
- Introduction of the principles of rational use of energy in planning and execution of interventions as well as in management of heritage sites and buildings.

Assessment and control of the heritage can be achieved by:

- Development of an integrated quality control system based on the criteria of compatibility, sustainability and authenticity.
- Developing the science of monitoring from on-site applied technologies to the satellite technologies to assess harming processes and their consequences.
- Developing new predictive behavior models for periodic maintenance
- Innovating in the creation of materials and structural components for cultural heritage.
- Development of materials adapted to better preservation of historic materials applying nano and other emerging technologies.
- Understanding the historic materials and technologies.

The innovative and low intrusive intervention techniques should be developed and introduced in practice. The introduction of the replaceable additional or supplemental structural components is the essential part of the new intervention strategies. The special attention should be paid to preserving urban and built environment. Therefore, understanding of thematic and spatial governance interactions in cities is essential. The innovative integrated analysis and planning mechanism taking into account climate and demographic changes should be also developed beside the holistic rational management and dissemination strategies. It will enable flexible use of Cultural Heritage for living cities.

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Prospects for international cultural heritage research cooperation

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Key words: Word Heritage protection, natural disasters, structural safety

1 Introduction

Among the scientific entities devoted to scientific research on Word Heritage protection are the different international scientific committees of the well-known International Council for Monuments and Sites (ICOMOS). The international scientific committees of ICOMOS cover a wide spectrum of issues related to cultural heritage, including construction materials (stone, timber, earth), construction types (fortifications, 20th c. heritage, vernacular architecture), intangible heritage, movable heritage, theory, management, documentation, training and other (see in www.icomos.org for more information on the scientific committees).

Most of today's scientific research effort regarding the protection of monuments, historical sites and landscapes is devoted to the analysis of the effect of a number of word-scale phenomena that are massively and increasingly impacting on the heritage. Among these word-scale phenomena are (1) urban expansion and modern civilization, (2) the impact of tourism and cultural attraction, (3) natural disasters, and (4) historical time and the degradation of materials and structures in the long-term. The reader is invited to cooperate in research oriented to better understanding the physical or social mechanisms involved and the way monuments should be protected to endure each of these threads.

After a brief discussion on some of the major phenomena challenging the protection of the World Heritage, the paper focuses on the material and structural long-term deterioration and the assessment of the structural safety of historical constructions.

2 Research topics related to the protection of the World Heritage

The cultural heritage is threatened by a wide set of problems encompassing both natural and artificial phenomena. It is interesting to note that the most deteriorating phenomena to which cultural heritage is subjected have significantly evolved in recent times. In the past, monuments and sites deteriorated mostly due to the natural decay of the materials, natural erosion (including the growing of vegetation), natural disasters, wars, abandonment or lack of maintenance. Nowadays, modern living standards and the modern global interest for the cultural heritage have increased the chances for recognition and conservation of monuments worldwide. Maintenance, conservation practices and structural survey have reduced the potential impact of natural decay, erosion and natural disasters. In turn, modern life has brought the new challenges meant by new cultural paradigms, urban expansion and massive tourism, which pose new and very severe difficulties to the protection of the cultural heritage.

Unfortunately, some of the threads of the past are still active and keep on conveying significant destruction. This is the case of wars and natural disasters. In the case of recent violent conflicts, cultural heritage has unfortunately become a specific target whose destruction is exploited by aggressors as a way of humiliating or discouraging the other part, or for the sake of political or religious revenge; in this case, the focus on cultural heritage seems motivated by the recognition and appreciation it deserves as a source of both cultural identity and economic development.

No matter the developments attained in the understanding and prediction of natural disasters, and the way of protecting our heritage against them, they keep on surprising and striking us unstoppably year after year (figure 1). Moreover, natural disasters seem to occur with increasing intensity and frequency. Years 2005 and 2006 brought larger disasters in distant places of the earth, including very severe earthquakes, tsunamis, floods and hurricanes, having caused significant losses in architectural heritage and cultural sites worldwide. Research on this filed should concentrate on the characterization of the effects of natural disasters on heritage structures (the study of the resistance and vulnerability of buildings and sites to earthquakes and other natural phenomena) and the design of strengthening measures to improve their resistance (to improve their ability to endure the effects of natural disasters). There is also the need to lay-out emergency actions for the conservation of the architectural heritage after the occurrence of natural disasters.

Figure 1: The impact of natural disasters: Bam Citadel in Iran before and after the earthquake of 2003

The increase in the number of destructive natural events seems related to the climate change – another phenomenon possibly caused or harnessed by man – which, in turn, is also posing a very difficult challenge to the conservation of a large part of the cultural heritage. Climate change is causing increasing erosion in coastal polar sites due to the massive melting of glaciers and polar ice sheets. Moreover, the effects or global warming are causing significant stability problems to earthen constructions, which constitute a very important part of the built World Heritage. However, not only earthen structures are affected by the climate change; due to its relative fragility, environmental changes are threatening all vernacular architecture on a global scale. A very important topic for research lays in the protection of the vernacular built heritage and, particularly, in the conservation of the very important heritage consisting of earthen structures. Conservation measures should be envisaged to reduce the sensibility of such buildings to the climate change and to preserve their structural and material integrity.

Modern living and urbanization is not only producing a continuous expansion of the urban centres and a large transformation of the territory. Modern living also causes the abandonment of vast amounts of ancient sites composed of vernacular houses constructed according to traditional or historical technologies. Moreover, traditional technologies are also lost due to

massive migration to the cities and the adoption of modern and more industrialized construction procedures. Measures should be envisaged and taken to keep such vernacular centres socially and economically alive and still attractive to their original population.

Another challenge to the conservation of the World Heritage is now being posed by worldwide expansion of tourism (figure 2). To limit the growing impact of tourism and cultural attraction there is a need of principles and methodology to prevent from congestion and deterioration. In particular, principles and criteria should be developed to measure objectively the impact of visitors and to determine reasonable limits for the capacity of cultural places, on a scientific base. Measures or procedures oriented to ameliorate the effect congestion and to harness a responsible communication of the cultural significance of the place to visitors and local residents should be also developed.

Figure 2: Monuments as powerful cultural attractors worldwide

The last aspect referred to is that of the impact of historical time on the cultural heritage. In monuments and buildings, materials gradually decay and structures tend to experience cumulative damage (figures 3 and 4). A wide spectrum of actions (encompassing environmental thermal cyclic action, multiple minor or major earthquakes, wind, settlements, chemical attack, erosion, and other) contribute jointly to cause a gradual deterioration which, in the worst case, may lead to the partial or overall collapse of the building. Lack of maintenance or inadequate use may also contribute to the gradual deterioration.

Certainly, structures are now being more adequately managed and maintained, which prevents from part of the causes leading to the deterioration. However, the recent collapse of a number of buildings which had survived during centuries and had even endured severe earthquakes (the Cathedral of Noto or the Basilica of Assisi in Italy (Binda et al., 2003, Croci, 1998) shows that there is still need for research oriented to the understanding of the long-term deterioration phenomena and to envision possible remedial measures to enlarge the lifespan of structures.

Figure 3: The decay of materials (cloister of the Monastery of Poblet, Spain)

3 Specific problems related to the structural safety of the architectural heritage

The assessment of the structural safety of historical structures faces significant challenges: First of all, an adequate level of required structural safety must be defined. Second, a method is needed to evaluate the safety of the structure. Third, the engineer o architect must envisage and design strengthening measures which, while improving the safety to the required levels, preserve the original structure and reduce the alteration to the minimum possible extent. In some cases, authenticity (respect for the original configuration and nature) and safety (enough capacity to resist possible actions) may seem in conflict. All these are important topics in need of further research.

Certainly, national and international codes dealing with structural issues do provide criteria on required safety levels and calculation approaches for the assessment of structures. However, codes and rules oriented to the design of modern structures may not be adequate when applied to ancient structures and may lead to inappropriate strengthening operations. Historical structures are very complex due to the nature of their materials and their structural organization; moreover, historical structures can not be analyzed without the consideration of their historical context and the possible actions which may develop in the long-term or for long return periods.

In the case of historical structures, the engineer and architect have normally only a limited amount of information available on the features of the building. The materials – masonry or rubble infill, mortar, stone blocks – often show very heterogeneous and largely variable mechanical properties. Moreover, it is hardly possible to carry out a very exhaustive sampling without damaging the existent fabrics. Non-destructive inspection methods provide only indirect information requiring previous calibration based on complementary partially destructive inspection and testing. As opposed to modern buildings, an appropriate characterisation of the materials or construction details may not be possible in the case of many ancient constructions. However, conventional approaches require detailed information on the geometry, the morphology and the material properties of the structure.

Figure 4: Example of structural damage due to soil settlements

Conventional evaluation procedures are exclusively or largely based on quantitative approaches. With only the concurrence of quantitative analysis, the application of the codes to historical structures may fail to provide sound and reliable conclusions on the real condition of the buildings and the need for any intervention. This, in turn, may lead to either underestimating or overestimating the safety of the structure and, therefore, to implement inappropriate actions.

These are some of the issues currently addressed by the ISCARSAH committee of ICOMOS. As a result, the committee has produced a set of *Recommendations for the Study and Restoration of Historical Structures* (ISCARSAH, 2003) intended to provide some answers and alternatives to these difficult problems. As stated in the Recommendations, historical constructions require a different, broader and more flexible understanding which not only considers the result of structural analysis (the quantitative approach) but also the contribution of other approaches such as history (the historical approach, i.e., the study of the past-performance of the building), comparison with similar buildings (the qualitative approach, i.e. drawing conclusions by investigating the structural response shown by other similar buildings), monitoring and possible experiments (the experimental approach), figure 5. The final conclusions should never result from a single approach, but from a synthesis of the evidence provided by several approaches.

Additional research on methodology and techniques for each of these approaches (quantitative, historical, quantitative and experimental) is also needed. In spite of the significant effort devoted during the last decade to the development of numerical methods for the analysis of masonry and timber structures, there is still a need for efficient and accurate methods. In turn, producing reliable numerical methods requires previous experimental research aimed to the determination of the mechanical and resisting response of such materials. The experimental information made so far available is not yet enough as to permit a sound calibration of possible numerical models. Research is also needed with regard to experimental and monitoring

strategies and techniques. The way these approaches are to be combined to draw reliable conclusions on the safety of the structure is also in need of further investigation.

Figure 5: Possible approaches to safety evaluation: (from left to right: historical, qualitative, experimental and quantitative approaches)

4 Conclusions

Among the main challenges faced by the conservation of the cultural heritage are the impacts of modern living and urbanization, tourism and cultural attraction, climate change, natural disasters and the long-term deterioration experienced by materials and structures. Future research should devote significant effort to investigate on the physical phenomena and to envision possible remedial actions aimed at protecting the materials and the structures against their negative consequences.

In particular, there is the need to assess the structural performance of traditional or historical constructions and to evaluate their structural safety for different actions, including dead load, soil settlements, climatic environmental effects, wind and earthquake. The assessment of the safety of historical constructions faces very significant difficulties due, among other reasons, to the limited amount of information which is normally available on their morphology and material properties. Conventional codes and methods oriented to the assessment of modern structures are not always useful. The safety assessment of historical structures must be undertaken using a flexible and broad understanding based on the integration of both quantitative and qualitative evidence provided by structural analysis, historical investigation, monitoring and experiments. Additional research is still needed on these individual approaches and the way they must be combined to draw reliable conclusions allowing the design of appropriate conservation measures.

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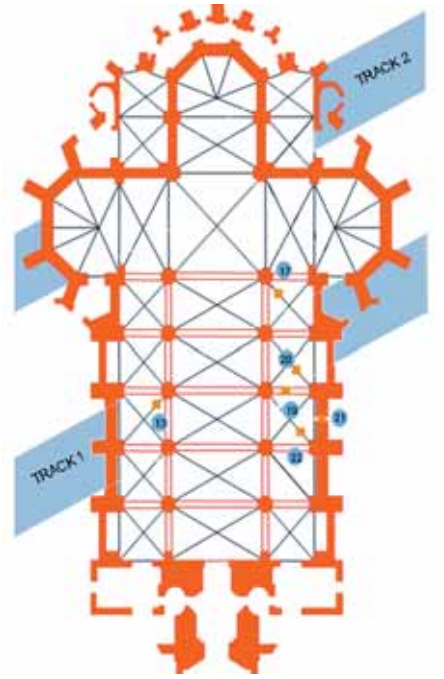
International collaboration on natural hazards expected for the 7th framework program

Helmut Wenzel

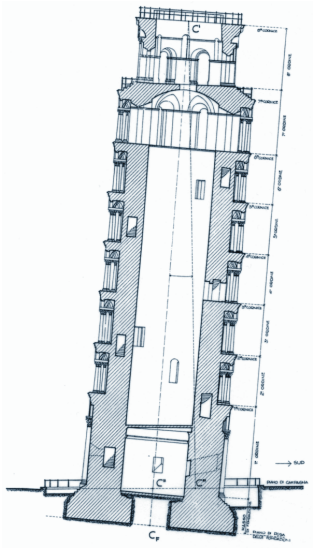
Monitoring of a Church during tunnelling



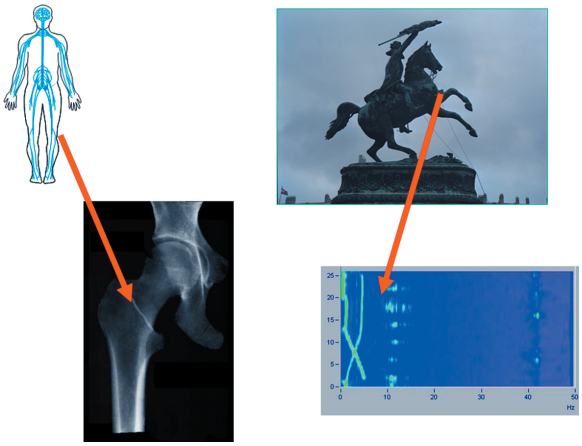
Erzherzog Karl Statue integrity check

Laser monitoring Westminster, London

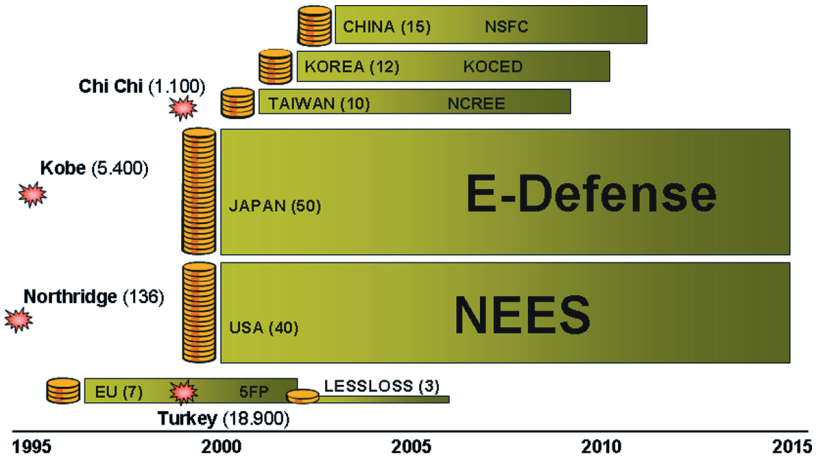
Leaning tower, Pisa, Italy



Virtual doctor for structures



Annual investment EQ Research by Federal Institutions

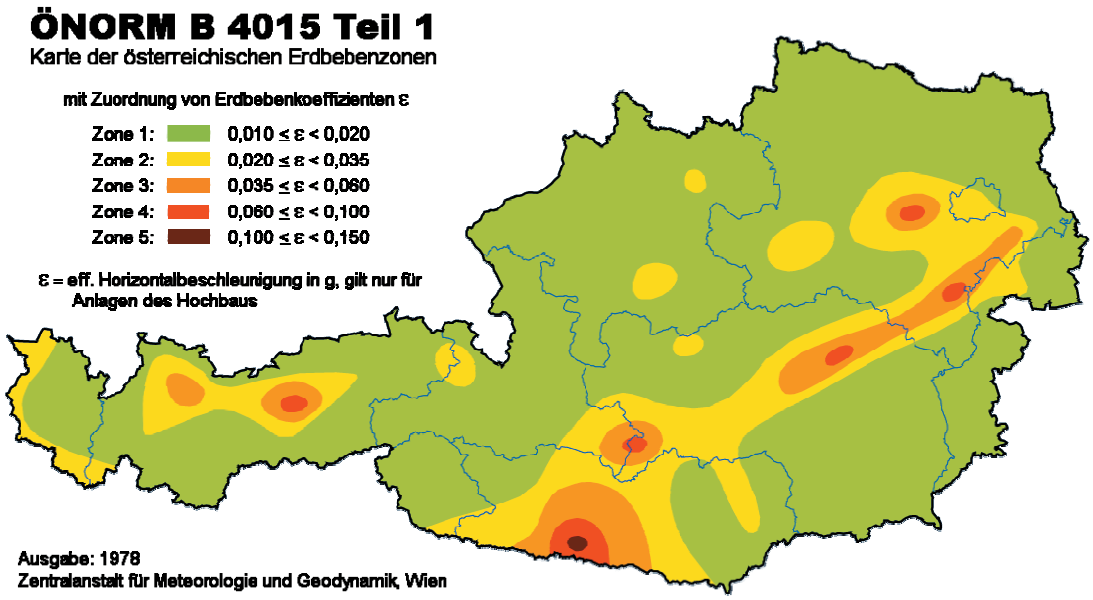


Human Loss: 1900-2000 239.000 in Europe

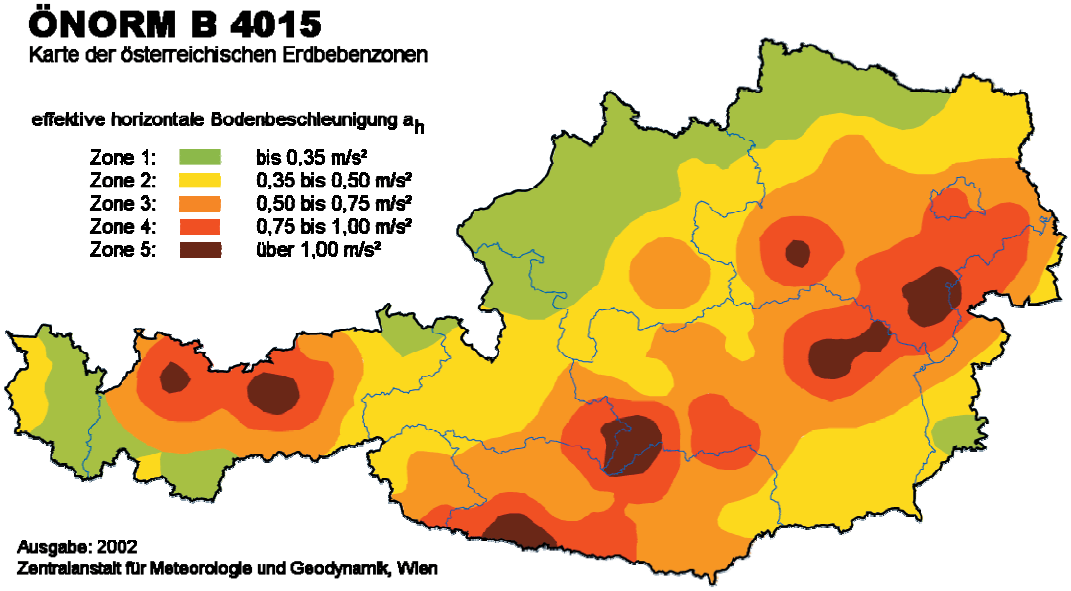
Current situation

- Last Century (1900-2000) Earthquake Loss: 239000 Lives in Europe
- Damage to Infrastructure 325 billion €
- Indirect Damage?
- There are huge global initiatives on Earthquake Engineering Simulations
- *Can EUROPE afford to stay away?*

Austrian seismic Code 1978



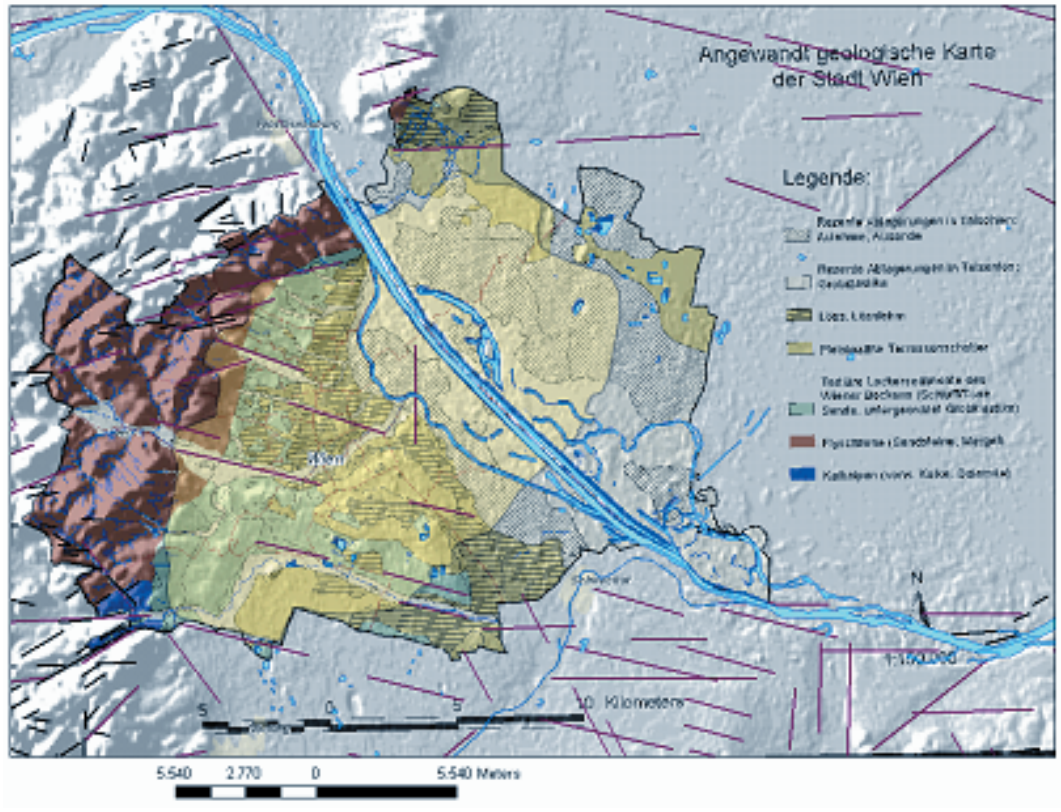
Austrian Seismic Code 2002



Castle of Schönbrunn, Vienna

8 million visitors per year

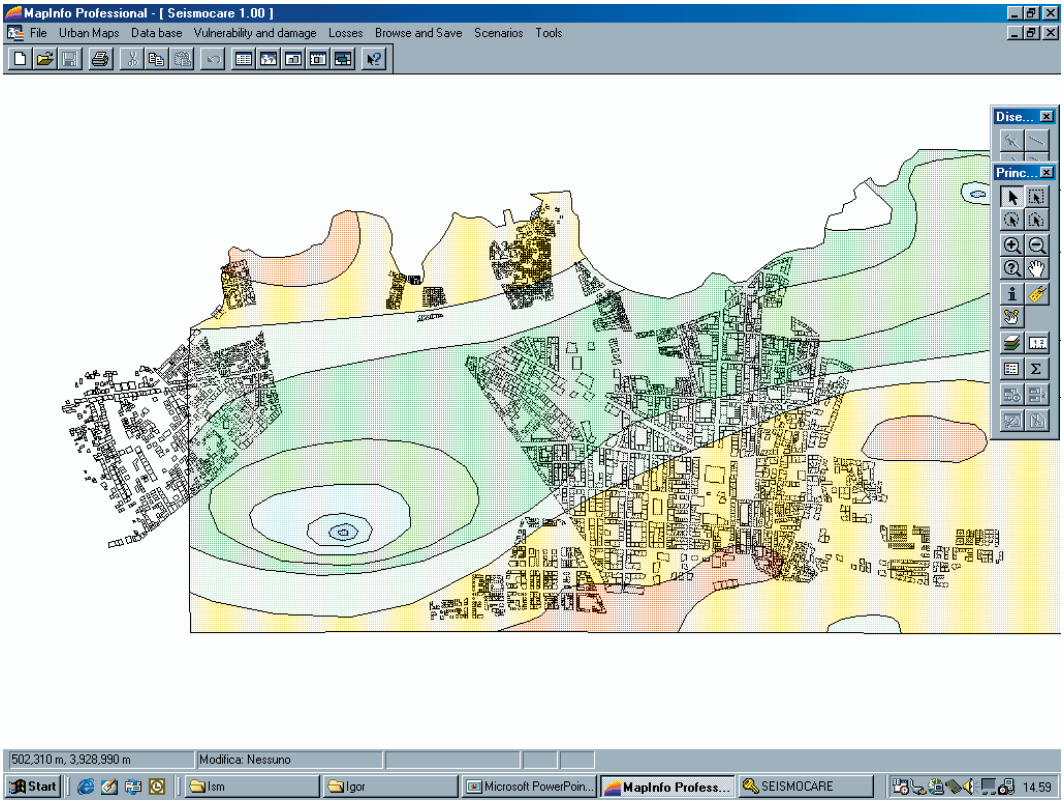
Vienna, fault locations



Kocaeli quake, 1999, Turkey

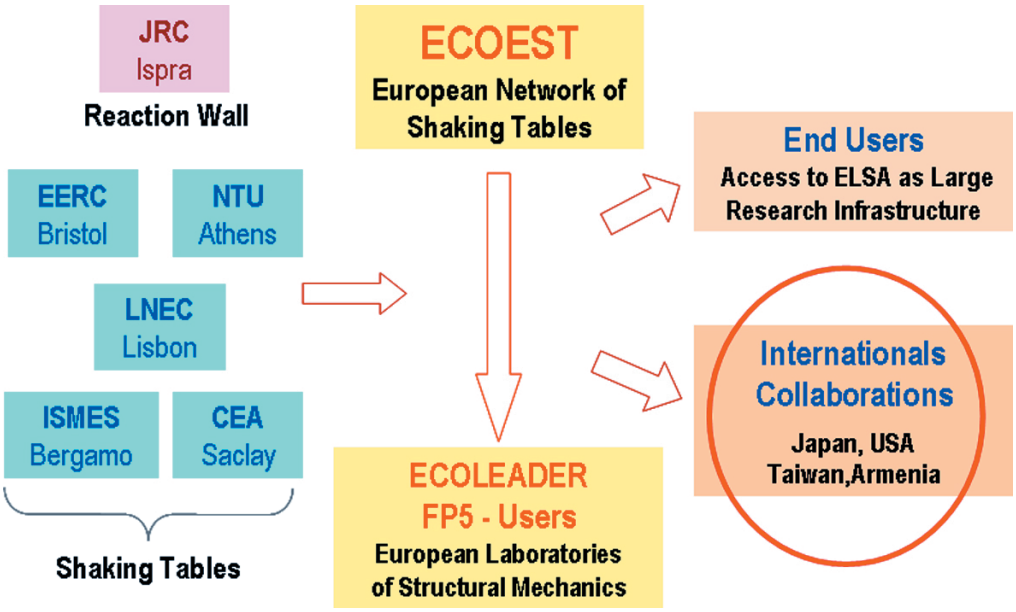
Advances Needed

Micro zonation



Local amplification map due to soil condition

ECOLEADER

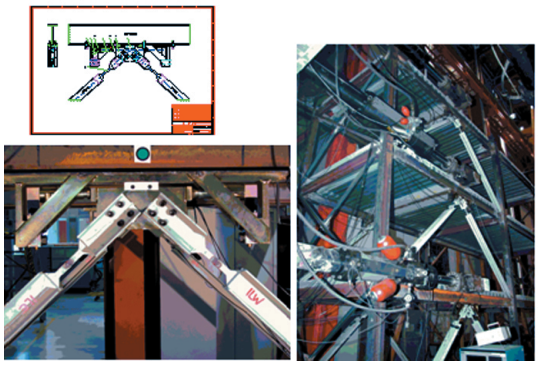


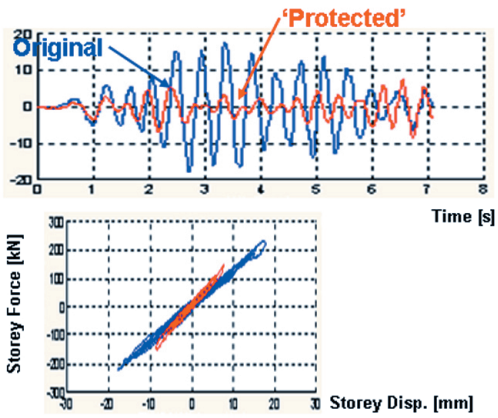
Application to:

- Steel Structure
- RC structure

Devices:

- Viscous, Hysteretic, Friction





International collaboration

Earthquake Engineering & Disaster prevention

USA

- Network for Earthquake Engineering Simulation (NEES-ORG), Davis
- San Diego Super Computer Centre (NEES-IT), California

JAPAN
- Building Research Institute (BRI), Ministry of Construction, Tsukuba
- National Institute for Earth Science and Disaster Prevention (NIED), Tsukuba

TAIWAN
- National Centre for Research in Earthquake Engineering (NCREE)

ARMENIA
- Armenian Nuclear Regulatory Authority (ANRA)

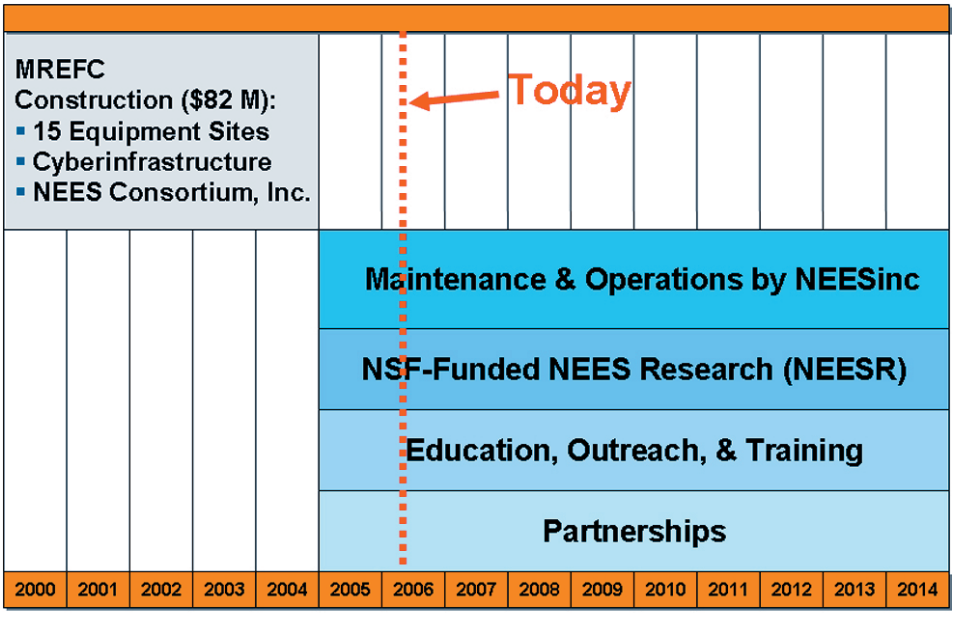
International organizations & nuclear safety
- International Atomic Energy Agency (IAEA), Vienna, Austria
- OECD Nuclear Energy Agency (OECD/NEA), Paris, France

Main subject of collaboration

Earthquake Engineering & Disaster Prevention
- Exchange of scientific and technical information
- Common organization of Workshops and Conferences
- Exchange of short visits of researchers
- Harmonization of Data Models for Experimental Databases
- Development of Technologies for Distributed Laboratory
- Harmonization of codes and standards

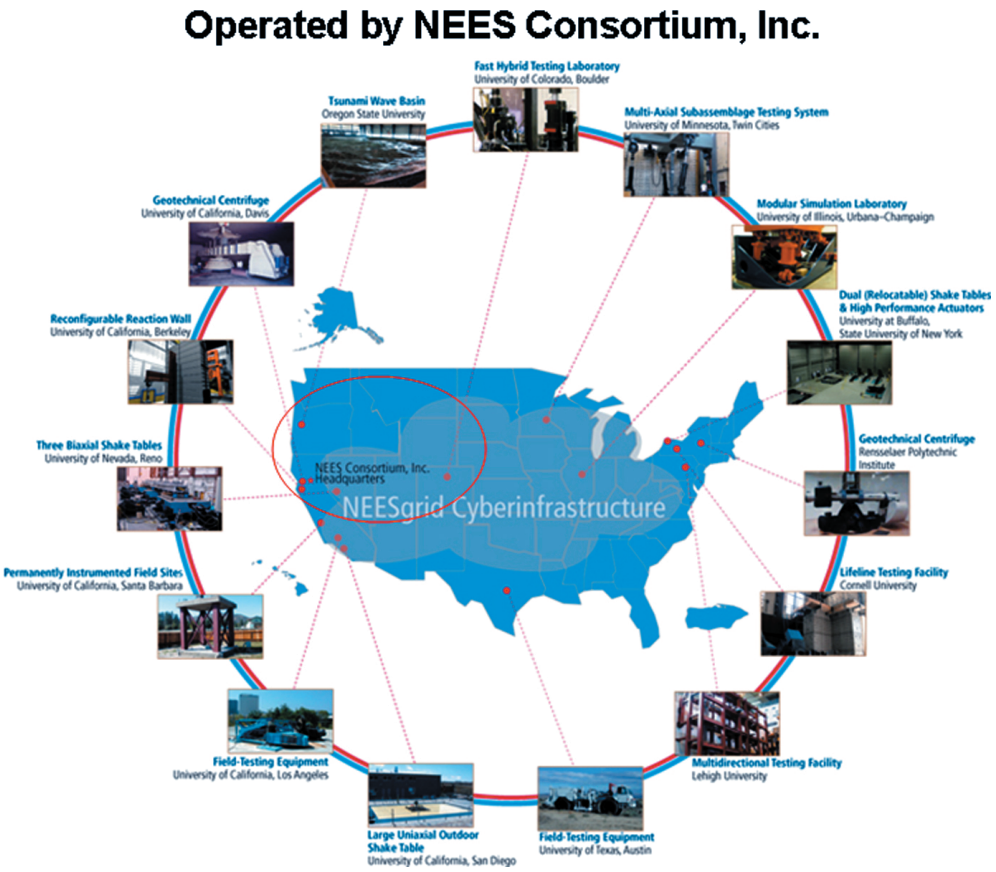
International Organizations & Nuclear Safety
- Co-management of Coordinated Research Projects
- Technical management of International Benchmarks
- Redaction and delivery of documents on specific topics
- Consulting for Seismic Behaviour of Structures

NEES Timeline



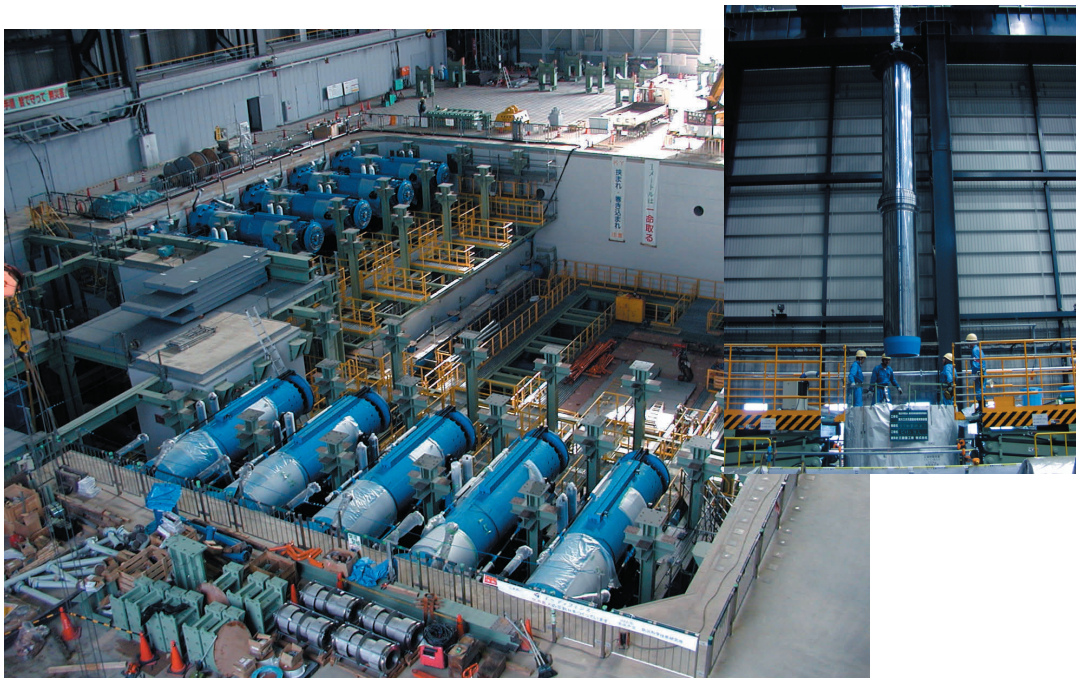
NEES shared use infrastructure

Operated by NEES Consortium, Inc.

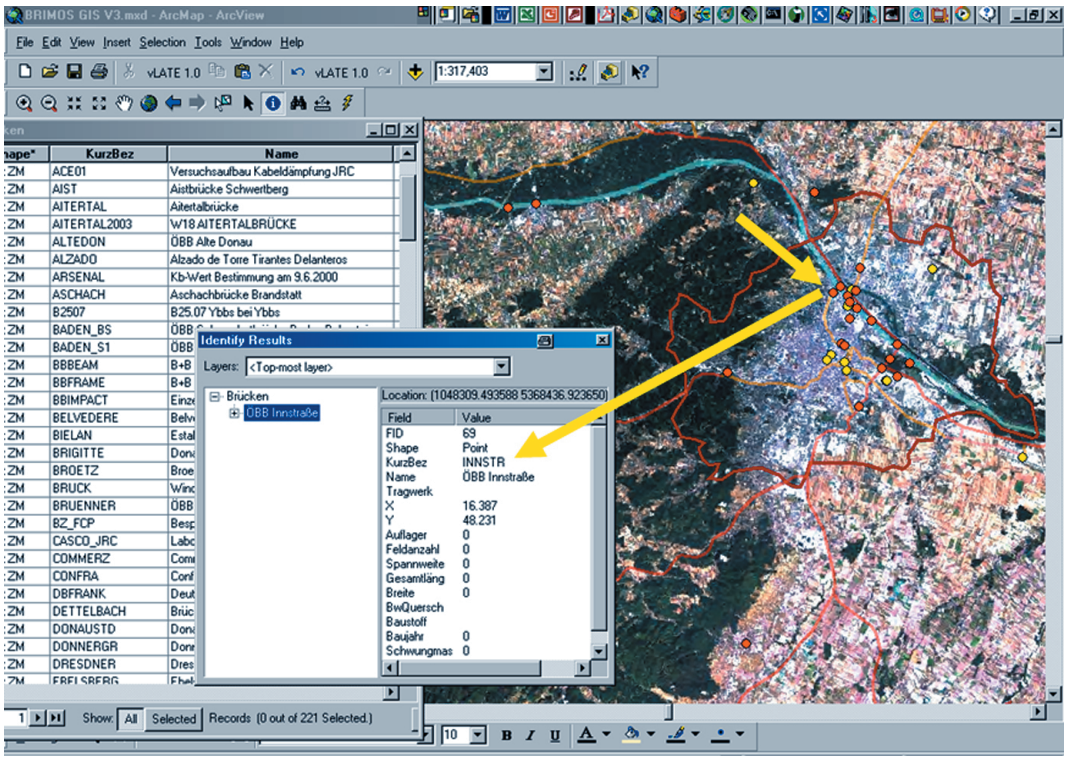


1200 tons at 10 m/s E-Defense

E-Defense, Japan



EU Knowledge Base, Onthology

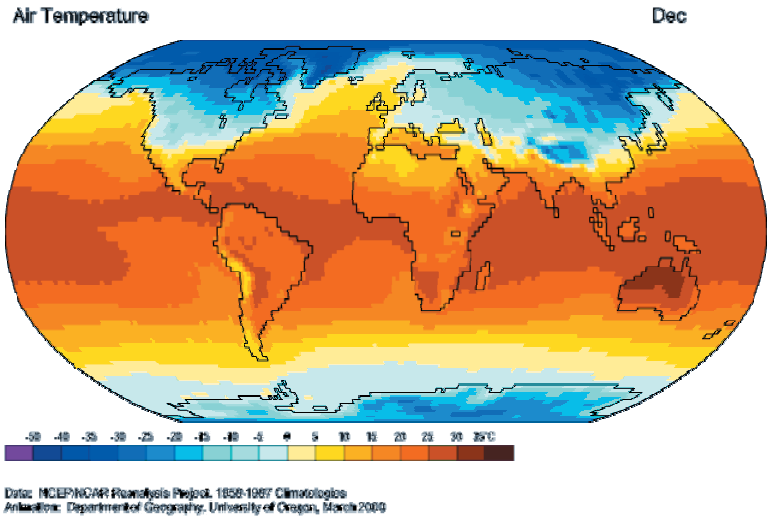


EU knowledge base, onthology

Worldclim

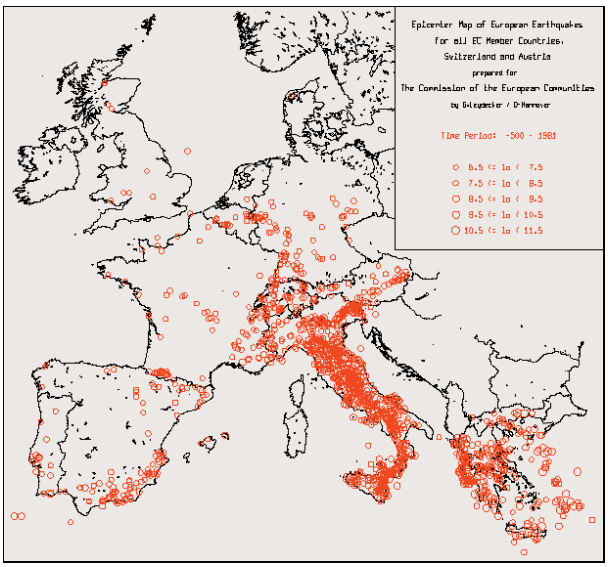
Worldclim is a set of global climate layers (grids) on a square kilometer grid. The last version released (March 2004) is Version 1.2.

The data layers were generated through interpolation of average monthly climate data from weather stations on a 30 arc-second resolution grid (often referred to as "1 km²" resolution). Variables included are monthly total precipitation, and monthly mean, minimum and maximum temperature, and 19 derived bioclimatic variables.



Historical earthquake catalogues

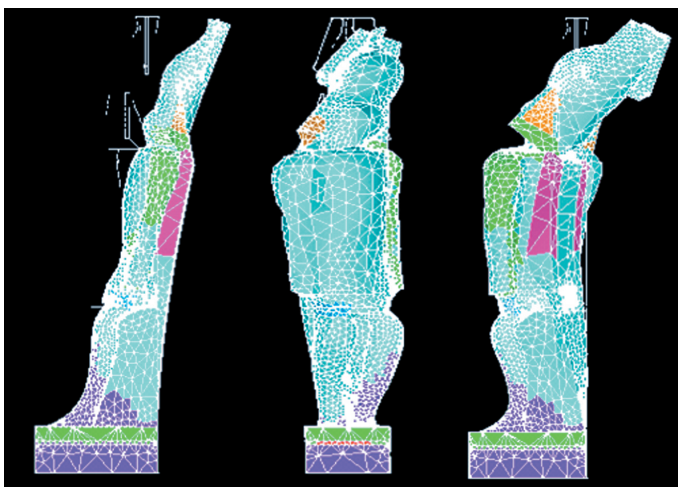
Knowledge of the geological history of the region and the tectonic conditions, earthquake catalogues are a prerequisite for a statistical analysis. Such catalogues of seismic events should be as complete as possible and cover a wide area and a long period of time. Written records of the effects of earthquakes are collected and evaluated, and earthquake parameters, such as location of the epicenter and epicentral intensity, are determined. The results of these studies are compiled in computerized earthquake catalogues.



Opportunities to be taken! Brooklyn Bridge

Condition of the Bridge, Security?
Do we have a European Answer?

Opportunity Ramses II in Egypt
Ramses II
3rd Important Monument In Cairo (Pyramids, Sphinx, ..Ramses II..)
3300 Years Old.
11.4 m High, 120 Ton weight
One Piece of Red Granite
To be Transported for 30 Kms



EU Know how, onthology

Conclusions

- We need International Collaboration.
- The international Partners are well equipped with projects and funds.
- 6FP has left our research alone.
- If the situation does not change soon we will fall back dramatically and cannot take the responsibility for the citizens.
- Can EUROPE really afford this?

Sustainable historical cities – worldwide challenge for interdisciplinary international research

Denis Ricard

Secretary General of the Organization of World Heritage Cities

The Organization of World Heritage Cities is composed of the 208 cities inscribed on the UNESCO World Heritage List as possessing outstanding universal value for mankind. The OWHC was created to assist those cities, which have a combined population of over 122 million, to adapt and improve methods of conservation as well as to promote the most effective management of their heritage, enabling them to reap the benefits of social and economic development, capitalizing on these assets in practical ways in day to day decision making. Many World Heritage Cities are indeed models of good management. Their unique experiences in resolving problems can serve as examples of best practices for use by other cities.

Over sixty per cent of our cities are in countries belonging to the European Union. It is, therefore, one of the main concerns of the OWHC that greater interest be generated and greater priority be given to support the preservation and enhancement of the European cultural heritage. In this realm, Europe has much to share with the rest of the world.

A continent with such a rich and varied history cannot afford to lose the evidence of its glorious past. The European Union with so many historic towns and cities within its boundaries, and not only those on the World Heritage List, must provide those cities with the opportunity for economic and social development.

The World Tourism Organization estimates that about 35 to 40 per cent of international tourist movements have a cultural motivation. This trend is growing and presents a great opportunity to our cities but at the same time a formidable challenge. We must seize this opportunity to renew and augment the life and economy of our cities by showcasing their uniqueness through both their built heritage and their intangible heritage. We must also accept the challenge to provide visitors authentic, local cultural experiences, while taking care to safeguard the centuries-old monuments and traditions and thus to maintain the ability to remain competitive on a long term basis.

Most of us will agree that Cultural Tourism can serve as an incentive to preserve historic monuments, to develop new economic activities, thus creating jobs and revenue, as well as to instill pride in the cities' inhabitants for their cultural heritage. We all, I am sure, have had the opportunity to visit many historic towns in Europe, some forgotten by time, that now have experienced a rebirth with the increased interest in cultural sites.

I refer to cultural tourism specifically, because it is a widely recognized means of promoting economic development based on cultural heritage. However, our World Congress in Kazan, Russian Federation, in June, 2007, will also explore other ways by which heritage preservation can contribute to the sustainable economic development of a city while safeguarding its cultural integrity.

The OWHC has long promoted the cooperation of the various actors involved in cultural heritage conservation and management. It has been said that the OWHC is the only international platform where Mayors, Decision-makers and experts meet together to discuss issues of mutual concern for World Heritage Cities. This synergy of authority and expertise has yielded thus far many positive and significant results in conserving and managing the heritage of our cities.

The job of a Mayor of a World Heritage City is not easy. Most Mayors are not heritage experts but the responsibility of preserving historic monuments becomes theirs once they are elected. To assist the local authorities in this difficult task, the OWHC provides training courses for new Mayors, helping them to become more sensitized to the issues of heritage. We feel that this is of the highest priority because Mayors are in a singular position to understand the needs of their cities, to establish priorities and to implement the results of research and planning. They, along with the Heritage Management Specialists of the cities, know only too well what hangs in the balance and their concern, as expressed to us daily, is great.

It is in that sense that the OWHC would like to support the research in and the evaluation of science supported and knowledge based best practices, which include community participation, in order to safeguard and enhance territorial cultural heritage assets for long-term wealth creation, identity and social cohesion. In this direction, the OWHC would provide information from the cities directly to the researchers, thus giving the opportunity for a more precise assessment of the cities' needs.

The research and development of widely accepted methodologies for evaluation of historic city cultural heritage value and status and the development of verified enhancement planning tools by the city officials could prevent disintegration of monuments due to the functioning of the city. Furthermore, this could bring about a new planning approach for safeguarding historic cities and settlements based on inter-settlement regional and inter-regional grids. The city officials would be able to give greater insight into the problems they face such as demographics, tourism, the need for urban tissue studies relating to urban conservation plans or public space regulations, infrastructure and traffic control.

Historic Cities have often expressed the need to develop advanced systems and tools for the mapping of built heritage and of its state, that is, diagnostics of pathology and decay, within the historic centers. The Cities have also expressed the need to set up integrated knowledge-based decision-making systems that embody advanced diagnostic and monitoring tools, including the use of NDT/GIS based management systems. These systems will combine, in an effective way, the structural, historical, architectural as well as building materials and environmental data in order to assure the compatibility and authenticity of the structures, to optimize their sustainability and to ensure that the historic buildings can be used while satisfying the occupants' needs and standards of living and working.

The diffusion of the advanced know how and methodologies produced by research requires proper educational programmes to build new capacities needed for the protection of cultural heritage within the cities.

To this end, the OWHC would serve as a channel for the dissemination of technology, research results and knowledge of information developed. Our cities could participate in training programs for the protection of cultural heritage in order to recover traditional techniques and knowledge, especially construction techniques and materials, in order to apply reliable conservation procedures. Also our cities could take part in demonstration projects and perhaps to a greater extent pilot projects putting into practice the methodologies that have been developed.

The 7th World Symposium of the OWHC, held in Rhodes, Greece in 2003 dealt with the subject of research. I would like to take this opportunity to thank Prof. Antonia Moropoulou for her contribution to the success of that Symposium as Coordinator of the Scientific Committee.

One of the concepts developed at the Symposium was that of "Historic cities as open labs for research." The Symposium proposed that the evolution in the field of Cultural Heritage protection demands validation of newly developed concepts and strategies in situ. Historic Cities can and definitely should be used as open labs, transferring, applying and validating knowledge produced.

The OWHC, as a network, could serve as a channel of communication to facilitate the transfer of research information to its member cities throughout the world. One of the most successful projects of the OWHC, called City2City, involves technical assistance from our more advanced cities to those cities, mainly outside of Europe, which require help in the area of conservation or management. This project evolved because it is imperative that heritage, which is an essential element of cultural diversity, be developed adequately in the North as well as in the South. In one instance, conservation experts and construction companies from Bergen, Norway have been helping the city of Ilha de Mozambique in carrying out projects. However, there have been other cases where the transfer of expertise has been from North – North and South – South.

The recommendations of the Rhodes Symposium also emphasized the need for Mayors of Historic Cities to realize that cooperation with relevant research, academic and educational institutions is essential in order to achieve the development of knowledge based decision-making systems. For example, the OWHC considers very important the collaboration of our cities in European projects, such as PICTURE, where as End Users our member cities submit comments and opinions on research advancements. Furthermore, the cooperation with local authorities should include relevant ministries of national governments, the construction sector and stakeholders of historic buildings, while recognizing that the European Union funding programs are crucial to the advancement of conservation and good management.

The general theme of the Rhodes Symposium was "Keeping Heritage Alive-Education and Training for the Preservation and Promotion of Cultural Heritage". In the conclusions and recommendations of the Scientific Committee, "keeping heritage alive" was perceived as a situation where sustainable cities include the active participation of the public in the development processes. In such a model of city development, while research becomes a tool to define new concepts and investigate effective, innovative and compatible planning and intervention techniques and materials for sustainable preservation of Historic Cities, education becomes a necessity to keep societies informed.

The public should be involved in research where social and economic problems would be addressed. Perhaps a project posing questions directly to the public would enhance the social aspect of research. On the other hand, the cooperation of Mayors of historic cities with research and academic institutions would offer the opportunity for education to their citizens.

The public must understand the importance of their cultural heritage in order to be convinced of the need for its preservation. The establishment of sensitizing strategies addressed to the new generations of EU citizens is essential. The understanding of thematic and spatial governance in cities would help to better plan future development without harming European cultural heritage, for example the harmonization of transport needs and cultural heritage conditions in territories. In this way, conflict between the local authorities and the community might be avoided. Living in an environment with specific demands requires stricter control, for example, on the use of cars, the treatment of refuse, the type of paint or other materials used for repairing houses, as well as on the practices of businesses in these historic areas. To achieve a positive dialogue

between the local authorities and the public and to ensure the effectiveness of actions taken, requires the support of experts to provide the needed information, arguments and methods.

The pilot programs initiated by the EU also aim to raise public awareness. Synergy is required of experts, local authorities, other levels of government, and the EU in order to bring about beneficial results to this end. The structure is already in place within the framework of the OWHC which could help this synergy to be more effective.

To keep our historic cities alive and full of inhabitants in livable dwellings requires funds from the European and National levels for research and projects, which will ensure that the heritage of humanity remains a heritage with humanity. Time is not on our side. We realize that the stress placed on our monuments by man and the environment he has created, leaves you the scientists and researchers struggling to keep one step ahead of ruin. Even a short pause in your efforts could have irreversible impacts.

The OWHC wishes to contribute to the process that determines needs, disseminates information, addresses social and economic issues and promotes public awareness. Our role in this process and consequently our relation to the research supported within the European Commission programmes should be developed. The OWHC stands ready to join in this crusade for the better preservation of our cities and a better quality of life for our citizens.

Research for historic cities

Jean-Luis Luxen

President of CHEDI, "Culture, Heritage & Development – International"

Background
Why and for whom to preserve historic areas:
- Quality of living environment.
- Urban rehabilitation, a factor of social integration.
- Historic area, an economic asset for community development.

Operational Priority:
- Development of a monitoring tool as an exercise of applied research

Indicators of the state of conservation
A set of indicators to be identified.
Purpose: benchmarking between similar cities evaluating change through periodic comparisons.

Development of an operational, economical, software to be managed by local authorities.

Two types of indicators
- quantitative: statistical on numeric measures (reference to the "Urban Audit" of the Eur. Commission)
- qualitative: based on direct observations, surveys and analyses of sociological nature.

Approach of *multi-criteria analysis* for a collective synthesis and judgement.

Three categories of indicators
Three categories of indicators to be explored by a representative sample of European cities:

- Cultural indicators: (townscape, construction forms, materials and traditional techniques, cultural and historic resources…)
- Economic and Social factors: (income, employment, education, social cohesion, security, housing conditions, mobility, economic activity, tourism…)
- Management of the city: (legal and institutional framework, financial, human and natural resources…)

Challenges of European cultural heritage research: a viewpoint from civil society

Eléonore de Merode

Heritage Awards Co-ordinator, EUROPA NOSTRA

It is an honour for me to be here – to learn from your experiences, but also to share with you some messages from Europa Nostra – the pan-European federation representing civil society committed to the safeguarding of cultural heritage. Our President was unable to be here with us today, but Europa Nostra nonetheless wishes to express its support for cultural heritage research which goes hand in hand with our organisation's own key concerns.

Many of you may be familiar with the *European Union Prize for Heritage – Europa Nostra Awards*, run by Europa Nostra in partnership with the European Commission, in the framework of the Culture 2000 programme. This public competition is the European Union's flagship programme for recognising and promoting best practices in the conservation of tangible cultural heritage throughout Europe. Of course, quality research constitutes the indispensable foundation of outstanding conservation practice. Therefore this European Heritage Awards Scheme includes a category for recognising outstanding studies and the results of research. Through this research category we strive to raise awareness that without the commitment and dedication of research communities who invest considerable time, efforts and resources in finding solutions to complex problems which at first hand appear impossible to overcome, we would not be able to ensure the survival of our cultural heritage for future generations.

I would like to briefly outline *four challenges* that Europa Nostra sees as priorities for cultural heritage research in the future:

1 – to mainstream action benefiting cultural heritage into all EU policies and programmes

Article 151.4 of the Treaty establishing the European Community states that "the *Community shall take cultural aspects into account in its action under other provisions of this Treaty"*. This statement means that cultural heritage should be duly acknowledged and dealt with in all relevant EU policy and action areas – active citizenship, education and training, the environment, taxation, common agricultural policy and rural development, tourism, Neighbourhood and Mediterranean Policy. It is encouraging to see that the cultural heritage has already been integrated in some fields of action of the European Union, such as the Structural Funds and the research programmes, and we hope that it will continue to be taken on board in the successor programmes. However, the potential for using the different Community programmes in favour of culture are far from being completely exhausted. This requires an comprehensive strategy and a common vision, as well as enhanced coordination between the different services and Institutions of the European Union. Such was the core message, which we would like to share with you, of the major European Policy Forum **"***Cultural Heritage Counts for Europe***"** which was held in Brussels last December by Europa Nostra, in cooperation with the European Economic and Social Committee. This has been most recently emphasized in the

Draft Report on the protection of European natural and architectural cultural heritage in natural and architectural heritage in rural and island communities (2006/2050(INT)) submitted four days ago to the Culture and Education Committee of the European Parliament by MEP Sifunakis. Clearly, cultural heritage research would also benefit from this integrated strategy, which calls for interdisciplinarity in research, as well as the exploitation of the synergies between cultural heritage and other areas.

2 – to diversify the fields of research related to cultural heritage

Immense progress is being made in the research on the technical aspects of heritage conservation. However, it seems important that research on other aspects also be intensified. For example: research on the value and benefits of cultural heritage, on the links between the intangible and tangible dimensions of heritage, on the contribution of traditional skills and knowledge to heritage conservation, on the involvement of the private sector, on community participation, on education. Probably, all of us here are convinced that cultural heritage has beneficial impacts on society, the environment and the economy. Activities related to cultural heritage conservation, enhancement and education contribute greatly to the achievement of current EU policy priorities, and in particular the Lisbon objectives (knowledge economy and job creation), the Gothenburg agenda (sustainable development and environment protection), and the promotion of social cohesion and inclusion. We also feel that cultural heritage contributes fundamentally to our quality of life by creating an enjoyable living environment. People derive satisfaction from heritage, which is likely to have positive benefits also on their well-being, which will in turn impact on the economy. Yet, it is not easy to illustrate those benefits with hard facts and figures. However, if we are to boost our case in favour of cultural heritage and convince governments and public institutions that cultural heritage should occupy a prominent place on their agendas, it is crucial that some indicators and benchmarks be developed to demonstrate why and how. We are encouraged in this respect by the recent adoption by the Council of Europe, last October, of the Framework Convention on the Value of Cultural Heritage for Society, which recognises the importance of many of these aspects. However, much innovating and pioneering research still needs to be done in these fields at the European level.

3 – to share knowledge and best practices

The opportunities of and threats to cultural heritage knows no boundaries –similar problems and challenges to conservation occur in different countries. However, with the enlargement of the European Union to 25 extremely diverse Member States – soon to be 27 – the need for multi-lateral cooperation, communication and networks in the aim of sharing information has never been greater. It is therefore important that we mobilise all actors and pool all our assets to work together in favour of cultural heritage and break down the barriers.

4 – to effectively communicate the results of cultural heritage research to the wider public, including civil society

If we are to win over an increasing number of people to the cause of cultural heritage and get them actively involved in its safeguarding, it is vital that the value of cultural heritage and the results of specialised research in the field be communicated effectively. If we wish the results of research to be used and be practically applied to cultural heritage, they should be communicated in a comprehensible and user-friendly manner conservation practitioners and to the end-users, as well as to the decision-makers. The *European Heritage Days* – for which Europa Nostra since very recently acts as the Liaison Bureau in cooperation with the Council of Europe and the European Commission – can serve as a platform for raising awareness and appreciation for cultural heritage amongst some 20 million European citizens who participate in these Days; but

also to make known the efforts undertaken by various stakeholders, as well as the results of research directly or indirectly related to heritage.

I should like to conclude by mentioning that, in light of the constantly and rapidly evolving European environment, *Influencing policy developments at a European level* has emerged as one of Europa Nostra's key priorities for the coming decade. Europa Nostra has responded to the need to provide a platform for coordinating input from civil society organisations and elaborating a true European strategy for cultural heritage, including support for research, by creating *a European Policy Working Group* which has been active for nearly three years now. I hope that many of the enlightening ideas, inspiration and recommendations gained from the presentations and discussions in Prague will be integrated into the agenda and future position papers of our organisation and communicated to the stakeholders. Finally, I would like to state that Europa Nostra looks forward to the future exchanges and collaboration with the organisers and participants of this meeting, in favour of cultural heritage research.

Future cooperation of ICCROM with the European Union

José Luis Pedersoli

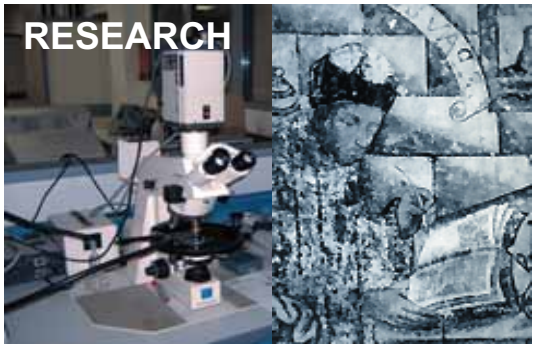
ICCROM

Towards the improvement of preservation and fruition of cultural heritage

1 International Centre for the Study of the Preservation and Restoration of Cultural Property – ICCROM

- IGO with a worldwide mandate to promote the conservation of cultural heritage
- 117 Member States (24 EU countries)
- Established in Rome in 1959 following the decision made at the 9th UNESCO General Conference in New Delhi, 1956
- ICCROM aims at improving the quality of conservation practice as well as raising awareness about the importance of preserving cultural heritage

'Conserving culture, promoting diversity'



COOPERATION

2 Envisaged cooperation ICCROM – EU

CHALLENGES – RESEARCH

NEEDS ASSESSMENT

IMPROVE ACCURACY and COMPREHENSIVENESS

- Share relevant information and data
- Seek interdisciplinary consensus
- Combine networking resources

- Evidence-based.
- End-user integration.
- Stakeholder's interests.
- Avoid duplication.

EVALUATION OF PROPOSALS AND OUTPUTS

IMPROVE DIRECT APPLICABILITY and PROPER USE of RESEARCH RESULTS

- Strengthen the use of interdisciplinary expertise and criteria to evaluate research proposals and outputs.
- Impact forecasting (preservation, access, costs).
- Follow-through research → development.
- Structured user / field validation.

DISSEMINATION and ACCESS

IMPROVE DISSEMINATION of EU RESEARCH OUTPUTS ACROSS THE CONSERVATION-RESTORATION FIELD

ICCROM's international training and information platforms

- Efficient channels and mechanisms.
- Scientific literacy building.
- Europe and beyond.

European collaboration of the Getty Conservation Institute

Tim Whalen

Director, Getty Conservation Institute, USA

Key words: international research collaboration, conservation

The **7th European conference on the Cultural Heritage** is the *culmination of many years of effort to bring together the diverse expertise residing in* all corners of Europe to focus on a single purpose: to ensure the long life and proper stewardship of the cultural heritage of Europe for future generations. The theme of this session – *Europe's Cultural Heritage Research within International Context and Cooperation, is* an important one and I will share a few thoughts on this topic with you this morning. You have already heard from my distinguished European colleagues, so I hope to give you a somewhat different perspective.

As Director of the Getty Conservation Institute – an international institution dedicated to the conservation of the visual arts – I applaud your focus on *research* in conservation and wish to congratulate *first* the researchers here today for all of your efforts; *second,* the European Commission for continuing to fund important research in cultural heritage and *third,* the Czech Republic for playing a special role in helping to catalyze the exchange of knowledge about cultural heritage conservation. This *exchange of knowledge is the result of a series of 18 expert meetings in Prague* organized by, and through the leadership of, Miloš Drdácký and his colleagues since 2001, one of which was co-sponsored by the GCI. Putting together 18 meetings in five years is indeed a remarkable accomplishment, and deserves a special acknowledgement.

When the Getty Conservation Institute was created in 1985, we used the important centers of conservation expertise in Europe as a model especially for our science department. Research is at the core of our mission to support the field of conservation and 20 out of 100 GCI staff members are research scientists. The GCI also hosts conservation scholars, interns and visiting scientists from around the world.

The vision of the first directors of the GCI was to work primarily in those areas where we perceived the greatest need, such as endangered archaeological sites in China, Latin America and Egypt. As the GCI has matured as an institution over the past 20 years, I think we have all come to the realization that the global needs of the World's heritage require a global response. As all of us in the field of conservation have seen, globalization, environmental change and tourism each day present us with new threats and challenges, while resources for dealing with these issues are scarce. However, globalization has also made working together easier and distance less of a barrier. Our collective experience, expertise and best practices in conservation can now be connected and disseminated globally. Just as global trade has increased and we become economically more specialized and interdependent, conservation research also appears to work best when specialized teams can be brought together to form collaborative networks to solve problems. No one has a monopoly on good ideas for conserving heritage and we can expect many future innovations will come from outside the immediate field of conservation.

As I look back on the experience of the GCI in conservation research, I would argue that developing effective partnerships has been the most important key to successful projects. Moreover, as we move forward in our work at the GCI, I look forward to working even more closely with our European colleagues. Let me give you two examples of the kinds of partnerships I am talking about and then I will briefly mention a few other collaborative projects with European partners.

Here in Prague, in1992, the Getty Conservation Institute and the Office of the President of the Czech Republic began collaborating on the conservation of *The Last Judgment* mosaic on St. Vitus Cathedral. Completed in 2003, this project would not have been successful if we had not had the wonderful support of three partners: *first,* the political support of the *Office* of the President was essential to give us the time needed to do the extensive research necessary to find a solution, *second,* the dedication *of* the Czech conservators and their detailed knowledge of the mosaic were essential in the research process and critical in the application of the solution, and *third,* the Materials Science Department at the University of California was important in developing a range of possible solutions. The GCI provided the core of the research team, but without any one of the partners the project would not stand today as an important example of innovative applied research in the field of conservation, as well as a general solution to the broader conservation problem of unstable glass in polluted environments. I think the two institutional lessons of the St. Vitus mosaic project are that successful collaborations are at the heart of innovative and creative work – and that finding real solutions to difficult problems can require long-term commitment.

Now I want to talk about a new project that is just starting. I recently signed an agreement with the European Commission for the Getty Conservation Institute to participate as a full partner in a 6th Framework scientific research project on the Desalination of Historic Masonry. This project has 10 partner institutions – mostly from Italy, France, Germany and Holland – and will be completed in 2009. As is well-known, environmental problems such flooding have damaged cultural heritage here in Prague, in Venice, and in New Orleans. This research project will help provide guidelines to conservators for the treatment of salt-laden brick and stone buildings. As I write this letter, GCI scientist Dr. Eric Doehne is in Venice participating in the first meeting of this EC project. At the end of the project, the Getty Conservation Institute hopes to hold a workshop in New Orleans to disseminate the results of the research, while similar workshops will be held by the other project partners in Italy, Germany and France.

There are many other projects where the Getty Conservation Institute is collaborating with a wide range of conservation professionals and scientists, especially in Europe. Two recent examples include the *"Modern Paints"* initiative, a collaboration between the Tate Modern, the National Gallery in Washington DC and the GCI to ensure we can identify and conserve the materials found in modern paintings. Modern Paints Uncovered, a conference on this topic was just held at the Tate Modern in London May 16-19th. In addition, the GCI project *"Organic Materials in Wall Paintings"* recently held a conference in Torino at the newly created Conservation Center at the former Royal Palace of Venaria. This conference brought together experts in wall paintings conservation and organic analysis from institutions in Europe and the United States to enhance the way conservation science supports the conservation of wall paintings.

In this brief time, I hope I have given you an impression of the importance of international collaborations in our research in cultural heritage at the Getty Conservation Institute.

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