HERITAGE PROTECTION
FROM DOCUMENTATION TO INTERVENTIONS

Proceedings of the EU-CHIC International Conference on Cultural Heritage Preservation, 29 May - 1 June 2012, Split, Croatia

Edited by: Roko Žarnić, Vlatka Rajčić, Barbara Vodopivec
HERITAGE PROTECTION. From Documentation to Interventions. Proceedings of the EU-CHIC International Conference on Cultural Heritage Preservation, 29 May – 1 June 2012, Split, Croatia


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Edited by: Roko Žarnić, Vlatka Rajčić, Barbara Vodopivec

Published by: University of Zagreb, Faculty of Civil Engineering

2012

Printed in Croatia

Price: 48 EUR

The production of this publication was supported by the European Commission in the framework of the 7th Framework Programme, Coordinated Action “European Cultural Heritage Identity Card, EU-CHIC”, FP7-ENV-2008-1, GA 226995.
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CULTURAL HERITAGE IDENTITY CARD - EU-CHIC

Roko Žarnić

The Coordinated Action 'EU Cultural Heritage Identity Card' (EU-CHIC) proposes a strategy for the use of the most efficient methods and tools to harmonise criteria and indicators for tracking environmental changes, and human interventions, on tangible cultural heritage buildings and assets across Europe and its neighbouring countries. It demonstrates how significant cost-benefit advantages can be achieved for all owners, managers, authorities and conservators who are charged with the protection of such movable and immovable assets. Through promoting the monitoring and systematic reporting of all human and natural changes-of-state, the application of the EU-CHIC results aim to assist in making the most appropriate knowledgeable and relevant economic choices for effective preventive conservation work.

The main objective of EU-CHIC was to develop and test guidelines that are required for the efficient compilation and storage of data pertinent to each asset under observation. The emerging systems aim to support sustainable maintenance, preventive conservation, and the rehabilitation of historic sites and monuments. They will also assist in the application of newly developed strategies designed to evaluate efficiency, and in the creation of user-friendly methodologies used for screening time-varying changes to heritage buildings as a result of human intervention and environmental impact. Participating Action partners will promote and assist in the introduction of the EU-CHIC results in their respective countries, and further facilitate their use in neighbouring countries through links with governmental and other authorities responsible for cultural heritage protection and preservation work.

Coordinating activities at a national and international level, the consortium consisted of 12 partners from 11 countries - Slovenia, Austria, Belgium, Croatia, Czech Republic, Germany, Greece, Israel, Italy, Poland, and Spain. Development of the Action was achieved through the activities of four core Work Packages, supported by coordination and dissemination activities. The main tasks of the project were to:

- Review and document current methodologies and tools for data collection and assessment;
- Develop criteria and indicators for risk assessment;
- Develop guidelines for future development of methods and tools for the collection and storing of data required for evaluating time-varying changes of heritage assets; and,
- Consolidate recommendations and strategies, adjusted to the particular needs and heritage preservation approaches in different European and neighbouring countries.

A significant future aim of the EU-CHIC Action is to stimulate and/or assist in the creation of new initiatives for the regular monitoring and inspection of historic buildings and monuments in a manner similar to that implemented by the "Monumentenwacht" organisation in the Netherlands, and Flanders Region of Belgium. Such initiatives are anticipated in the various project beneficiaries’ countries and regions with the guidance and support of the projects’ Advisory Network and Committee. The five EU-CHIC Advisory Committee members, from Egypt, France, Norway, United Kingdom (Scotland) and The Netherlands, aim to lead the EU-CHIC Advisory Network and assist in cooperating with those responsible for safeguarding the cultural heritage, and with other stakeholders involved in heritage protection. The participation of Advisory Committee members in Steering Committee meetings have also contributed to an adaptation of the project goals and achievements to help meet, and address, real end-user needs.

The final EU-CHIC conference, entitled 'The International Conference on Cultural Heritage Preservation', held in Split, Croatia, will be an opportunity to present the background and achievements of the Action to a wider professional community, and to receive critical observations on the project outcomes through discussion. As the project concludes in September 2012, the Conference conclusions will be incorporated in, and assist in refining, the final EU-CHIC results.

May 2012

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EU-CHIC CULTURAL HERITAGE IDENTITY CARD: 
ADVISORY COMMITTEE SUMMARY

Ingval Maxwell

To be fully effective in the conservation, repair and maintenance work on any structure requires the need to have appropriate information to hand upon which to guide the pragmatic decision-making processes.

The genesis of the FP7 EU-CHIC project stems from the Cooperation in Science and Technology programme “COST Action C5: Urban heritage–Building maintenance” that was launched, with 15 representative member countries, in 1996. In its Final Report, published in 2002 (EUR 20447; ISBN 92-894-4138-0; Office for Official Publications of the European Communities), Action C5 pointed out “Europe preserves the most important part of world built cultural heritage, but up to now no common criteria for its evaluation have been established”. In consequence, the Action established an ad-hoc working group that developed a ‘Framework of Evaluation Criteria’ that was systematically elaborated “for future use on the European level in the field of building maintenance”. The Action also recommended that this framework “needs to be explicitly and carefully defined and could perhaps best be endorsed through the mechanism of a Building Card, Passport, Maintenance Manual or Logbook for each appropriate property”.

On promoting the need for a ‘Building Identity Card’, the Action C5 report also stated, ”To rehabilitate and restore the building, one must have a comprehensive understanding of individual building characteristics. It must also be possible to evaluate and assess ancient structures and materials within a standard procedure and according to quantifiable and objective criteria. The “Building Identity Card” project will create such an analytical framework, usable for several European countries”.

Initiated in September 2009, the 36 months duration of the European Cultural Heritage Identity Card project appropriately picks up on this recommendation. Through a consortium of 12 partners from 11 countries, participants have been committed to coordinating their activities at both national and international level.

In the spirit of mutual cooperation and sharing, significant and progressive developmental workshops have been held in Vienna, Ljubljana, Ravenna, Olimje and Athens. Each of these have significantly refined and enhanced the emerging outcomes from the programme through the recognition that associated activities in seemingly unrelated fields can be of considerable value and relevance.

Of particular note, the October 2010 Ravenna meeting was especially valuable in the development of EU-CHIC. In considering the various levels that the CHIC outcomes needed to satisfy, the meeting presentations enabled perceptions of the strategic, governmental, tactical, planning and operational levels of activity to emerge in an integrated form.

Similarly, a review of the May 2011 Olimje mid-term meeting presentations suggested that possible linkages and beneficial directions could emerge from a variety of concurrent projects, and this has had a positive bearing on the final outcomes of the project.

From the outset it has always been recognised that a major challenge for the future uptake of the EU-CHIC outcomes was to ensure that they had sufficient acceptance by a wide range of end users. This has determined that each stage of its final proposals have had to be ‘fit for purpose’ - where different requirements have had to be determined for different levels of need, and that the pyramidal approach to structuring, collecting and disseminating data was the correct approach to follow.

Considerable effort has gone in to developing and evolving details throughout the project, and all participants, project partners and beneficiaries are to be congratulated on the high-level contributions they have made to its complex challenges and intentions. The overall results, as presented at the Final Conference in Split, in May 2012, and through the pending Final Report, due in September 2012, are to be warmly endorsed, and encouraged, for that anticipated widespread uptake.

May 2012

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The International EU-CHIC Conference

Vlatka Rajčić

The International Conference on Cultural Heritage Preservation in Split, Croatia, will take place during the concluding stage of the EU FP7 Coordinated Action project “European Cultural Heritage Identity Card, EU-CHIC”. It aims to present new research and developments in the preservation and conservation of cultural heritage across Europe, and its neighbouring countries.

The Conference has five thematic topics. Four will present the results of the main EU-CHIC work packages, whilst the fifth will offer the latest progress and results of projects related to cultural heritage preservation financed by the EU Framework Programme 7.

Topics covered by the Conference are:

1. Documenting cultural heritage – history and innovation:
   • History of cultural heritage documentation; impact of the digital era on cultural heritage documentation; good practice examples
2. Surveying and monitoring techniques and systems:
   • Methods, tools and techniques applicable to cultural heritage survey and monitoring systems
3. Damage risk assessment:
   • Mitigation of natural hazard due to sudden events (earthquake, fire, floods etc.), and long-term impacts (deterioration processes, climate change, anthropic pressures)
4. Policy making, legal and economic aspects of cultural heritage preservation:
   • Knowledge based decision making procedures, and awareness transfer; sustainable tourism developments; EU Cultural Heritage Label; EU directives; standardization (CEN, ICOMOS CIPA); and,
5. Concluded and on-going projects relating to cultural heritage preservation:
   • SMooHS; Climate for Culture; Perpetuate; Elaich and Populous.

Altogether, 33 speakers are expected to address the above topics: with five in the first, seven in the second, three in the third, eleven in the fourth, and seven in the fifth. All speakers have contributed to the extended abstracts published in the Proceedings, with full papers being collected and compiled over the next few months. These will be published in the final EU-CHIC publication that will be made available at www.eu-chic.eu. In addition, 14 full papers presented during two earlier EU-CHIC Workshops will also be published in the Proceedings. These include nine illustrative cases of built heritage documentation systems presented during the Vienna Workshop on 29 April 2010, and six contributions related to practical applications of assessment methods and tools presented to the Olimje Workshop on 30 May 2011.

Concluding the Conference, a special Round Table event entitled “From current to future research in Cultural Heritage” will be held. During this, the future financing of the research requirements of European Cultural Heritage will be discussed, and a strategy outlined to achieve as much beneficial work as possible from current and future projects.

May 2012

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ABSTRACT: The paper presents a historical outline of the institutional development of monument protection in Slovenia, from the middle of the 19th century until the present day. Special emphasis is given to the development of the basic concepts of Slovenian conservation theory, and to the evolution of documenting cultural heritage assets. Illustrating the relevance of the EU-CHIC methodologies for Slovenia, three systems are presented in detail: the national Cultural Heritage Register; a system developed by a private company; and another developed in the framework of the national research project.

KEYWORDS: EU-CHIC project, Slovenia, monument protection, conservation theory, documentation methodologies, cultural heritage register

1 HISTORICAL OUTLINE OF MONUMENT PROTECTION IN SLOVENIA

Slovenian cultural heritage conservation, protection and preservation derive from the legacy of the Austro-Hungarian monarchy and, as it is also the case with many other Slavic nations under the Habsburg sceptre, it follows the tradition of the famous Vienna art school. Even although a growing interest in Slovenian monuments can be traced from the early 16th century, the Slovenian conservation profession was only formally defined under the jurisdiction of the Imperial and Royal Central Commission for Researching and Preserving of Monuments (Kaiserlich-Königliche Central Commission für die Erforschung und Erhaltung der Baudenkmale) from its inception in 1850. A student of the Vienna art school, Slovenian art historian, Fran Stele (1886-1972) can be identified as the founder of the Slovenian conservation profession. His approach was based, above all, on the teaching of Alois Riegel (1858-1905), Max Dvořák (1874-1921) and the German art historian, Georg Dehio (1850-1932). Placing Slovenian conservators in the heart of the central European development, »Konservieren, nicht restaurieren«, and the recognised value of the aging of monuments, were leading principles of the Slovenian conservation profession, at least until the final decades of the 20th century. The third reorganisation of the Central Commission in 1911 (after those of 1853 and 1873) established three decentralised regional offices in Slovenian territory in Ljubljana, Graz and Pula. Although this rather fragmental institutional organisation caused no considerable delay of the Slovenian conservation profession behind the emerging European trends, the Commission was again reorganized in 1918 after the fall of the Habsburg monarchy, when the Ljubljana regional office became the Monumental office for Slovenia. Parts of Slovenia, in the north, went under the jurisdiction of the Klagenfurt office, and the littoral part passed to the Trieste office. It was in this period, that the Ljubljana office started to work systematically on the documentation of monuments, and on the first Slovenian topographical projects. The end of the 2nd world war in 1945 not only changed the political system in Slovenia; it also marked a new step forward in Slovenian conservation doctrine. This was based on the acceptance of several international charters and conventions by the state of Yugoslavia. The Slovenian Peoples’ Assembly adopted Regulation on protection of libraries, archives, and cultural and historical monuments and of natural phenomenon on 27 January 1945 even before the federal state adopted the federal law on monument protection on 23 July 1945. The establishment of the Institute for protection and study of cultural and natural monuments in Ljubljana soon followed the Federal law on 27 August 1945. This Institute replaced the Monumental office for Slovenia.
from the interwar period. The Slovenian Peoples’ Assembly adopted a Law on protection of cultural and natural monuments on 19 May 1948 and, in accordance with it, in 1950 it renamed the Institute to the Institute for the protection of monuments of the Peoples’ Republic of Slovenia. Monument protection came under the jurisdiction of the Republic of Slovenia, and it jointly covered cultural and natural heritage. The 1950’s were a period of a great decentralisation in Yugoslavia, and the protection and implementation of protective measures for monument were passed to the regional and municipal museums, and monumental commissions. The National institute, however, continued to practice several conservation tasks, such as, the assessment of war damage; evidencing of the monuments devoted to the liberation movement; recording of archaeological and ethnographical monuments, and the proclamation of monuments. In the 1960’s the protection of monuments embraced new concepts, such as the protection and preservation of old towns and cultural landscape, whilst the 1970’s introduced an interdisciplinary approach to the conservation profession. Until then, conservation was predominately in hands of historians and art historians but, in consequence, other professions, such as scientists, archaeologists and ethnologists, became involved in the field of the monument protection.

The Law on protection of cultural monuments (1961) transferred the regional commissions to the regional institutes for the protection of heritage, and the Law on natural and cultural heritage (1981) formally and officially extended the public service for the protection of monuments into both cultural and natural heritage. Even although it was always conceptually seen as a related field, from 1946 the official interest for the natural heritage had been placed under a special department of the institute. From 1981 the regional institutes became institutes for the protection of cultural and natural heritage. New terminologies, typologies and categorization of monuments were developed (in accordance with international documents), and new proclamation procedures were determined. Above all, heritage protection became more and more correlated with spatial planning procedures.

The proclaimed independence of Slovenia in 1991, and related historical developments, awoke many national feelings. As a result, national symbols were employed to far greater extent than at any time in the former Yugoslavia. Thus, the importance of cultural heritage (moveable and immovable) greatly increased and this resulted in placing heritage protection requirements in the constitution of the new state. Heritage, being a constitutionally protected category, continues to play an important role in Slovenia. From the integration of Slovenia into the European Union in 2004, heritage persists as a national ‘anchor’ that is increasingly employed as one of the elements of a global sustainable development paradigm. Currently, many hope this will offer an alternative, and a solution, to the present crisis. Institutional and legal developments followed this conceptual evolution.

In 1995, heritage protection experienced a division of cultural and natural heritage protection requirements, and this was followed by the abolition of the Institute for the protection and institutional reorganization. The cultural heritage office passed into the jurisdiction of the Ministry of Culture, whilst natural heritage passed to the Ministry for Environment and Spatial Planning. A Law, adopted in 1999, gave legislative confirmation of this divided approach to the heritage protection. In 2004, the Slovenian state administration was reformed and, to this purpose, a public institution - the Institute of the Republic of Slovenia for the protection of cultural heritage was established, and the Directorate for Cultural heritage of the Ministry of Culture of the Republic of Slovenia formed. At the same time, INDOK – Information and Documentation centre was established at the Ministry of Culture, which amongst other tasks, manages and maintains a computer based Cultural Heritage Register, together with professional support of the Institute for the protection of cultural heritage. In addition, in 2004, the implementation of two EU directives on Environmental Impact Assessment (EIA; 85/337/EEC) and Strategic Environmental Assessment (SEA; 2001/42/EC) followed in a new Environmental Protection Act (2004). This Act established cultural heritage as one of the elements in environmental impact assessment procedure and spatial planning, and involved stakeholder participation in the decision-making process. This development paved the way for implementation of a sustainable paradigm also in the field of cultural heritage conservation.
In 2008 a new Law on Cultural Heritage Protection laid down current principles and the institutional coverage of heritage protection. It also foresaw an elaboration of an overall national strategy on cultural heritage protection. The National programme for culture 2008-2011 gave cultural heritage an important platform in the formulation of priorities: Maintenance and development of cultural diversity of Slovenia with protection of cultural heritage, and the enlargement of its accessibility. Thus, the cultural heritage protection in Slovenia falls under the jurisdiction of the Ministry of Culture. The Ministry performs associated administrative tasks such as monitoring the development of the protection system; preparing system solutions on the protection of the heritage; managing the register; ensuring the development of an information system, and documenting the cultural heritage. Another key institution is the Institute for the protection of Cultural Heritage of Slovenia. Its mission is to perform a public service covering a variety of administrative and professional duties relating to the protection of the immovable cultural heritage, and the movable and living cultural heritage associated with it. The Institute’s approach is not based merely on the numerous procedures linked to the direct conservation of heritage and the prevention of damage. Its key tasks are to identify, document, study, evaluate and interpret the immovable, movable and living heritage, and to present this to the public within the context of heritage protection.

The predecessors of the present Slovenian databases, inventories, and registers, etc., were the historical art topographies and the surveys of the movable and immovable heritage. These were prepared according to the geographical principle, embracing architectural monuments, sculpture, painting, crafts and archive material such as manuscripts and books. From the start, the purpose was to offer systematically arranged sets of data for professional work, and to raise awareness of the heritage value. The first topographies prepared in the 17th century created descriptions of towns, regions and churches and, in the 19th century, the principle of making a detailed inventory of art historical monuments prevailed.

Such initial art historical topographies were develop in Germany during the second half of the 19th century. In a manner similar to the development of the conservation profession, the topographical activities in the territory of Slovenia followed the tradition of the German land. Consequently, the early topographical descriptions of Slovenian towns can be found in German and Austro-Hungarian editions such as the *Kunst-Topographie Deutschlands, Österreichische Kunsttopographie, Handbuch der deutschen Kunstdenkmäler.* The first Slovenian topography, covering part of the territory around Gornji Grad, was methodologically based on the Austrian model, and was published in 1905 by Avguštin Stegenšek (1875-1920). Presently, Slovenia has not yet achieved an integrated topography, as scientific and professional work has been limited to specific areas. The topographical approach for the region of Kočevska (carried out in 1947, and published in 1968) is worth mentioning from the methodological point of view. This was achieved as a survey of monuments, along with an integrated attempt to reconstruct them as they were before the 2nd world war.

The Slovenian art history profession believes that, despite the availability of more and more sophisticated computer database systems, topographies must still remain a priority source of information regarding monument protection, and that these should continue to be prepared and published in order to document the current status of the monument and its research. As computer based databases have to be constantly up-dated and upgraded by new findings and data, both approaches need to be combined to provide comprehensive information on each cultural heritage unit.

Since the precise elaboration of a proposal for a joint European approach and system for cultural heritage documentation, and the storage of data, is the core objective of the EU-CHIC project, national documenting systems can, vice versa, benefit from a bottom-up and top-down approach that bring different disciplines and methodological approaches closer together. In Slovenia, one of the first attempts to elaborate an integral documentation system was defined by architect Peter Fister. In 1979 he published “The base and the protection of architectural heritage”, and this is still one of the basic references in the field. Amongst other initiatives, the author established an architectural documentation methodology on the basis of topographic lists, with predefined integral survey elements. In 1993 Jelka Pirkovič published the “Basic terms and concept of monument protection in Slovenia”, where she defined the basic principles of Slovenian monument protection, and related documentation principles that, subsequently, found their place in relevant legislation. Numerous other authors contributed to developments in the field, and their findings have often been published in the leading conservation Slovenia journal “Monument protection”, since 1948.

Cultural heritage is, of course, a subject of much research and professional work in numerous public institutions, museums, archives and other places. Professionals from the state administration, research institutes, the academic sphere and relevant institutions...
jointly cooperate in a number of national and international research projects (noting especially FP7 projects, such as Net-Heritage, Climate for Culture, EU-CHIC and others).

The Cultural heritage register (referred to in the next chapter, and presented in more detail in a separate paper) remains the central database of cultural heritage in Slovenia, yet, for example, it still needs to be developed in terms of risk assessment. In recent years several holistic, interdisciplinary approaches to documenting heritage items have been develop in the academic and private sector arena. Two of these are presented in the following chapters; the Populus system of a private company, which is also presented in more detail in a separate paper, and the MIR system, developed as a research project. DEDI system is also worth mentioning, since it brings together national and cultural heritage (see: www.dedi.si). The aforementioned three systems are offered as examples of recent research based developments in Slovenia. Although various emerging initiatives might be seen to threaten and fragment the field of cultural heritage documentation, on the other hand they can enable the implementation of the latest scientific findings on the cultural heritage in Slovenian territory.

2 NATIONAL CULTURAL HERITAGE REGISTER

The Cultural heritage register has been implemented since 1991. It is constantly being upgraded, and is the only cultural heritage interactive database in Slovenia that is fully supported by relevant laws and acts. The management of the register is carried out on a national level by the public service under the jurisdiction of the Ministry of Culture of the Republic of Slovenia, Directorate General for Cultural Heritage, Documentation and Information Centre. This Ministry closely cooperates with the Institute for the Protection of Cultural Heritage of Slovenia, which gives a high level of professional support to the register. Register with GIS application can be found on the web page: http://giskds.situla.org/giskd/

The management of the Heritage Register is determined according to the Cultural Heritage Protection Act (2008). This act defines and determines amongst other matters the “Public interest of heritage protection” (Articles 2, 3); “Subject of public interest (Article 8); and “Registered heritage” (Article 9). It prescribes and determines in Chapter VII “Heritage register and documenting of cultural heritage”: the form of the register (Article 65); the content of the register (Article 66); its management and use (Article 67); access arrangements (Article 68); the method of documenting heritage (Article 69); and the executive regulations (Article 72).

Data sources for the registry are found in the databases of the Ministry of Culture of the Republic of Slovenia, of the Archives of the Republic of Slovenia, and of the Ministry of the Environment and Spatial Planning.

The entry of cultural heritage monuments/sites on the register has certain legally defined implications for the state, community and owners, yet this is not determined by proclamation of the monument. Entries to the register are made on the basis of the Institutes’ professional proposals. Legal conditions and data embrace ownership, and act on the declaration of cultural monuments (among others containing legal protection status). By inscription on the register, each cultural heritage unit gets so called ESD – evidenčna številka dediščine - identification heritage number that is used in all stages of its protection and conservation procedures. Users can, amongst others, always obtain information on the legal status of the unit.

The management of the heritage register is defined in detail by the Rules on the Cultural Heritage Register (2009). From 1991 the register was limited to the immovable cultural heritage but the new Cultural Heritage Protection Act, which introduced the movable, and living heritage register, subsequently developed this. These new rules therefore define the immovable, movable and living cultural heritage.

The Rules on the Cultural Heritage Register define the required data to be used in the description of cultural heritage units in the register (Article 5): basic data, protection data, additional Remarks and annexes (maps, photos, scanned acts on declaration of cultural monument). Structure of data is presented in more detail in a separate article.

Data sets on building elements, the state of conservation and restoration activities, and survey were not foreseen in the legislation and are, therefore, not implemented in the system of the cultural heritage register. However, details of the Protection Regime (in areas of impact, where applicable), values, and justifying declaration are contained in relevant decree.

Figure 3: Scan of the Decree declaring immovable and historical monuments on the area of the community Ptuj (Uradni vestnik občin Ormož in Ptuj, 21.Decembre 1989, number 35)

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2 Detailed description of the system is given in a separate article.
The application of the “Cultural Heritage Registry” enables definition of the heritage units by timeline (unknown; stone-age; metal-age; middle-age (600-1000 AD); middle-age (1000-1500 AD); 16th and 17th century; 18th century; 19th century, and 20th century), and by type of heritage including the definition of borders and areas (historical landscape; archeological heritage; landscape heritage; architectural/garden heritage; memorial heritage; settlement heritage; secular architectural heritage; and religious architectural heritage). A part of the Franciscan Cadastre has just been implemented into the application. The Ministry of Culture is in the process of implementation a joint heritage register as prescribed in the Cultural Heritage Protection Act (2008), i.e. a register of immovable, movable and living heritage. In addition, it has recently added some digitized documents to the cultural heritage units. More than 20,000 documents are incorporated, being sourced from glass plate negatives, slides and the field records of the conservators’ collections owned by the INDOK center. Digital documents from the register are also accessible via the Europeana portal (www.europeana.eu/portal).

The legal regime for the protection of cultural heritage, is called eVrd (www.evrd.situla.org), was established and is managed by the Ministry of Culture. It provides information on the legal requirements that need to be taken into account in the spatial planning of the areas under protection. The Ministry of Culture, and the Surveying and Mapping Authority of the Republic of Slovenia provide the sources of information for the database.

3 CONSERVATION PLAN FOR RENOVATION (POPULUS system)

The company Populus Ltd. (http://www.populus.si/vsebine/podrocje-dela) has been active in the field of urban planning and spatial planning since 1991. Their expertise lies, amongst others, in the elaboration of community spatial plans where they pay special attention to the joint efforts of different professional interests, such as urbanism, architecture, art history, and sociology. Special attention is dedicated to the well-founded integration of cultural heritage in the spatial plans on the one hand, and to the local population attitude/acceptance of the planned space interventions on the other. Cultural heritage, with its historical and cultural value, its tradition and identity value is considered as being a cohesive element of the utmost importance for the well-being of the local population, their quality of life and, last but not least, the economic prosperity of certain environments (tourism, for example), with the focus not only being on the cultural heritage unit, but also on the area and space as a whole. The identity of place offers a more comprehensive understanding of the living and, at the same time, the permanent character of monuments, sites and cultural landscapes. This approach provides a richer, more dynamic, and inclusive vision of cultural heritage. The identity of place exists, in one form or another, in practically all cultures of the world, and is constructed by humans in response to their social needs. The communities that inhabit place, especially traditional societies, should be intimately associated with safeguarding its memory, vitality, continuity and spirituality. Being able to elaborate spatial documents of the highest quality on the basis of the new Cultural Heritage Protection Act, together with the Spatial Planning Act (2007, 2009), introduces the Conservation plan (Rules on Conservation plan, 2009) and the Conservation plan for renovation (2010). The company has developed a special documentary system on the basis that it is related to the well-known GIS system. Their system is designed as a basis for creating cultural heritage protection/conservation guidelines, and conservation plans, of a relevant area, town and/or unit. Three steps, which can also be adopted as separate procedures, are proposed for evaluating the identity of place: (1) preparing data, (2) defining the bearers of place identity, and (3) carrying out evaluation workshops. One of the most unique elements of the Populus system is the incorporation of the Charrett methodology. Here,
the company carries out a sociological based survey amongst residents of the area that is the subject of the study and conservation plan. Thus, important information is obtained from the local environment for further elaboration in the spatial planning. This survey includes both residents and local experts. Following the graphical representation of the survey results, it can be seen that there are practically no differences between the residents’ and experts’ evaluation, except for the intensity of the response.

Figure 6: Index sheet no. 16 showing evaluations of significances by experts and local residents. (Original in Slovenian)

The Populus Company has already implemented the system and uses it as a base for the preparation of community spatial plans. The system is readily applicable to other established systems and databases, such as that of the Ministry of Environment and Spatial Planning; the Ministry of Agriculture, Forestry and Food; the Ministry of Culture, the Surveying and Mapping Authority of the Republic of Slovenia, and community databases of spatial plans.

4 RESEARCH PROJECT “ART AND WAR. THE DEVELOPMENT AND DEMONSTRATION OF THE MODEL FOR PLANNING CONSERVATION OF CULTURAL HERITAGE OBJECTS IN WAR CONFLICTS”

Over a period 2007-2009, the Franc Stele Institute of Art History of the Scientific Research Centre of Slovenian Academy of Arts and Science, University of Ljubljana, Faculty of Civil and Geodetic Engineering, and the Building and Civil Engineering Institute (ZRMK Institute) carried out a scientific project, entitled “Art and War”. Financed by the Ministry of Higher Education, Science and Technology and the Ministry of Defence of the Republic of Slovenia (CRP MIR Project) the main objective was to develop a methodology for a detailed system of documenting to enable the renovation, protection and conservation of cultural heritage objects in the event of war, terrorist attack or natural catastrophe. In the course of the project an application was developed and proven on a sample of 35 sacral objects that were selected by art historians on the basis of several criteria: characteristic elements for sacral objects, age, history (e.g. several reconstructions); materials (various building techniques); a large range and height of constructional elements; and special construction solutions (domes, pillars). Risk assessments were prepared in the event of natural disasters (earthquakes, floods, avalanches and other large scale accidents), hostilities, and terrorist attacks (the presence of nearby potential targets, and the facility access control), and several models of construction stability assessments were tested in the projects’ pilot phase.

The general aim of the project was, and still is, to promote the database as a central source regarding seismic safety, and the assessment of damage and risk vulnerability of the sacral objects. Such a documentation database could enable the determination of a priority list for renovation, and the economic impact analysis of these and other interventions.

The application is not yet implemented, as it still exists in the pilot/test phase. However, the developing methodology is interesting, and it has the potential to be integrated in one of the existing or forthcoming models because of its applicability (it has, for example, incorporated a ESD number that enables a link with the Cultural Heritage Register). Moreover, further research on the project would be of a great importance, as it would result in a system and methodology applicable to every documentation method, required in the field of preventive conservation, and in the protection of cultural heritage as a whole.

Figure 7: General methodology to determine protection, renovation and reconstruction measures. The first phase of collecting and documenting is followed by an analysis, and is concluded with relevant proposed measures (protection, conservation, renovation) or interventions (reconstruction).

The work methodology to obtain and complete template forms, derives from the development of a relevant
database system and terrain survey work carried out by an interdisciplinary team. Each part of the template is filled in for every selected cultural heritage unit (35) by different approaches, or through data obtained from the databases of the Ministry of Culture, and the Surveying and Mapping Authority of the Republic of Slovenia where elements of their computer database, was specially developed for the project.

The home page of the database, entitled “Database on Conservation of the art historical heritage”, gives several entrances to the base core:

- Add new object
- Edit entry (ID data)
- Edit entry (state of the object)
- Find object

In addition, it provides an extended enabling search engine, to find an object by its ID number, type, municipality etc. It is possible to generate several different views and reports:

- List of objects by art history category
- List of objects by municipality
- List of objects by the responsible regional unit for the protection of cultural heritage
- List of surveyed objects.

Reports can be further generated on several additional categories (e.g. state-of-the-art, etc.).

Pages of individual objects, prepared in the standard format, were developed solely for the purposes of the project. These are divided into several sections:

- Object ID data (name, address, GSP coordinates, end-rates, EŠD – Identification heritage number, derived from the national Cultural Heritage Registry and remarks)
- Basic data (original name, people’s name, regional unit, responsible for the protection of cultural heritage, administrative unit, layout, cadastral unit, plot number, historical survey – date, description and architect of the registered intervention; building and other interventions – date, description; data on connection to the water, electricity, hot water gas or any other network)
- Facade (photo material, drawings etc.)
- Position of the object (4 primary and secondary compass orientations; geomorphologic position - plane, valley, edge, terrace, hillside; urban position – in/out/edge of the settlement; dominant position – giving 8 possible definitions; layout – simple, forked, combined; protection – neighbouring critical objects with description and risk factors; situation – GIS photo with area borders)
- Architecture (architectural and art historical description, architectural importance/value, art historical category – monument of national importance, in the process of declaration, being proposed for declaration, art-historically important object, not art-historically important object, no data; remarks)
- Files (List of all related files with links - photos, drawings, scans, sketches, documents, maps, plans of building constructions etc.)

- Building elements with filters: construction, architectural elements and tangible heritage objects. Each element is described by element name, part of the building, mark, type, material, length, width, height, direction and remarks.

The database developed a code-list methodology for the majority of sections and elements included in the survey. These code lists can be divided into identification data (elements; GPS coordinates; materials; municipality; object description; type of building; parts of the object; historical development; monument importance; administrative unit; state-of-the-art survey with use; visit density; building condition and maintenance definition; state-of-the-art survey of elements from the point of conservation; threats; protection view) and assessment data (risk assessment; vulnerability factors; damage mechanisms; threats/risk type; conservation state; interventions; damage; damage assessment; damage status; value and type; proposed conservation measures; proposed management measures; and proposed protection measures).
The project “ART AND WAR” has been limited to sacral cultural heritage objects and has been developed for a certain type of risk and the potential of damage during war, or from a terrorist attack. With additional upgrading it can be extended and adopted for other types of cultural heritage objects to also include major nature disasters and catastrophes, such as earthquake and flood. An important next step would be to further develop the risk assessment methodology (the weighting method as mentioned above) and to explore possible synergies with current existing and developed documentation systems, including the national Cultural Heritage Register. To achieve that, a lot of coordination work between the different institutions is required. As one of the basic objectives of the EU-CHIC project is to harmonize the approach to documenting cultural heritage at the European level, such a project could contribute to the further development and unity of the system. The starting point to implement such synergies on the national level could be the:

- So called ESD – identification heritage number - giving information on the protection regime of the cultural heritage unit and, as it is used in all three systems, to ensure a link with the register;
- Adequate use of standards (see Guidance on Inventory and Documentation of the Cultural Heritage, Council of Europe: 2009);
- Linking with existing databases incorporated in the system.

**ACKNOWLEDGEMENT**

This paper has been prepared in the framework of the EU FP7 project EU-CHIC: the European Cultural Heritage Identity Card. Expert support from Mrs. Darja Marinček Prosenc from the Populus Company, from Mrs. Ksenija Kovačec Naglič of the Slovenian Ministry of Culture, and language editing by Mr. Ingval Maxwell, is greatly acknowledged.

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CUTURAL HERITAGE LEGISLATION (selected for immovable heritage)

- Exercising of the Public Interest in Culture Act (ZUJIK, 96/2002)
- Cultural Heritage Protection Act (ZVKD-1; OGRS, 16/2008)
- Environmental Protection Act (ZVO-1; OGRS, 41/2004)
- Rules on Cultural Heritage Register (OGRS, 66/2009)
- Rules on Conservation Plan (OGRS, 66/2009)
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ABSTRACT: The present contribution does not intend to provide a comprehensive view on the CHIC project; its goal is to outline some relevant aspects to be adequately considered in the design and implementation phases of the project. The set of selected aspects includes: archiving standards and available data, minimum standards ensuring sustainability, interoperability of data, information system architecture, eGovernment basics, and long term preservation of digital content. These aspects do not cover all the key points to be taken into account in setting up the CHIC but may be considered a reminder in order to ease a fruitful implantation of the ID card.

KEYWORDS: EU-CHIC, eCulture, eServices, ICT

THEME 1.2

1 INTRODUCTION

The state of art of cultural heritage in Europe is well known and evident, the wealth of artworks and goods, expression of every kind of art from graffiti to frescos and architecture, issued along the centuries care of different people that inhabited the continent from Greeks to Renaissance and over, characterises uniquely the European cultural heritage. It sounds strange but it is this cultural wealth that causes problems that trouble the European Art. The present contribution will mainly focus on “built heritage”, even if major part of the topics may be shared by all kinds of heritage including the intangible one.

2 SOME ITALIAN INITIATIVES IN THE RECENT PAST

The Information Communication Technologies are transforming our way to work and to live. Their social and economical impact represents a key opportunity for new development in every field of knowledge. Another event is the awareness of the importance of cultural heritage, and the needs of exploit and manage it: the number of visitors to museums, historical monuments and archaeological sites, grows day by day.

The extension of the concept of cultural heritage of various nature, the relationship between their conservation and the relative fruition issues new challenges such as the combined utilisation of various databases online, the creation of supranational and multilingual dictionaries. The rapid obsolescence of technologies furthermore imposes the attention to data storage. However, the aspects, which most involve the online user, are both the interface and easy access to different subjects and contents.

This paragraph will provide a general overview on different approaches developed in Italy care of Regione Lombardia: SIRCoP, MMS and MIMS projects. Regione Lombardia was and still is one of the leading authorities at national level in the field of planned conservation. The S.I.R.Co.P. (Scheduled Conservation Information System) was launched by Regione Lombardia in year 1999 within a research and training framework related to the ICR work on “Risk Map”. The general framework was derived as a follow up of the risk map and implementation of the basic idea of BAA (Archivio Beni Architettonici ed Ambientali -“environmental and architectural assets” archive) extensions in the field of scheduled maintenance. The HyperMediaGroup of Politecnico di Milano was in charge, together with a team of experts, for the feasibility study and architecture definition of the Information System.

Thanks to the activity of the MEDICI Framework of Cooperation and its international network of cooperating partners the Monumentenwacht experience and its motto “Prevention is better than care” was a key reference from the early beginning of this regional project.
In the S.I.R.Co.P. vision the Information System acts as glue amongst different modules and activities foreseen archiving and managing information and data. One of the relevant issues is to turn the “extraordinary maintenance” trend toward “scheduled maintenance”. Unfortunately even today many aspects are pushing “extraordinary maintenance” including both financial and fiscal aspects and procedures; such a trend implies the lack of authenticity of historical artefacts and major costs.

On the opposite S.I.R.Co.P. promotes scheduled maintenance and conservation according to a timetable and granularity proposed care of experts and the Information System itself.

Starting from the upper level the Information System will collect and redistribute relevant information and case study. Locally it will offer flexible archiving tools and later on it will operate as historical information source useful in order to evaluate the consistence of historical buildings patrimony and keep track of changes and provide support to managers. This will specifically support both political and technical decisions providing priorities and possible pathologies on the basis of technical data base.

S.I.R.Co.P. - Information System - starting from the upper level the Information System will collect and redistribute relevant information and case study. Locally it will offer flexible archiving tools and later on it will operate as historical information source useful in order to evaluate the consistence of historical buildings patrimony and keep track of changes and provide support to managers. In addition the long term data repository provides case study, statistical information and high quality content for educational purposes. This will specifically support both political and technical decisions providing priorities and possible pathologies on the basis of technical data base.

On running conditions all relevant architectural heritage of Regione Lombardia will be adequately stored within the S.I.R.Co.P. data base.

But a truly integrated and modular approach was included in the parallel project called Monuments Information System (MIMS kernel). The idea of MIMS is dated 1997 but after several steps of feasibility study we are now in a position to launch the operational project. MIMS is a comprehensive solution ranging between data acquisition on the field and monument and site exploitation passing through conservation and management. Due to the richness of the built patrimony supervised by national and local authorities one of the weakness is the frequency and quality of technical surveys. In order to fit with available resources many times surveys are performed by students in architecture and civil engineering or poorly skilled personnel. The result is a non-homogeneous quality and frequently unfaithful set of surveys.

### 3 HOW TO SUPPORT SURVEYORS

One of the key features of the solution is the implementation of a dual level survey support system. The main survey support system is based on the belief network theory. The belief network (BN) is a “causal reasoning” tool suitable for a wide variety of applications (e.g. Windows trouble-shooter is based on a similar tool).

In order to provide a well-known example to my students I use to compare the planned conservation model set up by Monumentenwacht to a car maintenance system. We have a user’s manual explaining how to use and every day care, a car service booklet providing planned checks and maintenance and a technical handbook devoted to service centres professionals.

Surveys are in some way part of the activities related to planned car servicing stops. The booklet and/or the car record reports a time or mileage interval and a list of checks and maintenance operations. This list usually depends by the model, type and years of make. The personnel in charge for this task use to perform the sequence of checks and accordingly with the result of each or combination of them they decide how to proceed. From the abstract point of view we can consider each check is a variable. A variable is an element of a probability model that can take on a set of different values that are mutually exclusive and exhaustive.

In the general probability theory framework variables may accept both continuum and discrete values, in order to ease our task we only accept variables with a limited number of conditions (discrete variables), and we call each of the set of possible conditions a “state”. This process is known as discretization and the network of states and relations is known ad Bayesian network.

Everyday life presents us with many situations in which the accumulation of evidence (state) leads to a conclusion.

In probability theory, there is no a priori way of knowing which variables influence other variables. In general, the complete or joint probability distribution must be known to correctly perform inference. A real-world model usually encompasses a very large joint probability distribution (e.g. number of hidden layers in neural networks).
One of the primary roles of a Bayesian model is to allow the model creator to use common sense and real-world knowledge to eliminate needless complexity in the model. The method used to remove meaningless relationships in a Bayesian model is to explicitly declare the meaningful ones.

Following this approach first of all we identify the whole set of variables describing the model. After establishing all the variables in a model, we must deliberately associate variables that cause changes in the system to those variables that they influence. Only those influences will be considered.

The idea is to provide a first support to the surveyor thanks to a network of aimed questions. The surveyor answering to the questions mainly based on visual choices address the system toward the correct path in order to reach the solution or correct observation. Following this support framework, different operators with different skills will provide comparable results ensuring a reasonable uniformity of quality.

Bayesian probability theory is a branch of mathematical probability theory that allows one to model uncertainty about the world and outcomes of interest by combining common-sense knowledge and observational evidence. A belief network is commonly represented as a graph, which is a set of vertices and edges. The vertices, or nodes, represent the variables and the edges or arcs; represent the conditional dependencies in the model. Each arc should represent a causal relationship between a temporal antecedent (known as the parent) and is later outcome (known as the child). Inference, or model evaluation, is the process of updating probabilities of outcomes based upon the relationships in the model and the evidence known about the situation at hand.

Let’s consider as an example a structural wall made by bricks. The system will prompt “do you see any crack”, if “yes” the next node will be “choose one” of the graphic example provided showing the shape, location, and orientation of the cracks. So far the next node may be “look if is there any crack passing through the wall appearing on the opposite side” and if “yes” a potential red flag will be lift up. This is a simple example of node dependency leading to a correct analysis of the scenario. When a Bayesian model is actually used (on the occasion of the survey), the end user (surveyor) applies evidence about recent events or observations (making a choice based on the list provided by the support system). This information is applied to the model by “instantiating” or “clamping” a variable to a state that is consistent with the observation. Then the mathematical mechanics are performed to update the probabilities of all the other variables that are connected to the variable representing the new evidence.

After inference, the updated probabilities reflect the new levels of belief in (or probabilities of) all possible outcomes coded in the model. These beliefs are mediated by the original assessment of belief performed by the author of the model. The beliefs originally encoded in the model are known as prior probabilities, because they are entered before any evidence is known about the situation. The beliefs computed after evidence is entered are known as posterior probabilities, because they reflect the levels of belief computed in light of the new evidence. This is the case of our “red flag” lift up.

In order to construct a belief network we can apply a common set of guidelines:

- Identify and include all variables that are important in modelling your system. Once the set of variables and their states are known, the next step is to define the causal relationships among them. For any variable, this means asking the questions: What other variables (if any) directly influence this variable? What other variables (if any) are directly influenced by this variable? In a standard Bayesian belief network, each variable is represented by a coloured ellipse; this graphical representation is called a node;

- Use causal knowledge to guide the connections made in the graph. Causal knowledge in this context means linking variables in the model in such a way that arcs lead from causes to effects. Use your prior
knowledge to specify the conditional distributions. Each causal influence relationship is described by a line (or arc) connecting the influencing variable to the influenced variable. The influence arc has a terminating arrowhead pointing to the influenced variable. The absence of an arc between two variables indicates conditional independence; that is, there are no situations in which the probabilities of one of the variables depend directly upon the state of the other.

Taking advantage from the availability of smart phones (at that time the HP iPAQ) a second level of support is available thanks to the opportunity to take a picture plus a comment and send it in real time to an expert in the back office.

A relevant module of MIMS application is addressed to provide technical information and case study for educational purposes. Due to the current state of the art in this sector the MIMS project, even if elected as a reference project by ICOMOS, it is not implemented yet even at pilot level.

4 CULTURAL HERITAGE IDENTITY CARD

We can consider the idea to provide and “Identity card” to each artefact movable or immovable and why not intangible sounds interesting and useful. Even more useful if such and ID is de facto much more than a usual ID. It may be an ID including a unique identifier plus a kind of “patient folder”, a user manual and more, much more.

Such a relevant information set, if well-conceived and properly managed though the time might provide a significant improvement in artefacts conservation and management.

Stakeholders and decision makers may operate in a proactive environment; public authorities may extend e-Government procedures to built heritage ensuring a better interaction between owners and authorities. Professionals in restoration and conservation, art historians and curators will take advantage from the use of a similar system. Any tiny bit of information regarding the artefact collected or produced through the time will never be lost or neglected.

Looking toward the top of the management chain a layered set of dashboards will provide an outlook of the information set tailored for the specific user requirements. You may say: CHIC what a magic box! Why not? Let’s shape a similar information system.

Since we start thinking a similar system some major concerns come to the fore.

First of all let’s have an insight about what it is already available in the different European countries. A more or less complete list of artefacts is present almost all over Europe. Such lists do have different formats and data but, more relevant, they collect similar information with different resolution or rationale. Uniform access to different data sets both ad national and international level may be the basic step in order to create added value services. Some countries have developed specific research projects exploring different aspects of cultural heritage management such as the Risk Map or the Choogle data bank.

In parallel with this survey we must start thinking about potential use and added value related to the availability of a similar data set. This means to clearly identify potential end users but even “intermediate” users and their requirements. CHIC may be considered as a kind of information hub acting as an e-Service platform. This means that it will not be limited to support monument management and planned conservation but even touristic or educational services and more. A similar approach may contribute to identify innovative market models ensuring sustainability.

The idea of CHIC in general involves, among the others, both Cataloguing and e-Government aspects. Apart from the identification of the state of the art of the different data collections available in Europe and their level of interoperability a typical cataloguing problem is due to the richness and complexity of the information to be collected and filed.

In order to perfectly fulfil the needs of a CHIC we must collect information and data pertaining to different knowledge domains characterised by different levels of “difficulty”.

As usual when experts sit around a table trying to define a documentation standard they start with 10/15 data and at the end of the meeting 100 are not enough. Of course if we need to describe in detail an “object” taking into account all the potential aspect of the related information set this, at the end, led us to a kind of mini encyclopedia.

The challenge is to build up and populate a well-defined dataset covering as much as possible our heritage. Usually we prefer to deal with 1000 records containing the most relevant information instead of 10 fully described items. Later on we must be able to complete the “information form” filling up the empty fields or even integrate such data set adding some more details.

With reference to an information system this implies both scalability and layering. Designing the data set it’s a must to carefully consider all the different levels of standard: representation, description and content.

Sustainability and minimal critical mass are two key aspects. A data set limited to few objects does not reach any goal it is less than a pilot implementation in such a project, on the opposite side a data set requiring huge investment of resources, both human and economic, it is not sustainable.

Last but not least we must consider that one of the most profitable opportunities to collect information about an historical building is on the occasion of restoration activities. The team involved in the works has probably at that time the best information set about the specific building or sub-part of the building. Both if this is the best opportunity or not, we cannot lose such information even because this is strictly related to the new information set due to the running restoration activities.

What is relevant to point out with specific reference to the procedure design is that the information collection process must be layered and scalable.
4.1 CHIC AS AN e-GOVERNMENT TOOL
In the Internet era, a diffuse need of innovation and better performance affected governments and institutions in general. Citizens and even Institutions are looking for a general re-design of the public administration both in the front and back office. This is related with one of the potential goals of CHIC. In such a renovation process the ICT support turns “government” into “e-government” that means:

“Delivering complete services in public administrations to individuals, businesses and organisations combined with organisational change in order to significantly improve services and democratic processes and strengthen support to public policies; fostering quality and efficiency of information exchange; empowering citizens and public services clients.”

This is one of the attempts to define e-government used on the occasion of the World Summit on Information Society (WSIS 2005).

The CHIC may play a relevant role in e-Government implementation providing ad up to date solution in the field of cultural assets management.

5 FROM GOVERNMENT TO e-GOVERNMENT
More in general e-government can contribute significantly to the process of transformation of the government towards a leaner, more cost-effective government. It can facilitate communication and improve the coordination of authorities at different tiers of government, within organizations and even at the departmental level. Further, e-government can enhance the speed and efficiency of operations by streamlining processes, lowering costs, improving research capabilities and improving documentation and record-keeping. This means that governments have to rethink their information flows and processes. Reasonably a similar revolution will involve the entire structure.

“However, the real benefit of e-government lies not in the use of technology per se, but in its application to processes of transformation. e-Government is more than just putting in new computer systems. Rather, e-Government also involves complimentary changes to administrative practices and business processes.”

(National Research Council 2002)

Thus an increasing number of countries started e-government programmes. Some of them simply published on line an “institutional” static web page, other added some services and some took the opportunity to activate a in depth reform of both the front and back office.

If we consider our specific domain of interest, cultural heritage, the basic benefits and goals due to the implementation of an e-Government platform may represent a significant contribution to the sector. The question is: which are the guidelines ensuring a proper solution development?

As generally agreed once we have ensured a proactive environment and accessibility for all, in order to achieve the goal, we have to adequately take into account: Who is likely to go online to use government services? What is the typical behaviour of citizens on line? What types of barriers and obstacles turn people away from going online to use government services? What factors encourage users to feel comfortable with e-Government services? Once a person makes a visit online, will they return? Will they encourage other people to use the site or not?

The global survey of e-Government created by Professor D. West (http://insidepolitics.org/) offers an interesting insight on e-Government implementation: “Most governments around the world have gone no further than the billboard or partial service-delivery states of e-Government. They have made little progress at portal development, placing services on-line, or incorporating interactive features onto their websites. Not only are they failing to use technology to transform the public sector, their efforts mostly consist of no meaningful change or small steps forward” (D. West 2005).

6 e-GOVERNMENT AND CULTURAL HERITAGE
Apart from the comprehensive and inclusive view on e-Government as a unique platform it is evident that the use of typical e-Government instruments in the cultural heritage domain will have a positive impact. Enhanced efficiency, quicker responses, information sharing and transparency are only a limited number of potential benefits. The implementation of an e-Government approach with the re-design of the procedures and workflows together with the benefits due to multimedia communication tools will probably simplify and empower the process. Simply think to the administrative procedures now reshaped in on line versions, the immediate availability of the full set of information associated to a specific artefact or the completely new approach to surveys, the potential close communication between expert panels and on site surveyors. Public opportunities and administrative processes may be more transparent and effective, the unique opportunity to design and implement efficient procedures in a kind of “pipeline” ensuring minimal “stops” and scheduled times for each procedural step.

Some potential scenarios are already drown up ranging between monument management and fight to illicit artefact trade. Objects unique identifier, microdots, features extraction and invisible markers or trackers are reality nowadays. Long term data repositories may preserve an incredible amount of precious information supporting restorers, curators, researchers. The adoption of unique digital identifier may help in information harvesting and sharing.

7 A WEB OF RELATIONS
All the above dealing with terms and definitions, what about the different actors and their main relations? If we consider the potential set of interactions between government and other bodies we can find at least:

- Government to Government (G2G): interactions among different governmental bodies (local/central, ministry/ministry, local/public company, etc);
• Government to Business (G2B): interaction among governmental bodies and business companies;
• Government to Citizens (G2C): interaction between governmental bodies and one or more citizens.

All the above mentioned interactions are often active in the field of Cultural Heritage (e.g. private owner / local government / superintendents / ministries). A recent emerging class of interaction, at global level, is the transnational one (e.g. G2G, G2B, and G2C). Simply consider the European Union framework, how can I perform a transaction between Italian and German e-government systems? Such an interaction usually implies international standards setting and extended interoperability. Some European projects are developing transnational government services mainly referring to their own interoperability standards.

Back to the design approach of course the first idea is to offer information and public services on line. Due to the new opportunities offered by the technological framework we can provide new additional services.

8 STANDARDS AND INTEROPERABILITY

Another defining feature of the Internet’s success has been the open nature of the technical standards, and the innovation this has allowed. The innovation have been key to a large number of new technologies that have evolved out the Internet, and it is important that this continues so that we keep finding new ways to do some of these old things cheaper, better and faster.

In order to provide a comprehensive scenario we take into account different levels of interaction and services, government to government, government for citizens, government for business, and more. Interaction between different systems and organisations means interoperability in a broad sense. What do we term “interoperability”? <interoperability> is ability of a system (such as a weapons system) to work with or use the parts or equipment of another system [Merriam–Webster dictionary]

<interoperability> (computer science) means the ability of the user of one member of a group of disparate systems (all having the same functionality) to work with any of the systems of the group with equal ease… [Encyclopaedia Britannica]

Interoperability is currently one of the most popular buzzwords used in the ICT industry. This focus on interoperability and inter-workability has arisen due to the spread of the Internet and the increasing need to get different applications to “talk” to one another. Without a way to exchange information, high-tech systems literally can’t communicate with each other, and if they can’t communicate, they can’t work—interoperate—with each other.

The need to exchange data between different applications has long been a common requirement in several key sectors, such as research, banking… and e-Government. Information systems often speak different languages or dialects. This happens not only when the products that need to communicate come from different suppliers, but even among different generations or variants of the same product.

While an interoperability problem might be due to a minor incompatibility, its impact on a system can be dramatic, and the task of getting all the relevant parties to participate in solving the interoperability problem can often turn into a nightmare.

There are therefore compelling reasons (e.g. connected government) to create information technology products that can be guaranteed to interoperate (e.g. digital signature, digital certificates, e-procurement, etc.). This issue is fundamental in order provide a unique access point to personal data services for citizens as it is requested for the one stop services. Different governmental bodies at different levels and eventually public companies will be able to exchange data and provide integrated services to citizens and/or companies. This can only be achieved if all of these products conform to the same, publicly available, standards (e.g. open standards). We do not mean, of course, only technological standards but standards in the broad sense including semantic aspects and thesauri.

The availability of intercommunication has enabled incredible new scenarios based on information linking and exchange with potential positive effects in the e-Government sector. Interoperability is both the exchange of information and its utilisation. Interoperability will play an interesting role both amongst governmental bodies and at international level (e.g. European Union).

9 SOME RECOMMENDATIONS AND CLOSING REMARKS

In conclusion let’s recap the main key points outlined in this paper:
• Focus on potential intermediate and end users, in order to properly identify the set of information to be collected and the format/level of detail needed;
• Accurate analysis of the representation standard;
• Proper definition of the system architecture;
• Accurate analysis of the description standard:
• The information collection process must be layered and scalable in order to fit with partial surveys and different levels of detail;
• Clear identification of access rights and resolution of potential disputed and data overlapping;
• Clear identification of roles, responsibilities and duties (plus information editing tracking);
• Multichannel and multimedia information collection properly tagged and linked (ad hoc ontology);
• CHIC as an Hub providing added value services (for middle and end users);
• The Hub vision enables new market models (sustainability)
• In addition to the above list, with specific reference to the information technology side of the project:
• Proper definition of the system architecture; distributed, scalable, flexible, etc
• Interoperability of data, this will multiply the added value enabling the synergy among different data sets.
• On line data set accessible via different infrastructure: wired, wireless etc. Full support for mobile applications;
• Proper interaction design in order to ease the process. We have to adequately take into account the relevant impact that the vision “e-government-as-a-whole” may have on the cultural heritage sector. E-Government represents an opportunity or a threat for this domain? There is not an a priori right answer; it is responsibility of the main actors both on the institutional/public and private side to cooperate in order to shape e-Government as an opportunity not a threat. E-Procurement platforms may suggest offers that are not in line with historical quality preservation. European directives may unintentionally impact and jeopardize cultural assets. One of the key points in order to avoid such risks is to contribute to the innovation process from the early beginning.

Taking into account some of the most relevant aspects of e-government success or failure we are an in position to collect some recommendations:

• Have an idea about the citizens’ willingness to access e-government services;
• Do not forget to adequately consider all the different aspects influencing e-government solutions (cultural model, habits, literacy, etc);
• Understand the needs of all segments of public to make sure the e-Government system genuinely assists each users to fulfil his or her needs (citizens centred); and, enable users to participate in the design of e-government services (participatory bottom up design);
• Develop a strategic plan to deploy and guide e-Government services; do not forget to carefully plan the transition from Gov to e-Gov. Do not forget the digital divide even in developed countries and the related opportunity gap;
• Do not replicate in “digital format” the physical internal organisation and behaviour of the Institution;
• Use well established system development practices to carry out the day-to-day activities of developing, implementing and maintaining e-Government services;
• Carefully consider interaction design;
• Provide a secure experience for web visitors, enhance the trust relationship;
• Crate a learning organisation where employees are encouraged to participate in the developing and managing e-Government services;
• Develop effective ICT governance mechanism to assign roles and responsibilities for managing and making decisions about e-Government services (including updates and improvements);
• Develop ICT capabilities focusing on building a suitable ICT infrastructure to sustain long term investments in e-Government, nurturing the development of human capital within the government to use ICTs for e-Government, and facilitating the skills of employees to develop and manage partnerships with private sector firms and other possible partners;
• Do not forget to create a robust backup and disaster recovery system; last but not least take adequately into account long term preservation of data and services.

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CROATIA – PRESENTATION OF EU-CHIC RELEVANT CULTURAL HERITAGE DOCUMENTATION SYSTEM

Vlatka Rajčić

ABSTRACT: This document is written for the European project on Cultural Heritage Identity Card (EU CHIC) supported by the 7th Framework Programme of the European Union. It surveys existing information sources, databases and systems related to built cultural heritage in Croatia.

KEYWORDS: register of cultural goods, classification of the immovable heritage, information system, methodologies of collection and documentation, legislation

1 INTRODUCTION

The Ministry of Culture of the Republic of Croatia governs administrative and other activities that concern:

• Research, investigation, monitoring, notation, documentation and promotion of its Cultural heritage central info-documentation service;
• Designation of protected cultural property;
• Prescription of criteria for determining public needs programs in Croatian culture
• Care, coordination and supervision of financial aspects of cultural heritage protection
• Establishment and supervision of institutions for conducting activities in the protection of cultural heritage
• Evaluation of conditions for legal and natural persons on restoration, conservation and other issues of protection, and facilities for education and training professionals in cultural heritage protection work
• Implementation of traffic control, import and export of protected cultural property, establishing conditions for the use and purpose of cultural property, and the management of cultural property in accordance with the regulations, and by determining special conditions of construction for the Protection of Cultural Heritage
• Inspection of cultural heritage protection works.

2 REGISTER OF CULTURAL GOODS OF REPUBLIC OF CROATIA

According to the Law of protection and safeguarding Cultural goods, (Official Gazette of the Republic of Croatia, NN 69/99), all cultural assets are recording in the Register of Cultural goods of the Republic of Croatia. This Register is publicly accessible, and is maintained by the Ministry of Culture of the Republic of Croatia. It contains three lists:

• List of protected cultural goods,
• List of cultural goods of national significance and
• List of preventively protected cultural goods.

The Minister of Culture of the Republic of Croatia also prescribes the form, content and mode of maintaining the cultural goods.

According to Article 15, if a cultural good loses its attributes for which it was protected in the first instance, the Ministry of Culture will give the resolution for erasing the cultural good from the Register, with preliminary approval of the Croatian Council for cultural goods.

According to Article 16, the action of enrolment, changing or erasing from the Register, is published in the national journal for Law issues.

The List of protected cultural goods has the following sub lists:

a) Immovable cultural goods,
b) Maritime cultural goods, and
c) Movable cultural goods.

As an example, here is the part of the list from the National Journal for Law issue related to immovable cultural goods in Municipality of Dubrovnik, located in Province of Dubrovnik – Neretva.

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During the 1980’s the structure of the database for immovable cultural property was extended to include the elements required for the evaluation of integrated cultural, historical and natural values of the certain spaces. Due to this priority work, and the professional obligation to implement a different intensity, it was used mainly for the conservation and development of urban studies.

During the 1990’s, work was linked to priority national programs (post-war reconstruction, the National Programme of the Croatian islands, major development programs, etc.). Since 1991, work was planned as a fundamental undertaking in the reconstruction strategy by focusing on war-affected areas of the municipalities, rural and urban settlements and treatment of major monuments. Order was processed: 63 buildings (published in 1993 with the financial help of the Croatian Credit Bank for Reconstruction), 16 urban areas across Croatia, 21 rural units of casualties in the war in the county Sisak (published in 1996 with the help of the County) and 11 units to Eastern Slavonia (published in 1998). The first volume of the historical village on the Croatian islands was completed (County of Primorje-Gorski Kotar), along with a catalogue of the Ludbreska Podravina area (published in 1997, with the financial support of sponsors, in collaboration with the City of Ludbreg).

During 2001, processing was completed and the Catalogue of settlements within the Nature Park was printed. During 2002, data was collected, and work on the cataloguing process of the City settlement of Ivanic-Grad (catalogue was published in 2004) and the island of Primorje-Gorski Kotar County was started. In 2004 processing of the island continued, and work started on the area of the town of Pozega and the preparation for the treatment of municipal Dvor. In 2005 the islands of Istria were addressed, and work continuing according to the established methodology and priority of the other island counties, in cooperation with the Department of Archaeology.

### Table: Settlements

<table>
<thead>
<tr>
<th>Settlement</th>
<th>Cultural good</th>
<th>Land office particle</th>
<th>Land office municipality</th>
<th>Number of Register</th>
<th>Date of preventive protection completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUBROVNIK</td>
<td>Madonna of Merry Church</td>
<td>ć. zgr. 235, 236, 237, 3, 4, 5, 7, 11</td>
<td>Grk</td>
<td>P-469</td>
<td>30.05.2006</td>
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<td>St Anne Church</td>
<td>ć. zgr. 245</td>
<td>Grk</td>
<td>P-469</td>
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<tr>
<td>DUBROVNIK</td>
<td>St Oktoav sv. Vlaha</td>
<td>ć. zgr. 243</td>
<td>Grk</td>
<td>P-469</td>
<td>30.05.2006</td>
</tr>
</tbody>
</table>

Classifying Individual Heritage:

Regarding Individual Cultural Heritage objects, they are classified according to the thematic units of:

- **Old towns, burgs and forts**
- **Castles and manors**
- **Traditional building**

The typical representatives of above listed objects are presented in figure below.

**Figure 1:** A part of list of protected cultural goods in Municipality of Dubrovnik

**3 CATALOGUE OF HISTORIC SETTLEMENTS**

**Figure 2:** Typical fort, castle and traditional building located in Croatia
5 TEUTA - CULTURAL HERITAGE INFORMATION SERVICE

Cultural Heritage Information Service, developed in the Ministry of Culture, was primarily used from the outset for the activities connected to the protection and safeguarding of cultural heritage. Today it is used by the wider vocational community, and will soon be available on the Internet in the wider public domain.

The aim of the system is:

a) To give an insight into the holistic monumental base of the Republic of Croatia;

b) To give information about the level of documentation, and all existing records about the monument and;

c) To effect the protection of cultural heritage in its most direct way, because the digitalization of Documentation Collections is also cultural heritage, and the most efficient way of their protection. A Project of unique cultural heritage information system development was defined in 2000/2001, and began with its realization inside the Ministry of culture in 2002.

Figure 3: The web page of TEUTA Service

Comprehensive information that existed before digital documents (data base made in dBASEIV, with some ACCESS applications), were successfully migrated into a SQL server and merged into a single database. A user-friendly interface was developed in programme ACESS. The Information system is multi-use oriented and it enables a follow up of any changes on data, automatic net communication notification of errors, automatic net upgrading of system and assignment of permission on the end user’s level, or a group of users level. The information system backbone is a Central list of assets of cultural heritage, with support collections of documentation such as sound archives, photoCDteque, plan collections, microfilms, Register of cultural goods, advice for protection programs on heritage monuments, address book of relevant individuals and institutions, and numerous files necessary for the service of cultural heritage protection. Phototeque, for instance, has 35,000 photographic negatives and 54,465 positives.

The system is harmonized with European standards (recommendations and guidelines of European Council, ISO Standards) regarding content and structure, as well as the technical platform on which the system was developed. This is a prerequisite for the fast and easy exchange of data with related institutions in Croatia (principally with the Croatian Conservation Institute), but also on broader international level.

Figure 4: The data in TEUTA service for the Museum for arts and crafts

During the system conception, and its development, the experience of other countries in the field of cultural heritage documentation was considered (such as the development of the English Heritage system, Historic Buildings, Sites & Monuments Database, and the French system Mérimée, led by the Ministere de la Culture et de la Communication, Direction de l'Architecture et du Patrimoine. Contact was made also with neighbouring countries, especially the Republic of Slovenia, whose information system for cultural heritage is very similar to the Croatian system. It was also recognised that harmonizing with European standards is the main prerequisite for good future cooperation and data exchange.

Figure 5: Additional data for Museum of the arts and crafts

The next phase of development foresees the integration of geospatial data into a (GIS) system, to ensure an interdisciplinary approach and a quality background for spatial planning and the interpretation of cultural heritage in town spaces and the natural environment. Finally, the entire system will be connected into one holistic body through the existing system of the Croatian Conservation Institute called - BREUH (Base of cultural goods in Croatia, registered by conservators).
6 INTERNATIONAL COOPERATION ON INFORMATION SYSTEM

6.1 EUROPEAN HERITAGE NETWORK - HEREIN

Council of Europe initiated in 1999 the information system named European Heritage Network - HEREIN. Initially conceived as a time-limited project, HEREIN has grown into an information system of unlimited duration. It brings together European governmental bodies in charge of the protection of cultural heritage. Each country has adopted the European Cultural Convention, and the initial six participating countries have expanded to twenty five: Andorra, Armenia, Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, France, Georgia, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Hungary, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and Great Britain.

The objectives of HEREIN are to facilitate access to cultural heritage, and information about it, with the help of modern information technology. It provides a continuous and interactive information system on cultural heritage intended for use by administrative bodies, experts and other participants in heritage activities, including the general public.

Apart from the comparative database on national heritage policies of the States Parties to the European Cultural Convention that is the backbone of the online system (http://www.european-heritage.net/), it also offers other activities such as heritage site, virtual exhibitions, a multilingual thesaurus in the field architectural and archaeological heritage, expert forums, and calendar of major events related to the protection of cultural heritage.

6.2 THE DANUBE - THE WAY OF CULTURE

Croatian Ministry of Culture has participated since 1996 in developing the cultural and tourist map of the Danube - the way of culture within the Working Body 'Culture and Science' Working Community of Danubian Regions (DRWC). Beginning in November 2002 the Department of Cultural Affairs INDOK Heritage Directorate for cultural development and cultural policy is included in the section of the digital cultural map of the Danube area. The task is to obtain digital photographs of the cultural heritage covered by the maps, digitized to the region, and the preparation of other documents. The content is available at the network address http://www01.noel.gv.at/donau.

The map includes locations of the Danube region in a zone up to 50 km distance from the Danube. The Croatian territory is covered by forty-one (41) eighty-seven sites with one hundred (187) cultural property, illustrated with forty photographs. With a view to obtaining high-quality and representative documentation of sites and monuments included in this map, and also striving to improve the quality phototheca fund and establishing basic standards photo-documentation of cultural heritage, the phototheca Service Department INDOK Affairs heritage began in the autumn of 2004 a systematic photo-documentation of sites and monuments to be included in the "cultural map of the Danube". Part of the recorded material is available through the Croatian cultural portal <Culturenet.hr> in the area of culture - Heritage, gallery: Archaeological Heritage in the City Museum of Vinkovci.

Figure 6: The web page of the Cultural map of the Danube

6.3 HERITECH PROJECT

At the end of December 2009, the HERITECH project funded by the Belgian government was completed. Biograd will become the first city in Croatia that will have its cultural heritage stored and presented in digital format on the Internet. The HERITECH project, worth 139,000 euros, is dedicated to preserving and promoting cultural heritage in the 21st century. It is based on modern technology, and implemented in cooperation with the Ministry of Culture, Museum of Biograd, Biograd Tourist Board and the Vrana Lake Nature Park. Of the total amount, 109,000 euros given by the Belgian government is non-refundable, and the remaining 30,000 is the cost of providing services for the city centre.

The first phase of the project formed a unique database that contained about 70 protected cultural monuments in the area of Biograd, Filip-Jakov, Tkon, Pasman and Pakostane. The second phase of developing the system implementation, allowed content in 2D, 3D and 4D computer models to be made available through web pages and GIS browser, while the third and final phase, focused on knowledge transfer and training of Croatian experts on the management and upgrading of the HERITECH system.

The project was concluded at a Science Congress in Brussels, where Croatian and Belgian experts presented its achievements and benefits for the education and awareness of young people, and local communities, about the importance of their cultural heritage, and the importance of its management in accordance with the principles of sustainable development in tourism.
STANDARDS AND GUIDELINES FOR MAKING AN INVENTORY OF CULTURAL MONUMENTS

Monument inventories are lists of cultural monuments of an area, or lists of specific types of monuments in an area, but in referring to the national inventory, this usually includes the entire monument fund of individual countries. The initial intent of monument inventories was to ensure the knowledge base necessary for the maintenance and protection of cultural heritage, but they also serve as the basis for spatial and urban plans and for scientific research on cultural-historical and artistic heritage. The stored data can also be useful for museums, libraries, archives, educational institutions and a multitude of other potential users in the field of culture and cultural heritage.

Monument inventories can be kept in conventional files, but under this term we also mean the first computer database that, using the Internet, rapidly becomes more accessible to a wide range of users.

In Croatia, INDOK is in charge of the creation of the Central Inventory of Cultural Heritage. The INDOK-centre operates under the Directorate of Cultural Development and Cultural Policy of the Ministry of Culture.

Currently, there are a number of international guidelines and recommendations for making an inventory of monuments, which, depending on the general category to which the monument belongs is defined by the content and scope of information necessary for its precise identification (i.e., whether an archaeological site, historical whole, a single building or repositioned monument). The main purpose of the documents are to facilitate communication between the national and international institutions responsible for documenting and protecting cultural heritage, and to assist countries just starting to develop their own systems. The standards and guidelines for their production are presented in major guidelines and recommendations and these particularly emphasize the need to develop uniform terminology and classification systems.

DOCUMENTATION COLLECTION

Documentation Collection contains:
- Cultural Heritage Photo Library
- Central Archives
- Microfilm collections

The Croatian Ministry of Culture has a valuable conservation documentation system that has been developed by the action conservation service for more than two centuries. The documenting of Cultural Monuments is an inevitable factor in the organized activities for the protection of monuments. If a monument has to be studied, protected or have some degree of intervention on it, we must first accept the documentation. This enables us to start to understand the monuments even without direct contact of it (of course this does not diminish the importance of direct contact), and helps to identify suitable forms of protection.

Effective documentation is created through a prolonged process of collecting and recording data. This process is virtually never ending, because the knowledge and condition of the monument can change from day to day. The documentation should incorporate these new insights to be processed in some way (sort, organize) and made suitable for use.

The main purpose of creating documentation is to achieve an accurate perception of cultural property, so that we can better know and preserve it for future generations. On the other hand, the documentation allows us to record interventions on the monument, and to monitoring the monument after the operation.

Effective documentation is created through a prolonged process of collecting and recording data. This process is virtually never ending, because the knowledge and condition of the monument can change from day to day. The documentation should incorporate these new insights to be processed in some way (sort, organize) and made suitable for use.

Despite all efforts on their protection, monuments will deteriorate and decay. In this case, the documentation will be a testimony of what once existed. If sufficiently good and complete, it could also enable a reconstruction.

Conservation documentation in Croatia is kept at the Ministry of Culture, and can be seen on the link to Croatian Conservation Institute http://www.h-r-z.hr/index_en.asp

Figure 7: The earthquake in Zagreb- damages in Cathedral

Figure 8: The UNESCO site: Cathedral in Sibenik
Along with others, one Methodology for collecting Technical documents of cultural heritage objects is the Method of Institute for restoration of the town of Dubrovnik. It was implemented initially in 1979. The restoration process of Dubrovnik’s built heritage has been going on since the 1979 earthquake. The complex processes of restoration and revitalization of the historic nucleus has consequently produced a great variety and quantity of documents that are stored in Institute for restoration of Dubrovnik.

Topographic and cadastral plans (1:50) that satisfy the level of accuracy for architectural survey are the basic documents. Recent survey methods include photogrammetry. The system is compatible with geodetic raster and absolute geodetic heights. Historic data is given in the conservation documents. These are mostly created in the first phase of compiling the conservation documents - called the preliminary conservation study - that is based on archival research and an analysis of the historical and architectural characteristic of monument. It is an important preparation phase in which circumstances and phase of construction; time frame, style characteristics and historic stratification are defined. Other data is graphical interpreted from the results of the research.

Building element descriptions are given in the second phase of the conservation documentation compilation. This contains conservative and restoration research, archaeological works. In this phase, interdisciplinary work of conservators and engineers may be needed to achieve a more professional approach and better data. Structural systems should be defined and their stability checked to prepare for architectural and structural solution and the possible restriction in the future purpose of the monument. Also data on the building element materials can be found in architectural survey. Data usually obtain by this method is the analysis of historical and architectural characteristics, phases of the monument, the history of its construction, style characteristics, spatial and time frame and its valorisation in a global context, as well as conservative and archaeological research also gives information about the previous urban matrix.

Survey data is given in the architectural survey of the present condition: with or without showing measurements. Surveys without measurements provide a graphical substratum for all graphical displays for “reading” the historical stratification of the monument, and for conservators’ directions and instructions, and publication purposes.

Survey with measurements is used for architectural detailing which are accessible otherwise, if inaccessible, photographs are taken with added measurements on them. This survey approach also shows openings, verticals, change of wall texture and facings, together with technical descriptions, calculation of gross and net areas, details of the owner and photo-documentation.

The method has several additional specialist studies and information including: records of owners (property), touristic data, economic study, fire protection study, sociological and functional study, contracts with building companies that work on the restoration, project for restoration (all levels), and records of war (1991-1995) damage “…The restoration of Dubrovnik has been systematically carried out since 1979. The structures damaged in the earthquake have been rehabilitated. Moreover, a wide range of renovation measures has been undertaken. The example of Dubrovnik shows how the renovation of a particular cultural asset should be integrated into a wider context of the planned revitalization of an urban entity. A complex and an interdisciplinary approach to the restoration process of the historic nucleus has produced a great variety and quantity of documents referred to in this paper. Data about the documents are put into a context of the town’s historical continuity. Therefore the record of every activity has not only a documentary, but also a symbolic and a cultural value. The paper deals with numerous research studies and analysis carried out over the last 25 years. Leading experts from various fields have been permanently engaged in these activities,
and have thus made a valuable contribution to the restoration and revitalization of Dubrovnik. The paper presents the content of the documentation and the phased process of preparing documents needed in the renovation of different types of protected buildings, supported by factual data and information about hands-on experience. The production of technical documents for the rehabilitation of a protected building consists of conventional phases supported in this case with an awareness of the town’s historical complexity. This model assures a parallel, interdisciplinary participation of experts in the research, production of documents, analysis and design with the aim of accomplishing the most effective method of rehabilitation, preservation and presentation of monuments.

One of the chapters gives an analysis of the basic restoration documents modified and adapted to new types of damage caused by war devastation. In the last decade the buildings damaged in the war have been repaired except the roofs and stone fronts. The article briefly presents the repair of the earthquake damage. However, this project has not been carried out as planned due to an insufficient financial support. In the conclusion the author supports the presented models and phases of producing the documents needed in the restoration of Dubrovnik. Emphasis is also put on the significance of a professional approach as well as a clear documented approach to the restoration of every historic structure. The permanent use of secondary sources of the archive documents in view of research and citizens’ needs is a further proof of its quality and justification…” (Ivanka Jemo).

8.2 COLLECTION OF PHOTOGRAPHS

With the establishment of cultural heritage protection in continental Croatian in 1910 there was a need for systematic photo-documentation of cultural heritage that, on the basis of inherited photo-material, the second half of the 19th century, shaped and amended photo fund. Until 2001, when the Regulation on Internal Organisation of the Ministry of Culture (NN 70/01), along with other conservation documentation collections and specialized libraries, merged with the Department of Culture of the Ministry of Culture, the photograph was an integral part of the heritage protection of cultural monuments. Currently, A Collection of Photographs is in the Directorate of Cultural Development and Cultural Policy at the same Ministry.

The primary task of the photo service is photo documentation of the national cultural monuments for the purpose of performing tasks of protecting and preserving that cultural heritage. Photos provide an insight into the monument before, during and after works, and demonstrate the various stages of conservation and restoration activities on the monument, and are valuable records of monuments that in the meantime, due to age, social neglect, war or other causes may suffer from degradation, damage or are completely missing. Photograph mainly contains photos of architecture, or the immovable monuments of culture and the ambience in which they are located. In addition to photographic images, exterior monuments are equally represented, as well as their integral part, images of interiors - such as wall paintings and sculptural decoration, furniture - containing numerous images of cultural goods.

Figure 11: The photo documentation service inside INDOK system

Figure 12: The author’s photo collection of built heritage

Photo fund includes recordings of sacred and secular architecture over a broad time frame, being built for different social strata. Photos in the collection are equally interesting, therefore for historians, art historians, archaeologists, ethnologists, urban planners, architects and other disciplines of social orientations.

Figure 13: The themed collection of built heritage - Part from Internet page of Ministry of Culture
8.3 CROATIAN STATE ARCHIVES

The Croatian State Archives is the central archival institution in Croatia and it performs services relating to archival and current records created by state bodies, state and public institutions and enterprises, corporate bodies, families and individuals whose activity covers the whole or a greater part of the Croatian territory, or is of State interest. In order to make the memories of the Croatian nation available to public as much as possible, the Croatian State Archives provides ready access to its documents for all researchers.

In the field of cultural heritage, the central archives of the Croatian State Archives include the following sections of professional conservation documentation:

- Topographic collection
- Themed Collections
- Card basic records of cultural monuments
- Solutions of registered and preventive protected monuments
- A collection of files and reports conservation works on monuments of culture
- Collection of older material (closed)

8.4 MICROFILM COLLECTIONS

![Figure 14: The example of Microfilm collection (churches in Croatia)](image)

The Mikroteka Department for information and documentation of cultural heritage management activities for cultural development and cultural policies of the Ministry of Culture has microfilms of the technical documentation of cultural monuments, whose originals are in the service department maps and plans of conservation of cultural heritage protection, and other institutions.

From 1979 about 90,000 shots are taken. Regarding their source, they are divided into three groups:

1) Technical documentation resulting from fieldwork conservation departments of the Directorate for the Protection of Cultural Heritage of the Ministry of Culture;
2) Technical documents resulting from the work of institutions from the Ministry of Culture, having jurisdiction over immovable cultural heritage (Croatian Conservation Institute, the Institute for Art History, University of Zagreb, Faculty of Architecture - Department of History and forms of architecture, the Institute for the Restoration of Dubrovnik);
3) Technical documentation stored in museums and public institutions (Croatian Academy of Arts and Sciences, Mestrovic Foundation Zagreb - Split, Brijuni National Park, Museum of Contemporary Art).

The term refers to microfilm records: microfilm cards, film (i.e. microfiche), and 35mm microfilm rolls, and the accompanying finding aids (registers with a recorded documentation files).

For microfilm documentation, technical equipment, disclosure, and facilitating development of play (photo, MF - reproduction, scanning and storing in an appropriate medium), there is group of responsible persons that allow access to the documentation files.

9 THE CROATIAN CULTURAL HERITAGE NATIONAL DIGITISATION PROJECT

The goal of the project is to create and make accessible a set of digital collections of identifiable or national relevant content, and bolster the capacity of the institutions involved. The aim is to build a digital resource consisting of a number of digital collections produced by digitisation of archival, library and museum holdings of national significance and identity, and assumed to be of significant public interest. The project ought to involve a greater number of institutions engaging in a variety of activities – if only because of the proper selection of material for digitisation. The project also ought to bring together a consortium of institutions interested in the digitisation of holdings and whose resources and experience can contribute to its implementation. One of the important effects should be the diffusion of capacity for high quality digitisation, and the building of digital collections. Experience acquired by cooperation will help institutions to upgrade their own capacities and become ready to offer some other digital contents and services.

The project will produce digital collections, processed, described and located in a digital archive system accessible through the project network headquarters. The envisaged duration of the project is three years. After that, the project founder and leaders need to decide whether, and in which form, to continue the project, and who will take care of the project products and how that will be achieved.

The National Programme of Digitisation of Archival, Library and Museum Holdings are envisaged as an organisational framework for the implementation of the National Digitisation Programme. The network headquarters will permit uniform and comprehensive search of contents in the collections and the delivery of user copies of the material.
In organisational terms, the project would include the Project Office, the founder and the project leader, the Project Council, and institutions and organisations whose holdings would be digitised, or the leaders of specific digitisation projects integrated in the national project. The roles of the individual participants and the relations between them ought to be contractually determined.

The Project Office would be responsible for project coordination, the drafting of recommendations, standards and instructions, the selection of projects for digitisation, professional and technical assistance to participants, the design of the ultimate project product, assurance of quality, and project monitoring and progress reporting. The founder of the project needs to set up the organisational structure of the project, to ensure the resources for the Project Office, co-finance the accepted digitisation projects, the digital archives and the project network headquarters, monitor progress, and decide on cases that go beyond the competence of the Office. Institutions taking part in the National Project with their digitisation projects and digital collections are expected to devise and propose projects in line with the guidelines and instructions to be drawn up by the Project Office, digitise their holdings, process and describe the produced digital collections in accordance with the rules of the National Project, and deliver them to the Project Office for integration into the final project product. The institution(s) of the project leader is (are) expected to ensure the infrastructure for the operation of the Project Office and the infrastructure for the storage and access to the results of the project in keeping with the actual project needs.

It is also recommended to set up the Project Council, consisting of the representatives of the founder, project leader, Project Office and institutions more heavily involved in the project that would be tasked with monitoring and directing the course of the project, and acting as adviser for major decisions, etc.

The National Digitisation Project should also be used as a good organisational framework for the preparation of guidelines, standards and specifications that can also be used for other projects, and thus stimulate a harmonised and uniform approach to the development of digital contents and the design of cooperative systems and services. Due attention also needs to be paid to the role that the project can play in defining the concept and development of infrastructure for the permanent preservation and accessibility of digital collections. For a more detailed insight into the requirements and organisation of the project, the following listings of the necessary activities, and their leaders, are given below. The content and the mode of operation of specific activities, the course of the project and the detailed responsibilities of the participants, and the expected results of specific activities must be determined by the project plan.

10 NATIONAL CULTURAL AND EXHIBITION PROJECTS OF THE MINISTRY OF CULTURE AND VIRTUAL CATALOGUES

The Republic of Croatia is a country of unique natural and cultural treasures that, in its journey through time and space and history, link the resources that diversely shaped it’s visual, textual, musical, artistic and, simply put, cultural identity. Like stacking scattered stones, lifting the new beams on the ceiling, reconstructing homes, the national cultural and exhibition projects that have been implemented by the Ministry of Culture since 2007 are characterized by devoted research activities, providing the most comprehensive review of selected regional units by creating its own heritage cartographic scale and showing its inscription on the map of global and, especially, European cultural circles.

Such exhibitions contribute to the reconstruction of monument units of the areas being presented, to the restoration works, additional collection of heritage documentation, and they encourage economic and especially touristic development of the region. Such valued space presents a basis for further learning and acquisition of skills. It represents the same educational progress of local inhabitants on national and international levels, and encourages research, scientific and technical programs and projects. The implementation of National cultural and exhibition projects gather many connoisseurs and experts in topics aimed to mediate a broad variety of materials, as well as
many cultural institutions in which the materials are collected, processed, stored and made available to the public.

The lifetime of such exhibition projects, and each project in a specific exhibition space, has a limit to time and space. When the lights that illuminated the exhibits are turned off, the exhibition goes to the memory of those who worked on it, and to those who visited it, satisfying their interest in a particular topic. Digitization of cultural heritage, the process by which we protect and make available valuable archive, museum, library and other heritage materials – immovable, movable and intangible - represents a measure by which we extend the duration of such materials and large national cultural and exhibition projects. An exhibition that extends beyond its physical closure is a basis for further upgrading and subsequent networking based on the collected material, and this offers the possibility of virtual search by time, theme or some other way.

"Croatian cultural heritage", the portal of the Ministry of Culture, which brings together digitized material welcomes the web catalogue of the "Slavonia, Baranya and Syrmia – the Origins of European Civilization” exhibition project. This online catalogue represents a virtual catalogue model that from the first day of work on the physical realization of the exhibition systematically monitored its course and offered the support for the implementation of the exhibition, the most review of that cultural environment. To the extent that the "Slavonia, Baranya and Syrmia” virtual catalogue entered a worldwide virtual space, both by content and technologically, its wholeness and unity with the "Croatian cultural heritage” national portal represent a unique enterprise, and change to our previous vision of visual exhibitions. The exhibition, which lives its future virtual life, is not just more accessible to its authors and a limited number of visitors, but becomes visible to millions of visitors of the portal. The exhibition, which lives its future virtual life never stops, but becomes consistent with the new media on which data will be migrated, enriching the new contents and structure, networking and growing.

We believe that the model of the “Slavonia, Baranya and Syrmia – the Origins of European Civilization” web catalogue will be used again very shortly on the very first national cultural and exhibition project “Dalmatian Zagora- an Unknown Country”, and will continue to be an important pointer for future projects in the totality of the presentation of Croatian cultural environment.

11 LEGISLATION ON CULTURE

Since acquiring independence in 1990, new laws in the field of culture were passed and many others have gone through several stages of revision and amendment. Cultural institutions are registered legal and physical entities that may be private or public. The most important and the largest cultural institutions have been set up as public institutions.

There is no unified law on culture. General laws and regulations that influence culture and cultural policy include the Institutions Law, Associations Law, Tax and Custom Regulations, Law on the Implementation of the State Budget, laws that regulate the organisation and work of public administration bodies and units of local administration and self-government, etc., etc.

Specific Croatian laws and regulations that completely or predominantly relate to culture are:

- Law on Managing Cultural Institutions (NN 96/01);
- Law on Culture Councils (NN 53/01, NN 48/04, NN 44/09);
- Law on Financing Public Needs in Culture (NN 47/90, NN 27/93, NN 38/09);
- Law on Cultural Funds (NN 47/90 and 27/93);
- Law on the Renewal of Dubrovnik’s Endangered Architectural Heritage (NN 21/86, 33/89, 26/93 and 128/99);
- Law on the Rights of Independent Artists and Encouraging Cultural Creativity (NN 43/96 and 44/96);
- Law on Copyright and Related Rights (NN 167/03), Act on Amendments to the Copyright and Related Rights Act (NN 79/07);
- Museums Law (NN 142/98, NN 65/09); Law on Museums of Ivan Meštrović (NN 76/07); Law on Jasenovac Memorial Site (NN 15/90, NN 28/90);
- Law on Archive Material and Archives (NN105/97, NN 64/00, NN 65/09); Law on Croatian Memorial-Documentation Centre of Homeland War (NN 178/04);
- Law on Theatres (NN 71/06);
- Law on Audiovisual Activities (NN 76/07);
- Law on the Protection and Preservation of Cultural Assets (NN 69/99, NN 151/03, NN157/03, NN 87/09);
- Law on Library Activity and Libraries (NN105/97, NN 5/98, NN104/00, NN69/09);
- Law on Telecommunications (NN 122/03);
- Law on Croatian Radio-Television (NN 25/03);
- Law on Croatian News Agency (NN 96/01);
- Law on Media (NN 59/04);
- Law on Electronic Media (NN 122/03, NN 79/07, NN 32/08, NN 65/09);
- Law on the Preservation of Nature (NN 162/03, NN 139/08); and
- Decision on the National Classification of Activities.

11.1 SPECIFIC LAWS ON CULTURAL HERITAGE

- Cultural property may be publicly or privately owned and may be exported only in exceptional cases. The most important obligations are the care and maintenance of property and public accessibility, with the right, under certain conditions, to receive compensation from the budget for some maintenance costs. The owners of cultural property enjoy tax and duty benefits.
- The Law on the Protection of Cultural Assets, 1999 introduced the obligation of paying a "monument annuity" in the case of a cultural asset used in a printed work, for promotion, or when an income or
profit is made from an economic activity performed in an immovable cultural asset. This Law was amended in 2003 aiming to improve the system of collecting and distributing funds collected from monument taxes. The recent changes reflect EU regulations regarding the trafficking and return of cultural goods.

- There is special legislation (the Law on Archive Material and Archives, 1997 amended in 2000, and 2009) on the protection of archival material and its handling, librarianship, and the preservation of films and film material of historic, artistic and other cultural significance. The amendments in 2009 enable foreign legal and private entities to establish archives. New requirements for the position of director of the archive and new categorisations for archival professions have been introduced. Croatian Archive Council is obliged to submit a new Book of Regulations to the Minister in the next year. The special law regarding museums and collections - Museums Law - dates from 1998 and was amended in 2009 (special provisions regarding immaterial cultural heritage - see chapter 4.2.9). New requirements for the position of director of the museum and new categorisations for museum professions have been introduced. Croatian Museum Council is obliged to submit a new Book of Regulations to the Minister in the next year.

11.2 HERITAGE ISSUES AND POLICIES

- The Law on the Preservation of Cultural Assets (1999) states that every monument must have an owner and that licences will be granted for restoration and conservation work. Application of this Law is continuously monitored and improved. However, it seems that in practice people still do not trust private owners and investment partnerships. The number of well-presented and well-managed archaeological sites is growing.

- Special provisions in the Law are made with regard to immaterial cultural heritage. On the initiative and in agreement with the Croatian Commission for UNESCO in 2002, a special Committee for Immaterial Cultural Heritage was established. Croatia ratified the Convention for the Protection of Immaterial Cultural Heritage in 2007, and the Ministry was established as a central body for its enforcement. The aforementioned Committee was re-established by the Minister's decree in 2007, and now has 20 expert members. The list of protected immaterial cultural goods currently contains 77 units, seven of which are to be included in the UNESCO list of protected immaterial cultural goods by December 2009.

- Although the Law on Archive Material and Archives (1997) has made it possible for units of local administration and self-government to found archives, and also provides for new independent private archives (founded by companies, universities, political parties, religious organisations, the media and so on), there has not been any marked interest in their establishment nor have conditions been created for founding public archives outside the existing state and private system. In the past four years, branches of state archives have been established in three cities, as well as a new archival institution - Memorial-Documentation Centre, about the Homeland war.

- The network of public libraries is not evenly spread over the Croatian territory. Due to the different levels of information technology development and availability, different library systems are in use. The Ministry of Culture and local authorities are investing in the improvement of the library system. In the past four years, 33 cities have opened either new or newly restored libraries as joint investments between local authorities and the Ministry of Culture. The library information system in Zagreb has been fully centralised at the city level. A new University Library was opened in Split on 19th December 2008 to complement the network of national university libraries. The new library was also opened at the Faculty of Philosophy, University of Zagreb on 11th March 2009.

- The war in Croatia and the transition processes affected museums in many ways: physical damage, destruction and theft of museum property, decrease in the number of professional staff and a drastic fall in the number of museum visitors. In 1998, a uniform legal system was introduced, museums became independent (partner-museums), and definitions were given for institutions that could work as museums or care for the movable cultural heritage, for standards of computer networking, supervision over work and professional levels. Holdings were reviewed to establish the number and the condition of items in the museum collections. However, these changes led to many disputes among museum branches and institutions, and in some local units the very existence of museums or collections was jeopardised.

- The Ministry of Culture has developed a network of 19 local conservation departments that are spread all over the country.

- The government, together with local authorities, is investing in the construction and reconstruction of new museums and galleries (e.g., Museums of Contemporary Art Rijeka, Croatian History Museum in Zagreb). In the last few years a number of museums have been opened (e.g., Narona Museum Vid, Archaeological Museum in Osijek, Novigrad Lapidarium, Museum of Antique Glass in Zadar, etc.). The establishment of new museums (Homeland War Museum Zagreb, Museum of Sacral Art Split, Museum of Croatian Emigration Zagreb, Museum of the Vučedol Culture, etc.) is planned.

- One of the greatest weaknesses in the treatment of heritage in Croatia was the relative neglect of the traditional rural heritage. The interest in old traditions and public resources diminished, while the developmental investment has been concentrated in a limited number of areas thus marginalising others. In summer 2006, the Minister of Culture announced the introduction of special loans and support
schemes for rural heritage. This will also be one of the priorities for the programming of EU pre-accession funds in Croatia.

- A National Working Group (set up in 2005) presented the National Programme for Digitalisation of Cultural Heritage (including archives, libraries and museums) to the Minister of Culture, in September 2006. This programme aims at improving digitalisation of cultural heritage and includes educational and "operational" components. Special funds were earmarked for this programme in the 2007 and 2008 cultural budget. The main institutions for implementation of this Programme are the National and University Library and State Archives and two main portals where digitised heritage can be found are http://arhinet.arhiv.hr/ (Archive Information System) and http://www.kultura.hr (Croatian Cultural Heritage).

- For more information, see European Heritage Network: Country profile Croatia

REFERENCES

Web sites:
[1] http://www.kultura.hr/eng/ (about Croatian Cultural Heritage Documentation Collections, important Institutions and persons as well as number of various pieces which are in certain Collection)

Key documents on cultural policy

MODELS OF DOCUMENTATION SYSTEM OF THE INSTITUTE FOR RESTAURATION OF TOWN DUBROVNIK

Ivanka Jemo¹

ABSTRACT: Documentation from the Register of Cultural Heritage of Republic of Croatia is generally the sum of the data on the monument that are important for determining its monumental status and classification within the categories. This is the basic identification card of cultural property and it causes further action in the preparation of detailed documentation for its protection, maintenance and use. Old Town of Dubrovnik, as an urban complex, is protected cultural heritage and, as such, is registered on the UNESCO World Heritage List.

KEYWORDS: models, documentation systems, restoration, town of Dubrovnik

1 INTRODUCTION

Specific documentation of the cultural heritage of Dubrovnik devastated in the earthquake of 1979, when Dubrovnik was added to World Heritage List, occurs in a function of its renovation.

The Dubrovnik area was heavily damaged on 15th of April 1979 in the catastrophic earthquake that caught Montenegro with intensity 9-10 ° MCS. 1071 buildings were damaged, of which 33 were fortifications, 106 religious buildings, 45 buildings of different purposes, and 885 homes and business areas. Of the total number of damaged buildings, 89% of the area refers to damage to cultural monuments of the highest category. The Damage Assessment Study from the earthquake in the Dubrovnik area was based upon the Interstate adopted methodology consists of 25 bound volumes, covering all the damaged buildings.

From the map Condition of buildings after the earthquake, which is part of a Damage Assessment Study, in the City /within the walls/ are about 80 buildings with damaged and badly damaged structures, which are then declared uninhabitable? Around 240 buildings have been registered with minor structural damage. According to the report of the Institute for the Restoration of Dubrovnik 1979-1992 the estimate of total losses in 1980 was $ 436,437,380.

The systematic and long-planned restoration of Dubrovnik was based on a special law, the Law on the Restoration of Dubrovnik's architectural heritage since 1986 and secured funding from various sources, mostly provided by the Republic of Croatia. Immediately after the earthquake the Institute for the Restoration of Dubrovnik was founded, and for thirty years has continuously organised and implemented the reconstruction work, including the necessary reconstruction of war destruction in Dubrovnik during 1991/2.

Emergency protective works soon grew to a complete structural reinforcement of damaged buildings, and a comprehensive revitalization of the historic zone, including continuous documenting and conducting research that followed the repair works. Experts from all over the country were involved, who, through scientific and professional institutions, lead in particular by an expert advisory committee, monitored all phases of the renovations, from preparation to implementation.

Reconstruction as a concept is not explicitly defined in Croatian building regulations. It always includes simultaneously conducting several activities in the immovable cultural property to ensure its revitalization and strengthening - for example: structural repair and aseismic reinforcement, restoration, reconstruction and, in some places, restoration, renovation, cleaning of recent inappropriate interventions and so on. It is the best term for a set of different activities that always accompany a significant intervention in cultural property.

In the reconstruction process, the very important first stage is the preparatory phase. This includes detailed documentation of the cultural heritage: architectural survey, archival research, conservation and restoration research, study of the physical structure, stability and resistance to earthquakes, testing foundation soils, and the definition of conservation guidelines, which leads to the finalisation of various project phases for the reconstruction-repair and restoration.

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Architectural surveys of the existing situation are made under the Area Planning and Building Act - the Regulations on the contents of projects for buildings, and professional standards. Guidelines for recording are given in the study “The content and processing of surveys of the existing survey of the architectural heritage of Split” in 1983, and amended in the terms of the client in point 3.1 and 3.2 these Terms. Architectural surveys of the existing situation are made at the scale of 1:50, a requisite level of image processing at the level of project execution that serves as a base for the conservation analysis and execution of the repair.

2 THE CONTENTS ARCHITECTURAL RECORDINGS

Architectural recordings of an existing situation must include:

- A situation made on the geodetic base with marked boundaries of the old recordings in scale 1:200. The situation define: overall dimensions of each object and the overall dimensions of the entire block, the position of buildings on the land, and any building distance from the border of the parcel. In addition to the horizontal peak, the situation must include altitude data: number of floors (schedule of characteristic elevation levels must be regulated by the terrain and object). Relative elevation ± 0.00 must be defined in absolute elevation.

- All floor plans at 1:50 scale and floor levels including the floor plan of the roof. Floor plans must be showed with the floors, and not by the altitudes so, for example, the basement floor plans are all on one page, and all ground floors on the second page, etc. The layout of the lowest levels should draw the surrounding streets, staircases, entrances, terraces, gardens etc. and tie in altitudes for elevation to the building entrance. Layout of the roof should show all roof surfaces, with a marked drop of water direction and position of all elements that are located on the roof (chimneys, ventilation, equipment installation).

- For each building at least two sections should be made - the longitudinal and cross, one of which must be through the staircase, all in scale of 1:50. All longitudinal sections must be linked into a single view.

- All fronts at a scale of 1:50,

- Architectural elements from the architectural plastic at the scale of 1:20 to 1:5, available free of scaffolding,

- A detailed photographic documentation of internal and external appearance of buildings, as well as details that are not available without a scaffold for the architectural recordings with the basic dimensions (chimneys, lintels, cornices, rosettes, etc.).

Recording study of the existing situation is made and delivered in two forms:

A – Without dimensions,
B – With dimensions.

2.1 RECORDING STUDY WITHOUT DIMENSIONS

In the floor plan it is necessary to draw the arches of the equidistance generating at every 10 cm. A recording of the existing situation without quotations must have drawn diagrams of openings (with marked windows) in all views, all of outflows and vertical drains.

In the drawings on the fronts, it is necessary to mark the structural elements, with the designated locations where the structure is changed and all walls built of stone spolia, as well as all the stone mouldings (sills, lintels, door jambs, window jambs, cornices, etc.). Possible especially valuable treatment of floors and ceilings should also be indicated in the plans and photo-documentation. In the cross sections show only available structural elements.

2.2 RECORDING STUDY WITH DIMENSIONS

Recordings of the current situation with the dimensions should have elevation annotations, in the plan have marked all of outflows and openings, description of the purpose of certain facilities, net surface materials on the floors, the height of the room. The drafts must be quoted as harvest projects and so that at every point on the plan can be read cross-section and interior view.

Quoted external dimensions of buildings, terraces, gardens, and any changes to the height of roof surface, the dimensions of Belvedere and chimneys and cornices, and channels are required. In the sections available elements of the structure should be displayed. In the fronts indication of textured walls can be omitted, but moulding and decorative elements should draw, all for better readability. The entrance to each apartment must be stamped with the label accompanying this room. It is necessary to mark the house number.

In the layout of the lowest levels, and in all sections, the relative and absolute dimensions must be aligned and tie to the nearest existing benchmark of absolute dimensions on the ground.

2.3 TEXT ATTACHMENTS

Besides graphic material also should be provided:

- List of tenants / owners / with tag disposition of flats, based on a statement on the field,

- Calculation of net area for each room and each functional unit / garden, apartment, business or religious area, common parts of buildings, etc. /,

- Calculation of the gross area of functional unit / apartment, building /,

- Technical description with focus on architectural and structural condition of the building, especially the description of materials, floor and wall coverings, condition of walls, plaster, damage from the war and earthquakes, and especially the description of the condition of the roof / type coupe and damage and / or the installation,

- Photo-documentation with raster

• Conceptual preliminary design solutions. This is an important first step of designing, stacking programme, in which we examine the available space - land or existing buildings, and set in
We aim to achieve a balance between the claim that the preparatory phase for reconstruction work is overloaded with necessary documentation, and that the reconstruction work begins on under-researched monuments, with a lack of documentation. Therefore, it is complicated and difficult to achieve an adequate amount and type of preparatory documents for reconstruction work, and ensure that the various professions and specialisations that accompany the procedure are satisfactory. As each case is specific in its problems, we cannot expect that everything can be prescribed, but the professional minimum required in the form and content of documents can be set. Consequently there is potential conflict between participants who consider every additional document redundant, and those who think that the monument is in the rank of world heritage and should deserve the full treatment. Experience in conservation circles, which reveals that resources can create the monument more harm than good, can be denied in such cases. Good decisions, based on a full understanding of monuments, can only bring benefits, especially if they are implemented to save them from ruination. This documentation is used for other purposes - often by domestic and foreign students for their seminars, graduate or postgraduate activities. In recent times citizens to regulate ownership rights have also intensively used an architectural survey of current situations.

There are two paths to how the cultural heritage of Dubrovnik could be strengthened, rehabilitated and revitalised. The first is transparent, with documentation and the authority of the profession, accompanied by specific and clear legal provisions. This second is uncontrolled, without documentation, short, and leading to the uncontrolled loss of monuments and value of the town.

This statement speaks of valuable contents in the Dubrovnik Historical Archives, which for over 800 years, collected materials related to the wider Dubrovnik area. "Fear of completing the job by memory" and "innate tendency to its citizens to do nothing on trust, but always use notary records" according to Dr. Zdravko Šundrica commits us, in the name of historical continuity, not to carry out any intervention that is not appropriately documented and legalised.

During several years of renovation in the historic town of Dubrovnik, its architectural heritage has been continuously documented. Various impacts related to its preservation, restoration and revitalisation have been studied. Various analysis, plans and projects – including urban planning, infrastructure development projects, testing of seismic parameters, ownership, conservation research, architectural and structural design, and detailed restoration projects - have been carried out. This wide range of expert research, and specific professional and technical elaboration, created the formation of detailed archives in the institution that carries out these activities the Institute for the Restoration of Dubrovnik.

Production of proper documentation is an essential precondition of any intervention in the fabric of the architectural heritage, to be realised in the preliminary
phase that precedes reconstruction. The essential professional and technical documentation should be prepared in accordance with the scope and complexity of the renovation project.

Figure 1: Archive of project documentation and fire protection system in archive

The adequate preparation for restoration work includes various interdisciplinary research, documentation and project activities. With regard to the status of the City as a protected urban architectural heritage this refers to the entity, the individual objects, or parts, that threatens its cultural-historical and artistic significance. According to area of expertise and the depth of the issues that are to be processed, records at the urban level require to be done in parallel with the projects on individual monuments. This recording and documentation of individual buildings is still in progress.

3 SPECIFIC RESEARCH ON THE LEVEL OF URBAN AREA

After the earthquake of 1979, the goal was to have continued revitalisation of the urban functions and infrastructure rehabilitation through the structural reconstruction of earthquake-damaged structures, and to re-evaluate some of the most important monuments of the city regions. To this end, numerous studies and plans were made of the protected areas through various professional disciplines relevant to the individual monuments. The cities, in general, were systematically addressed.

A Sociological study for the City (Sociological functional study for the monumental area Pile – Ploče – Sv. Jakov) and a Study of fire protection were produced, and two implementation plans (historic core and the surrounding area and historic units) have also been financed. In addition, studies into the Conceptual and Main Project of water supply and sanitation for the historical area; the Project of public lighting; Project of organization and management of cultural heritage; Elaborate of ownership, Study on economic valuation of business premises in the City, etc. have been produced. The Institute for the Restoration of Dubrovnik has also organized the implementation of three tenders: for town planning - architectural and solution building on the excavated archaeological site in Pustijerna; the urban planning area of contact Pile and Ploče; and the architectural solution of Revelin fortress.

For the purpose of the structural rehabilitation of earthquake damaged buildings, in order to develop rehabilitation projects for earthquake insurance, the Institute has conducted a series of research works on the stability of existing structures on concrete objects, and made a map, based on detailed seismic micro zoning following geophysical and geotechnical investigations. The elaboration of seismic parameters, and criteria for the rehabilitation and strengthening of buildings has also been produced.

After the war, the following surveys and studies were carried out: Basics of Information System of the old town of Dubrovnik; Analytical and parametric studies the behaviour of buildings during earthquake action. Evidence of damage to roofs, detailed investigations of physical and mechanical properties by non-destructive methods was also carried out in four palaces damaged during the war (1991-1995), and this resulted in a special report for each palace.

4 DOCUMENTING THE CURRENT STATE OF THE MONUMENT - THE FIRST STEP IN PREVENTIVE CONSERVATION

Recording the existing state of the monument is the basis for making a variety of conservation, construction, restoration and other research, analysis and reconstruction projects. At the same time, high-quality architectural shots of the condition of continuous threats from natural disasters to monuments / areas of high seismic risk are the only appropriate documents by which one can make a replica or reconstruction of any collapsed building. Therefore, the methodology for the study of architectural images of details and conditions by the Institute is an investment. As a rule, in the geodetic images of one unit, a detailed architectural survey interpolates the architectural image of the building.

There is a mandatory content and method of processing images of such existing conditions. This is required so that it is an integral part of the study, along with the statutory plans that are commensurate with the detail and execution of the project, and the technical description of the state of the buildings. In principle, the recording unit is comprehensive: a number is given of list of tenants, and the gross and net surface area of the building and floors is calculated, all graphics elevations - each of specified content - and architectural details, and actual photo documentation, is provided.

According to the program, the rehabilitation was continued after a pause during the war in Dubrovnik in 1991. Every year, a few blocks, depending on the insured funds, are filmed. These surveys have progressed since 1996 according to the classic requirement matrix and film, in digital form. In late 2005 a fully completed basic record of the City, which began after the earthquake in 1979 has been made. In the Institute’s stored archives a matrix of architectural images are marked by blocks, or units, that are used in
all subsequent stages of renovation works / map 1 - review of architectural recordings over the years.

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By the end of 2009 there were 175 sets of matrices that contained 7,478 pages of records. Of these, 142 sets are of the historic core, and the others relate to the individual most valuable cultural monuments from the former municipalities documented after the earthquake of 1979. In addition to films, images are stored in two sets of bound copies of the blueprint and the digital record is held on CD.

Because of inconsistencies in the survey records, the technical approach, changes in the buildings that have occurred during previous years, and the work of digitising and recording previously made records, all architectural shots of the City are current, and available through modern digital image processing.

In order to attain the required high level of architectural documentation of the current situation of all architectural heritage buildings, the Institute experts have devised special conditions for the delivery method and level of detail of the architectural images, types of media on which they are displayed, and the conditions that are binding for all those to follow. Capital facilities, richly decorated church facades of stone sculpture, and archaeological masonry remains require a combination of architectural and photogrammetric recording.

Altogether 37% of recorded building, amounting to an area 100.138 m² of built space, was transferred into digital form by the end of year 2009. During these activities, operations into the study of architectural images in digital form, involved monitoring and updating the maps on the GIS resulting in / Map 2 - Review of architectural images in digital form.

A specific experience in documenting a particular model of post-war production of architectural images of war damage to the stone sculptures, facades, fountains and sidewalks, was created by the Institute for the Restoration of Dubrovnik immediately after the destruction (Figure 1). Urgent rehabilitation of urban areas, elevations, and utility facilities in the city whilst the war was still going on imposed the need for a rapid recording of the damage caused by shelling. Photographs of the actual situation accompany all images. It creates an exceptional documentary record of considerable value. This created a significant archive of architectural images of damaged stone sculpture and this is the only objective evidence of how some parts of the city were damaged, which, because of the methods adopted for the
reparations, this degree of damage can no longer be identified. After the war, the detailed architectural images of damaged and burnt buildings were prepared as the basis for other research and development projects to assist in their rehabilitation. This has involved the thorough photography of 11 burnt and damaged buildings and 19 sites with badly damaged stone sculpture including – sidewalks, staircases, church and house facades, fountains, and cloisters. In separate reports the damaged roofs were processed, during the shelling of the town in 1991.

Figure 5: Restoration of war-damaged roofs

The requirement was for accurate surveying data blocks of a series of buildings for the making of architectural images and projects; monitoring progress updates, and the record central storage documentation, in one medium. This approach assisted in the creation of a programme of reconstruction, infrastructure projects, street paving, etc., all of which initiated the implementation of a pilot project geographic information system of the old town of Dubrovnik. The Department still actively uses this approach

5 CULTURAL AND HISTORICAL RESEARCH

Based on the acquired experience of the first ten priority reconstruction projects following the earthquake of 1979, the expert advisory committee established a model for performing preparatory work for the restoration of individual monuments. This involved making architectural surveys of their existing state prior to starting the phase of development into the basic cultural and historical documentation. This contains the processes of archival research and a detailed review of the facility.

At this stage, instructions for the mandatory conservation investigative research facility are given, as well as the archaeological research needs of the monument and area around it. Until 1990, all buildings and urban areas in the reconstruction programme were required to make these preliminary conservation studies, and investigative research probes.

The necessary archaeological research was carried out during the construction works because the remains of the earlier phase of the City existed below the foundations of the damaged buildings. Reports from these studies were individually archived with each object. Archaeological investigations were particularly conducted and documented in the garden of the primary school, Pustijerna, and in southwest part of the city. The most authoritative and competent experts in the conservation service monitored the archaeological research and evaluation of its importance to enrich the knowledge of the stratification of the City. Consequently, the Institute for the Restoration of Dubrovnik has stored 57 conservation studies resulting from the rehabilitation program in the historic core, and from the wider area of reconstruction after the earthquake.

6 RECONSTRUCTION PROJECTS

The reconstruction after the earthquake not only allowed for the reinforcement and repair of the damaged structural system of the monuments, it also included their complete revitalisation and purification of recent inadequate interventions. It is often required a change of use of some buildings because, unfortunately, they could not be restored to their original residential purpose, due to the legal limitations on the size of dwellings (e.g. the palace). This complex process of rehabilitation of the monument is required to be addressed in the design phase.

Based on the architectural imagery, and the preliminary documentation software solutions to solve the issue of future uses, the spatial features of the monuments are analysed and harmonised across the conservation project options

In the next stage, a preliminary design is established in principle, to resolve the structural reinforcement and implementation of the installation where a principal design project emerges as a function of obtaining building permits and construction works. A variety of projects are archived in the Institute for the Restoration of Dubrovnik (in various degrees of completeness), with some from involving the completion of work interrupted by the war (e.g. Revelin Elementary School Phase II, Pustijerna, Androvićev Palace in the street, etc.).

The change of use of some residential buildings, which stemmed from the need of presenting their original architectural features, were promoted by the City for public purposes, thereby gaining some important culture edifices: e.g. the scientific library; public library; an institution for rehabilitation and protection of cultural heritage; museums – Marin; R. Brown Memorial House; Maritime Museum; Natural History Museum; the memorial house Vojnović - Matić Croatia, etc.

At the same time, the inner city area (Gruž) built replacement dwellings for those residents who wanted to permanently move out of town, or altered replacement dwellings for those who wanted to go back after the restoration work. These new apartment projects are also
archived in the Institute for the Restoration of Dubrovnik. Specific projects reconstructed after the war, and whose content and form was tailored to the needs of documentation and the efficiency of improvements, can be divided into three groups:

- Projects for the burnt palace and detailed images (except the remaining ruins) include tests for mechanical and physical properties of the remaining walls. These are carried out in all stages of the project for the construction permit and repair.
- Documentation for the reconstruction of damaged stone facades, pavements, and fountains. In addition to detailed architectural images of the damage includes photo documentation, and a quality bill of the reconstruction project for more complex objects and, given a more limited project, approval by the competent conservation service.
- Documentation to repair roof damage, the bill contains a typical photo-documentation; while the actual state is determined only after scaffolding access on the roof was possible. Basically, the approach returns the roof to its original state.

A special kind of documentation is required for seismic rehabilitation projects. This includes works of injecting external bearing walls and the installation of tie rods in the block within which the inhabited buildings were most damaged by the earthquake. This structural repair approach has been carried out continuously since 2000 after the earthquake, where all necessary approvals, including building permits, are obtained.

In recent years (for capital projects such as the Bishop's Palace in 1998; the Rector's Palace in 2003; and church Blaise in 2007) an analysis of the resistance of existing structures to various earthquake intensities have been made in order to obtain input parameters for the project rehabilitation.

Based on these findings, the aim is to determine optimal recovery methods, with minimal changes in the structure of the monument. This research is based on the detailed structure of the documented monument using design and advanced computer software.

The design document archive stored at the Department exists for 49 restored buildings before 1991, of which 20 are the most valuable in the city. After 1991, 9 construction projects for the rehabilitation of burned-out palace were archived, with all previous studies and research, including the renovated Palace Square; Bishop's Palace; St. George in Pile; St. James on Visnjica - the reconstruction project of St. facade of the church Blaise; repair the facade of the church Sv. Ignatius on Bošković Square; a project of infrastructure stocks Strossmayer street reconstruction project public areas - holes in Bošković Square; rehabilitation projects in war-damaged stone elements: Stradun-pavement and opened shops on the ground floor facade and terrace of Sacred Heart Church; the staircase Jezuite, Amerling fountain cloister, convent, balcony Bošković street; etc.

In recent years, a complete documentation for the rehabilitation of the Church of Sv. Cross the Upper Konalu, part of the architectural heritage of Dubrovnik, project construction and rehabilitation of complete

7 UNREALISED RECONSTRUCTION PROJECTS

Before the war, 32 major design and project updates were prepared that were not realised. Of these, 14 buildings within the city walls required repair of the serious damage caused by earthquakes, and where work was authorised by permit for construction. In parallel with the documentation for these rehabilitations, a number of functional - software solutions for complex major operations within a building, or an entire complex, have been prepared. But, structural repairs are required to enable the complete reappraisal of post-World War II damage and rehabilitation work on some valuable buildings and components, or entire urban areas. These structures have been devastated and there is an inadequate use of all their original material and symbolic elements: including damaged and derelict masonry, disrupted original dispositions and space arrangements, destroyed or negated decorative plaster, etc.

Because of legal restrictions on the size of dwellings, it is not possible to return valuable palaces recently used as a residential buildings (rather than genuine family patrician houses) to their original purpose. The difficulty is to preserve the internal layout of space and quality of the architectural treatment that will not impair the authenticity of the object in the planned new use so that these aspects can contribute to its preservation and presentation. After a detailed conservation survey and evaluation of five palaces in Pustijerna, their specific new purposes are exclusively in the field of culture, with six of them being possibly converted to the tourist needs of the city. The remaining 27 buildings in Pustijerna are still retained by the residents.

If the property’s legal point of view allows it, the current policy ideal is that the most valuable palaces, their content and purpose, could be presented, with their multi cultural - artistic value, to the general public through restoration.

Based on an international architectural and urban competition, the archaeological site in Pustijerna adopted a resolution that resulted in doubling the residential and urban area through increased housing for minimum of 25 flats.

With the neglected and devastated former monastery complex of St. Mary's, and former Government building, a detailed programme study was designed to create an archaeological museum and art centre for the city, but the project has not been completed because of the associated archaeological research and large number of dwellings.

A project completed after the war by the Institute for the archaeological site adjacent to the primary school. This involved the design for the planning, presentation and use of the premises for a playground and an open working area with children.
In Rijeka dubrovačka, the complete preparatory documents, involving major renovation and restoration projects for four summerhouses, have been prepared. This documentation was once used to search for investors and, possibly, a new owner/user that would be willing to invest significant resources in the conservation and use of these valuable pieces of architectural heritage of Dubrovnik.

The series of recorded and photo-documented detailed damage to the stone facades of other residential, commercial, public and religious buildings will be a valuable basis for future rehabilitation and reconstruction projects that might be planned.

All the described documents offer a great professional resource that is held by the Institute. It is continually used in a variety of ways: citizens use it for resolving property rights or the rehabilitation of housing using architectural images; and students and different experts use it for various studies, seminars, research etc. The quantity and variety of documents requires specific expert guidance, and that is why the Department of Registrar hired a technically educated worker.

Because of the great quantity of paper documents on which the matrix and projects are stored in three rooms, a special fire detection sensor and gas extinguishing system was installed to protect them.

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INFORMATION SYSTEMS ON CULTURAL HERITAGE IN THE CZECH REPUBLIC

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ABSTRACT: A concise overview of information systems covering whole country and maintained by the National Heritage Institute of the Czech Republic. The different forms of presentation to the public are described together with the explanation of specific content of the involved information systems.

KEYWORDS: cultural heritage, lists of monuments, monument recording, data on cultural heritage

1 INTRODUCTION

Fast development of the information technologies has provided new possibilities for the computerised information management. New information systems and databases are created, and some of the current records and inventories on cultural heritage are being digitised and transferred to more complex databases and Information Systems. The most complex data management and information systems exist on the level of the state organisation with the authority on the whole Czech Republic. This is also the case of the state protection of cultural heritage. However, to complete the picture, other information systems and databases related to cultural heritage exist and are being developed in the Czech Republic. The basic distinction among the varieties of information systems related to cultural heritage currently available in the Czech Republic can be made as following:

- Information systems directly related to the state protection of cultural heritage
- Information systems and databases designed to follow a certain theme/field/interest (e.g. StruFail Database of Damages of ITAM, Documentation of minor sacral architecture in Czech-Switzerland National Park, register of the Research Centre for Industrial Heritage FA CTU Prague, PhotoPa database of photogrammetrically measured monuments Fsv CTU Prague, etc.).
- Other information systems and databases containing also information relevant to Cultural Heritage administration and protection (e.g. land register, cadastre, census data etc.)

The document will focus in detail on the first group of information systems:

2 INFORMATION SYSTEMS DIRECTLY RELATED TO THE STATE PROTECTION OF CULTURAL HERITAGE

The beginnings of inventory activities in the field of cultural heritage go back to the mid-19th century. On December 31, 1850 the Austrian Emperor Franz Josef I gave approval to set up the Central Commission for Research and Conservation of Monuments (k. k. Central-Commission zur Erforschung und Erhaltung der Baudenkmale). In 1859, the commission was placed under the Ministry of Culture and Education and in 1873 renamed to the Central Commission for Research and Conservation of Historical and Artistic Monuments. Individual workers of the committee, so-called territorial conservators, immediately started to deal with registration activities. From the end of 19th century detailed inventories of so called historic and artistic heritage of political districts of the Czech Kingdom were gradually compiled and published in more than 40 volumes.

In 1919 after the establishment of independent Czechoslovak Republic, the Ministry of Education and Public Awareness founded National Photometrical Institute, whose task was recording of historical and artistic monuments, surveying, photographing, and making their copies in order to create a documentary archive of photographs, plans and other documents of cultural heritage wealth.

In 1958 the first Czech Law on the Cultural Monuments was issued. This act (No. 22/1958) wisely defined terms

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like cultural monument, cultural property, etc. based on nominal values contained in them regardless of their records. Political will, however, directed towards to limit the state protection only to registered sites. The first comprehensive listing of previously registered objects was drawn roughly from 1962 to 1964 and became the basis for future national cultural heritage list.

The second Law 20/1987 restricted the term cultural monuments only to the items listed in the central national register managed by the State Institute for the Preservation of Cultural and Natural Monuments (SUPPOP), later State Heritage Institute (SPÚ). After 1995 the Central Register of Cultural Monuments consisting of a set of registration cards (see Fig. 1) was transferred and began to be operated in the computerized list form. So called re-identification of the register items has followed in the years 2000-2007. Since 2003 the State Heritage Institute has been renamed to National Heritage Institute (NPÚ).

According to principles of e-Government and Smart Administration Strategy supported by directions of the government of the Czech Republic the data from registers administrated by the National Heritage Institute should be digitized and made accessible for public and other administration bodies on several different levels of accessibility. Since 2008 such process has become faster and more intensive.

2.1 INTEGRATED INFORMATION SYSTEM OF CULTURAL HERITAGE (IISPP)

The IISPP is a hub (Internet portal) which links individual information systems (GIS, MIS, Monument and IS on archaeological data) which up to recently existed as separate data resources on cultural heritage in the Czech Republic. It is still under development in terms of full integration, i.e. using only one authentication for all integrated systems. The state of completeness depends on the individual systems and their contents. In future as a whole, it will represent a flexible platform which can be able incorporate all variety of information in different formats and open for a further development and integration of other IS.

Its state of completeness can be characterised as uneven due to the fact that it combines a variety of data from a variety of sources. For example, basic data from the Central Register of Cultural Heritage Monuments (see next chapter) are already publicly available. On the other hand, it should be also possible to deposit, sort and search documents and files of a selective nature like surveying documents, historic research or restoration reports, etc. The actual presence of the individually recorded data is still limited due to a variety of reasons. The purpose of this system is not and cannot fill all the blanks, but gradually gain access to all the digitized data managed by the National Heritage Institute.

CENTRAL REGISTER OF CULTURAL HERITAGE MONUMENTS (USKP)

A nationwide list of records collected and maintained according to the legal regulations (defined by the Czech Law 20/1987 on State Protection of Cultural Heritage). Originally it was established as an archive of registration cards and other documents stored in paper form. In recent decades the “list of monuments” has been transformed into the more complex information system based mostly on computer means. The main purpose is to gather and continuously append documents and data files by which the specific heritage values can be identified, described and safeguarded. The register is maintained by the National Heritage Institute, Central office (Národní památkový ústav, Ústřední pracoviště, Valdštejnské náměstí 3, 118 01, Praha 1).

The Central Register comprises of the following parts:

- List of cultural heritage monuments (KP)
- List of World Cultural Heritage Sites in the Czech Republic (UNESCO)
- List of National Cultural Monuments (NKP)
- List of Cultural Heritage Town Reservations (MPR)
- List of Cultural Heritage Village Reservations (VPR)
- List of Archaeological Heritage Reservations (APR)
- List of Cultural Heritage Town Areas (MPZ)
- List of Cultural Heritage Village Areas (VPR)
- List of Cultural Heritage Landscape Areas (KPZ)
- List of protective buffer zones (OP)

The pre-computerised version of the central register has been based on the paper inventory cards. Figure 1 represents an example of the file card of one unmovable Cultural Heritage object.

Digitized data from the Central Register of Cultural Heritage (USKP) are available on-line through the Integrated Information System of Cultural Heritage (IISPP) on https://iispp.npu.cz/. Apart from the public part it also contains restricted part which is designated for registered users granted with individual rights, mostly employees of the National Heritage Institute or state administration. The restricted parts contain confidential information about property owners or about movable heritage objects (precious furnishing of churches or chateaux) or offer the user applications with more interactive access to the core data. Currently the IISPP system is available in the Czech language only.

The content presented in Figure 1 is as follows:

1) Municipality,
2) District, Value, State of conservation, Use;
3) Region;
4) Register number;
5) Name (specification) of historical monument;
6) Detailed specification of the location of historical monument – settlement (quarter), house number, street (square), or local track, plot number etc.;
7) Protective buffer zone;
8) Owner (administrator, permanent user);
9) Description of monuments, including sculpture, painting, or other decorations;
10) Time, style and attribution;
11) Movable furnishings;
12) Evaluation of the political and cultural importance of the monument. Reasons of protection;
13) Conservation status of monument and any proposal for action;
14) Past and current usage and any proposal for action;
15) Reference to literature;
16) Reference to photographic documentation;
17) Reference to surveying and other documentation;  
18) Registration list compiled (name, date, signature);  
19) Record of additional sheets;  
20) Notes, records of changes and supplements.

Figure 1: File card of unmovable cultural heritage item. Old wooden winch well.

2.2 MONUM-NET

An independent part of the IS which among other tasks presents data from the Central Register of Cultural Heritage (USKP) is maintained and continuously updated by the National Heritage Institute and is accessible via the Internet.

Except the brief information about both movable (only for registered users) and unmovable cultural heritage monuments (see Fig. 2) the Monum-Net system also provides information on the following:

- World Heritage Sites, National Cultural Monuments and protected areas in the Czech Republic
- Cultural heritage in danger. Basic data as in figure 2, specification of the state, photo documentation
- Restoration permissions for individual proprietors. Specification of the permission.
- Surveying and documentation activities, with short annotation and photo documentation if included
- Bibliography on Cultural Heritage
- Library of the Central Unit of the National Heritage Institute
- Contacts and organisation structure of the National Heritage Institute

Restricted access allows seeing owner(s) address(es), parcel numbers from the land register and also document titles, numbers and dates of important correspondence items exchanged with state administration authorities responsible for cultural heritage protection.

Figure 2: Example of Monum-Net record on unmovable Cultural Heritage for public user. Fields: Specification of monument, Protection state, Date since protected Registration number, District, Urban unit, Urban part, Cadastre, Address, House number, House street number, Municipality, Administration and building office, Tax revenue office, Historic land.

2.3 META INFORMATION SYSTEM (MIS)

The MIS is a specific part of the Integrated Information System of Cultural Heritage containing data that are maintained and continuously updated by the National Heritage Institute. The Meta-information system of the National Heritage Institute ensures a unified savings, descriptions and access of digital or digitalised documents (photographs, maps, plans, text documents etc) about objects of cultural heritage interests or professional activities of the National Heritage Institute interests.

MIS is composed from a central part, where the description of documents is stored (met data) and from local parts, where the actual documents are stored. The central part of MIS is intended for searching and viewing the available document. Part of the documents is made available to an anonymous user (public). The public access allows a full-text search and display of basic descriptive entries and preview of public documents. Complete content and functions of MIS is available to registered users after log-in.

Restricted access allows seeing and downloading interior photos and more meta-information, mostly technical parameters and information about the author and the location of the original documents. Registered users can download images in original size. They are also entitled to upload new documents including meta-data into the system and edit their own records.

The biggest advantage of the authorised access is the possibility to use parametric search according to different preset categories. Unregistered users are limited to search only by keywords, or other full-text identifiers (registration number of the monument, pGIS code…).

Navigation from the public GIS page of IISPP is also possible.
2.4 GIS

Geographic information system of the National Heritage Institute is one of the main pillars of the Integrated Information System of Cultural Heritage (IISPP). It is mainly due to its ability to present the cultural heritage objects in a digital map, promptly identify their location, borders of areas under interest and study relations among individual members using thematic map layers. Conception of GIS of the National Heritage Institute is based on consolidation and centralisation of all data in the central database by means of ArcSDE and providing an on-line access to them by means of ArcIMS and T-MapServer technologies.

The GIS information system provides 4 mapping projects available to public and another 7 projects for the registered users. Example of a mapping project open for public is presented in Figure 4.

In general, the restricted access allows seeing much more thematic map layers. But there are also entire map projects visible only in the restricted area. Either these are projects that are important for internal tasks NPÚ as for example “Revision of borders of protected areas and buffer zones” or “Safeguarding plans and limitations” or projects that they are still filled with little data to be presented for public like “Building and urban history researches (SHP).

2.5 IS - ARCHAEOLOGY

Information system on archaeological data (ISAD) was created in 2002-2004 by the National Heritage Institute. The objective was to create a unified storage place for all archaeological data obtained during the care of the archaeological fond by the means of modern information technologies. The information system was created in order to manage the data and ensure their effective use by the National Heritage Institute as well as other users in the area of cultural heritage protection, stat and public administration and last but not least to present the data to public on the Internet.

The applied technologies of map, database and web server allow a complex differentiated access to the individual data sources by means of a common Internet browser. The system is continuously updated and upgraded with an aim of its gradual integration into the Integrated Information System of Cultural Heritage (IISPP).

The public can access two mapping projects of this GIS based system. The first one allows search and print out of data (name, point of location, unique key code, administrator, cadastre and region) on Areas with Archaeological Findings (UAN) listed in the SAS (State Archaeological List) which is managed by the National Heritage Institute. The other mapping project is about Important Archaeological Localities in the Czech Republic, see the Figure 5.

Like in previously described cases a restricted access allows more comfortable and effective work with the data, their searching and organizing in map layers.

In general, the restricted access allows seeing much more thematic map layers. But there are also entire map projects visible only in the restricted area. Either these are projects that are important for internal tasks NPÚ as for example “Revision of borders of protected areas and buffer zones” or “Safeguarding plans and limitations” or projects that they are still filled with little data to be presented for public like “Building and urban history researches (SHP).
3 CONCLUSIONS

The IISPP system is well-designed and it seems that it aspires to become a truly comprehensive tool for understanding and protection of Cultural Heritage monuments. Its structure allows addition of any new data sets collected or digitized now or in future. On the other hand some areas are still very unevenly (sometimes only fragmentary) loaded with data. This is probably a general problem of not having enough relevant data. Moreover some search tools still need some development to be user friendly and efficient. The public access is very restricted, probably more than is necessary. There is no reason to hide data which are available on other freely accessible websites. In the near future the National Heritage Institute is supposed to support cooperation with other organizations to create and publish individual GIS mapping projects.

ACKNOWLEDGEMENT

The study has been carried out for the European project on Cultural Heritage Identity Card (EU CHIC) supported by the 7th Framework Programme of the European Community and with the support of the Institution Long-term Conceptual Support RV0: 68378297.

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GREECE - PRESENTATION OF FOUR EU-CHIC RELEVANT METHODOLOGIES

Anastassia Kioussi1, Kyriakos Labropoulos2, Antonia Moropoulou3

ABSTRACT: Documentation of the current state of immovable cultural heritage is an essential basis for cultural heritage preservation and maintenance required. In this framework, EU-CHIC project aims to introduce the concept of the “Cultural Heritage Identity Card”, a systematic collection and storage of data on immovable heritage objects across European and neighbouring countries. In order to develop a common methodology needed for the efficient compilation of the data regarding each monument under observation, it was necessary to focus on research and documentation of the most efficient information systems on cultural heritage. This was achieved through an integrated survey of existing Greek documentation protocols in the field of cultural heritage protection, revealing all criteria and factors affecting the monument at all levels and responding to the necessity of performing inspection, diagnosis and intervention works.

KEYWORDS: Cultural heritage, monument documentation, information systems, monument archiving

1 INTRODUCTION

Protection of Cultural Heritage is a demanding task anticipating both supervising and management, in order to ensure building’s sufficient maintenance as well as to increase building’s lifetime, by ensuring that incidents of future failure are avoided (preventive maintenance), by optimally allocating funds, and by employing human resources. Effective and proper decision making for monuments preservation relies heavily on data compilation and processing and contributes to the implementation of sustainable conservation. However, this is often difficult to achieve due to the variety of existing information systems on monuments, which differ according to the building architectural type, its individual needs and uses, the administrative structure in each country as well as on or on the type of works performed [1,2]. In this framework, the EU-CHIC project has been initiated and aims to set-up a system introducing the concept of the “Cultural Heritage Identity Card”, which will develop into a systematic collection and storage of data on immovable heritage objects across European and neighbouring countries. Such a concept is expected to have a significant cost benefit for cultural heritage owners and managers by using common parameters, and will increase the level of professional know-how in order to minimize the detrimental impact of lack of knowledge and expertise [3].

In order to assess the current state-of-the-art in this field the elaboration of existing Greek information systems was performed. The purpose of this detailed study is to collect a meaningful sample of the existing information on Cultural Heritage documentation methodologies. It focuses on issues relating to the preservation and sustainability of Cultural Heritage, such as location of the building, monitoring processes, management, current state of preservation, building materials and intervention techniques applied in the past, all aiming to document the complete history of the monument. Each one of these protocols follows unique procedures. However, these methodologies have been compared in order to draw conclusions concerning the best way to develop a hypothetically optimal procedure. The information systems surveyed regard immovable cultural heritage under the administrative authority of Hellenic Ministry of Culture and Tourism. More specifically this work presents the documentation methodologies of the National Archive of Monuments, the Acropolis Restoration Service, the General Directorate of Museum Studies and Cultural Buildings and a risk assessment project of the Directorate of Byzantine and Post Byzantine Monuments.

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2 THE NATIONAL ARCHIVE OF MONUMENTS DOCUMENTATION SYSTEM – ‘POLEMON’

2.1 THE DIRECTORATE OF THE NATIONAL ARCHIVE OF MONUMENTS

The Directorate of the National Archive of Monuments is a division of the General Directorate of Antiquities and Cultural Heritage of the Hellenic Ministry of Culture and Tourism. The Directorate of the National Archive of Monuments is the designated authority for the collection, indexing and study of archival material that relates to the historical monuments and archaeological sites in Greece, by undertaking the electronic recording, documentation and management of archives related to the Greek cultural heritage in order to ensure its preservation under optimal conditions and promote its effective and creative utilization. Employing state-of-the-art technology, the Directorate actively promotes the dissemination of knowledge across a broad spectrum of cultural and archaeological realms, supporting scholarly research and facilitating the access to archival content.

It oversees the administrative development and history of the Archaeological Service, coordinates the digitization procedures applied by the Regional Authorities of the Hellenic Ministry of Culture and Tourism. Moreover, it acts as a liaison between the Central and Regional Departments of the Hellenic Ministry of Culture and Tourism on issues that fall within its jurisdiction, contributing substantially to the exchange of knowledge through publications, conferences and presentations. The Directorate is also responsible for maintaining the National Archive of Monuments, an electronic register of comprehensive information on every immovable and movable monument, compiling The Ongoing Catalogue of Listed Archaeological Sites and Monuments of Greece, available in printed and electronic form, which lists the decrees for the conservation of monuments, archaeological sites and places of historical interest in the country, from 1921 onwards, as well as a National Archive of Monuments Terminology [4].

2.2 A DIGITAL NATIONAL ARCHIVE OF MONUMENTS - THE NATIONAL MONUMENTS RECORD SYSTEM (POLEMON)

Establishing a unified documentation and management system is the basis for developing a National Archive of Monuments. The integration of a common set of digitizing and digital documentation practices facilitates effective strategies for cultural heritage management both on a local and a national level. This project implements the National Archive of Monuments Information System («POLEMON») which was designed to meet the needs of the various units and services of the Hellenic Ministry of Culture and provides an integrated set of tools for Monuments and Collections Management [5,6].

The very aim of the POLEMON Project, entitled "Co-ordinated Informatics Services for the Documentation, Management and Promotion of Cultural Heritage", was the creation of an information system for the National Monuments Record, together with an Integrated Museum Information System, for implementation at national level. The Polemon Project was underway from late 1994 to 1997, as part of the EPET II program administered by the General Secretariat for Research and Technology, Greece.

The information systems for the National Monuments Record and the museums share a complementary relationship. The need to develop two distinct systems arises from the different depth and breadth of detail each is required to serve. Added to this is the fact that the National Monuments Record handles information compiled and held by separate, independent and geographically dispersed divisions - regional divisions and other services within the Ministry of Culture. On the other hand, a museum is usually an integral institution with its own character, aims and activities. Having said this, the overall makeup of the two systems is congruent as far as information and functions are concerned. The main structural and functional features of the National Monuments Record system are as follows:

- It relates to fixed sites and moveable monuments, their interrelationship and chronological context.
- It supports administrative documentation of the monuments and objects.
- It is geographically dispersed, in line with the official administrative plan and distribution of departments within the Greek Ministry of Culture. Archival information is collected and undergoes specialist processing at local level, while the Directorate Monument Record and Publications within the Ministry of Culture is responsible for planning and co-ordination, and retrieves data mainly for administrative purposes.
- It is in line with the latest (Greek) legislation on Archaeology.
- Its architecture is that of a federated database system.
- It is connected to a system which supports mapping documentation and related functions.
- It can be linked to domain-specific cultural documentation databases which are compatible with those of the integrated museum information system.
- It can be linked to the Museum Information System.

Mapping support within the system includes the following features:

- Infrastructure for drawing up the National Monuments Survey using Geographical Information Systems (GIS).
- Land registry documentation to cover areas in the vicinity of monuments (mainly archaeological sites), within the framework of the geodesic and administrative reference grid of the National Land Register.
- Necessary requirements for the topographic recording of monuments

Given that functional complementarities between the two systems are desired, they have been developed within a common methodological framework.
Figure 1: POLEMON Database Form - Monument Situation and Use

The overall makeup of the two systems is congruent as far as information and functions are concerned. In particular:

- They both manage a formalised data corpus, which serves the needs of basic documentation and enables basic management tasks ("management documentation") to be carried out.
- They permit the development of specialist scholarly databases, to be used in storing the results of cultural research ("cultural documentation").
- They handle a variety of documentation material (photographs, plans, maps, documents etc.).
- They support terminological thesauruses.
- Data held on them can be used in "external" applications to which they have access (e.g. catalogue publication, interactive multimedia, land registers, monument preservation programmes etc.).
- They can be linked up to national and international cultural information networks.
- SIS (Semantic Index System) has been used for the development of both systems, so as to ensure their interoperability, high performance and smooth future development.

The Semantic Index System (SIS) is a tool for describing and documenting large evolving varieties of highly interrelated data, concepts and complex relationships, as opposed to large homogeneous populations in fixed formats (handled by traditional DBMS). As such, it is suited for the representation of scientific knowledge, engineering constructs and metadata. These kinds of data are also characterized by relative stability, i.e. they undergo few updates by comparison to, say, administrative, financial or observational data, which give rise to continuously changing sets of uniform items. SIS has been developed by the scientific team of ISL, under the supervision of Martin Doerr & Panos Constantopoulos.

2.3 ONGOING CATALOGUE OF THE LISTED ARCHAEOLOGICAL SITES AND MONUMENTS OF GREECE

The Ongoing Catalogue of the Listed Archaeological Sites and Monuments of Greece is compiled and published since 1993 by the Directorate of the National Archive of Monuments of the Hellenic Ministry of Culture and Tourism. Part of the greater project for the creation of an all-inclusive National Inventory of Monuments, it is a codification of all the official acts by which archaeological sites and monuments of the country have been designated and listed as such in the Government Gazette since 1921. Only immovable monuments, archaeological sites and historic places that required a specific legal act of designation, demarcation and protection are included, as the Greek Law (3028/2002 “On the protection of antiquities and cultural heritage in general”) places all monuments and sites dating before 1830 under the protective auspices of the State automatically and without further legislative procedures. From its original printed form (more than 120 volumes), the Ongoing Catalogue has now developed into a modern digital database updated regularly and accessible over the Internet at http://listedmonuments.culture.gr. The database holds more than 10,000 entries related to over 18,000 sites and monuments designated by the Ministry of Culture and Tourism. Visitors of the Ongoing Catalogue’s web site can search (in Greek) specific acts of designation, monuments or sites by name, geographical location, and state of ownership or administrative authority. Free keyword search is also available. All content is intended merely for informational purposes; only the original statutes published in the corresponding Issues of the Government Gazette have legal value.

2.4 THE NATIONAL ARCHIVE OF MONUMENTS TERMINOLOGY

Realizing the need for establishing a unified Terminology for the management of the cultural repository of the Hellenic Ministry of Culture and Tourism, and after the completion of the Project “Digitalization of the Collections of Movable Monuments of the Hellenic Ministry of Culture”, the Directorate of the National Archive of Monuments initiated the compilation of the National Archive of Monuments Terminology, and in the medium term, the development of the Thesaurus of Archaeological Collections and Monuments.

The Directorate coordinates the development of the Terminology and more specifically:

- the continuous enrichment of Terminology, and its further adaptation to the specialized needs of the Ministry's Archaeological Units and Museums
- the creation and establishment of a systematic process of validation
- the management of standardization and structure compliance issues

For the certification of the scientific soundness of Terminology, the Directorate appointed the Committee of Terminology Specialists of the Ministry, all
distinguished scholars in various thematic and chronological fields of Antiquity. The role of the Committee involves the validation of terms that result from the Ministry's Archaeological Units and Museums documentation records, stored in the system of the National Archive of Monuments. The prospects and the profits of this initiative are obvious. Beyond the continuous enrichment of the Terminology, the foundations for the creation of National Thesaurus of Archaeological Collections and Monuments are placed. The Thesaurus will serve the current needs of management, access and promotion of the archaeological assets of Greece. This issue forms a persistent requirement of the scientific community and the need for its scholar and institutional configuration is hence imperative. The electronic environment of the increasing volume of digital content, in which the Archaeological Service participates actively, dictates the establishment of methods and tools which can improve the management of cultural information, in close cooperation with the Committee. A dedicated space and an electronic Forum of Terminology are available in the Directorate's website to allow the work and communication of the Committee of Terminology Specialists. In this space, the registered members of the Committee can receive content of limited access and have the opportunity to exchange views for the validation of the terms. The development and the continuous growth of this important initiative, constitutes a major objective of the Directorate, which can be ensured through practical application, always in collaboration with the Committee of Terminology Specialists of the Ministry.

3 THE ACROPOLIS RESTORATION SERVICE DOCUMENTATION SYSTEM

3.1 THE ACROPOLIS RESTORATION SERVICE

The Acropolis Restoration Service (YSMA) is a special peripheral service of the Ministry of Culture. It was established by the Presidential Edict 97/1999 (Φ.Ε.Κ. 104/A/26.5.99) in order to organize and carry out the works of conservation and restoration on the Acropolis. Academic responsibility for carrying out the works has, since 1975, been held by the Committee for the Conservation of the Acropolis Monuments (ESMA), an interdisciplinary committee of specialist scholars [7]. The Director of the YSMA is responsible for the coordination and unhindered function of the works, for its adherence to the time-frame and for introducing to the ESMA matters for which the Committee is responsible. The YSMA is divided into the following sections:

- Technical office and work-site for conservation, consolidation and restoration of the circuit walls of the Acropolis
- Office and workshop for inventory, documentation and cataloguing of the scattered architectural members
- Office and laboratory of surface conservation
- Technical office and laboratory of electrical engineering support
- Cast laboratory
- Documentation office
- Photographic laboratory
- Secretariat Office
- Information and Education Office
- Accounting Office
- Office of support and management of material

3.2 DOCUMENTATION OF THE WORKS

Analytical documentation of the works of restoration and conservation of the Acropolis monuments along the lines defined by the international charters and agreements, was one of the primary aims of the ESMA, particularly because the detailed recording of interventions assures that the principle of reversibility would be upheld. Before the restoration programs were started, the existing condition of the monuments and of the surface of the rock was documented.

To this end, both traditional methods of survey, with the measurements depending on a set system of reference points, and experimental methods were employed. Examples of the most advanced techniques applied in the past are photogrammetric surveying of parts of the Erechtheion, the use of gammagraphy and ultrasound for determining the structural condition of architectural members of the Erechtheion and the Parthenon, and also aerial photography of the Acropolis rock by balloon. Today, that the works on the Acropolis are in full sway, with three restoration programs in progress, the interventions are documented in a systematic and detailed way, comprising recording of the works in daybooks, graphic documentation of the interventions, and systematic photographic monitoring, all kept in the

The recording of the interventions daily in the daybook of restoration works makes it possible to reconstitute the process of restoration after its completion. Recorded analytically in the daybook are the dismantling of the architectural members, the works of structural restoration and finally the re-setting of the members. In a corresponding, but separate, daybook, the conservation of the architectural members is also recorded on a daily basis.

Graphic documentation accompanies the written record of the works. The usual daily practice is to draw the architectural members that are dismantled at a scale of 1:10. With this goes a report identifying the member, with graphic commentary and description of its individual characteristics: this comprises the specific features of the member's construction, evidence of changes in its use, and visible damage. Likewise produced at the worksite are drawings, on transparent paper at a scale of 1:10, showing structural restoration and recording structural changes undergone by the
member in the process of the current anastelosis. These drawings show the newly identified fragments that belong together, the position and form of the new fillings, and the type of titanium clamps and dowels used in recomposing the members. The conservation team makes diagrams on a special transparent paper, showing, in different colours for different conditions, the various kinds of damage found on the architectural members of the monuments. Included in the graphic documentation are also drawings of the scattered architectural members and sculptures, by the team of the corresponding section. Photography too is employed for documenting the works of conservation and restoration. The picture produced supports the daily observations of the researchers at the work-site in a comprehensible and direct way. The systematic use of this method over the years makes it possible to study the monuments and their changes diachronically. Daily documentation of the works is done with black-and-white film and slides; recently digital technology is being used so as to have a more direct and effective recording of the interventions. The damage evident on the members and the surface conservation is documented in similar fashion by the team of the corresponding section. In addition to the daily use of photography as a means of documentation, the monuments or parts of them are specially photographed by the YSMA photographer at regular intervals or, exceptionally, when there is a special intervention. Photography is also used for the inventory of the scattered architectural members and sculptures. Cinematography too is used to document the works. This is done by a special outside team in direct collaboration with those carrying out the work. The documents produced are kept in the YSMA Documentation Office, where they are organized and inventoried so as to facilitate their retrieval. In their entirety, they comprise a valuable source of information, accessible to researchers, that makes it possible to comprehend the monuments and the works of anastelosis in depth.

3.3 THE ESMA ARCHIVE - THE YSMA DOCUMENTATION OFFICE

Having stipulated the documentation of the interventions as a basic principle of their works, upon their establishment the Committee for the Conservation of the Acropolis Monuments (ESMA) proceeded to form a documentation archive. Today (2007), 30 years after the works were started, the ESMA Archive, which has developed into the YSMA Documentation Office, comprises a virtual ark containing not only all kinds of documentation that has been produced and continues to be produced in the course of the works, but also documents-reproductions from other archives or donations from third parties related to the history and art of the Acropolis monuments, in particular the earlier interventions. Specifically, the Documentation Office comprises:

The Archive of written material contains the handwritten daybooks of the works. The Drawing and plan cabinet holding all types of drawings that are produced during the course of the work, the Photograph cabinet where is kept the photographic documentation produced before (at the stage of study of the monuments), during and after completion of the interventions. A special section of the Photograph Cabinet comprises the cinematographic archive of the works. It includes the regular yearly, documentary motion-pictures of the interventions, as well as complete movies on the subject of the works and the monuments of the Acropolis, produced by the YSMA. Finally the Library comprising the publications of the ESMA and the YSMA, independent volumes of studies and journals (around 900), offprint of articles from journals or collective scholarly publications (some 500) and an extensive appendix with notices from the Daily or Periodical Press about the YSMA interventions on the Acropolis monuments. The books and offprint are mainly specialized on the subject of restoration. A special section of the Library holds the archive of original studies, essays and proposals, which includes some 1500 volumes of typed studies, proposals, reports on progress and reviews of the works of the members of the worksites and of the working sections of the YSMA. In this archive are also the volumes of the Proceedings of the ESMA Conferences.

3.4 DIGITAL DATA BASE

The archival material of the YSMA, together with the daily information from the interventions, is processed in the digital application of the Documentation Office. Making use of communication technology for more effective management of the archive of the Acropolis works was considered for the first time in 1987 after the intervention on the Erechtheion had been completed. At that time a digital inventorying and management system was sought that would insure quick retrieval of information, organization and grouping of the documents, analysis and direct access to their components. In addition the system had to support a network with many users.

The initial phase of entering the material produced during the Erechtheion restoration was accomplished.
with the help of the software system Sigmini, which is a copyright of the École des Mines of Paris and the Union Minière of Belgium. Entry of the material from the Parthenon restoration began in 1997 with the help of the software system developed by the Athens Technology Centre. The material from the intervention on the Erechtheion was also incorporated in the new system. From 2001 on, with the establishment of work offices in the worksites of the monuments and the networking of the computers, it has been possible to enter documents directly into the digital database as soon as it is produced. Thus, the information entered is up-to-date and completely accurate.

The database processes both pictures and texts and it comprises four archives, the archive of architectural members, the photographic archive, the archive of plans and drawings and the text archive. The archive of architectural members contains information about the monuments, arranged in hierarchical order from the entire monument and its various structural parts to the individual architectural member.

Figure 3: Hierarchical analysis of selected monuments and architectural member at the left and the corresponding record at the right

In addition it includes special information divided into six groups/windows. These information groups regard the building characteristics of the members, traces of their historical phases, earlier interventions they have undergone, the damage they show, contemporary interventions for structural restoration and surface conservation.

The other three archives contain pictures and information about the corresponding documents. Each piece of documentation (photograph, plan/drawing or text) is associated to the architectural member to which it refers. The content of the document is described with special key words and it can be associated with six special information groups/windows of the archive of architectural members.

The documentation and information entered in the digital database can be accessed by means of searching criteria, simple or composite. The ability of the data base to provide not only simple catalogues of the information documented, but also answers, composite in terms of their content and associated with the architectural members of the monuments, makes it a useful and valuable tool for those carrying out the work and for the wider scholarly community.

Figure 4a: (First Step) The selection of South Wall on the 3D model of the Erechtheion

Figure 4b: (Second step) The choice of 58 blocks of N. wall of the Erechtheion

Figure 4c: (Third) The presentation of the recording of block 58 of Erechtheion
4 GENERAL DIRECTORATE OF MUSEUM STUDIES AND CULTURAL BUILDINGS

The Directorate is responsible for museum and cultural buildings interventions, extensions, upgrades or new buildings. The Information System used to document all the data is a system which has the form of technical reports, prepared by the architects responsible for any museum / historic building district. The procedure followed for the conduction of a study before the beginning of any kind of work includes: the autopsy in the building's framing, drafting architectural and historical documentation, which can be completed during the project by the responsible researcher. Sources for research on historical documentation are records and related local services. The data collected during the study, are kept in the appropriate museum / cultural building records and files [8].

Figure 5: Part of a typical museum study including descriptive documentation and plans of the museum

This system of recording the necessary data applies nationally, provides continuous updating and renewal of the data and includes historical data, archaeological analysis, architectural data such as structural analysis and documentation, information and data about building materials (laboratory analysis etc), the building’s technical characteristics, information on the conservation status of the museum and the individual interventions made in the shell (identification and documentation of previous works, pathology analysis), legal conditions and constrains (ownership, constrains description)data and management of the museum, geographical description.

5 RISK MAP OF CULTURAL HERITAGE AND MAPPING AND DESCRIPTION OF CULTURAL LANDSCAPE

5.1 THE PILOT ACTION PROGRAM ARCHI-MED

ARCHI-MED [9] constitutes a joint pilot action programme, promoting transnational cooperation in the field of spatial planning in the Central and Eastern Mediterranean space, under article 10 of the Regulation of the European Regional Development Fund (E.R.D.F.). The planning of the programme started in 1996 and was implemented between January 1999 and December 2001. The programme was implemented by Greece and Italy, which submitted a joint strategy for the region in question, in order to collect the required know-how and experience in spatial planning, and at the same time enhance cooperation among the central administration and the local authorities of the participating countries. More specifically, Sub-action 3, entitled "Preservation of cultural heritage and landscapes", was coordinated on a national level by the Ministries of Culture of Greece (national coordinator: M. Theodorou) and Italy (national coordinator: A. Bianchi), and implemented by the Directorate of Byzantine and Post byzantine Monuments and the Istituto Centrale per il Restauro (Central Institute of Restoration), respectively.

Figure 6: Documentation Card of the museum's / cultural building’s architectural and structural data

5.2 PROJECT: RISK MAP OF CULTURAL HERITAGE AND MAPPING AND DESCRIPTION OF CULTURAL LANDSCAPE

The Risk Map is a dynamic software application, using Geographical Information System (G.I.S.). The application provides information on the various risks threatening the cultural heritage in a specific area, as well as data concerning the condition of particular monuments [10].
The system enables the user to access the information in a quick and easy manner, through maps or tables, and to make various complex queries, combining information on various geographical zones, monument categories and decay categories. The Risk Map provides direct access to "mapped" information regarding the risks threatening the monuments, as well as the ability to continuously update its contents. Therefore, the Risk Map constitutes a valuable tool for the authorities responsible for the management of cultural heritage, on both central and local level, regarding the strategy to be followed on issue of preventive conservation and restoration of monuments, as well as on issues of spatial planning. The Risk Map was launched in Greece as a pilot application, within the framework of the ARCHI-MED Sub-action 3, and it was based on the methodology of the corresponding Italian model, implemented for years by the Italian Ministry of Culture and specifically by the Istituto Centrale per il Restauro.

The Greek application, structured on a Geographical Information System, is connected to a Relational Database and operates at the premises of the Hellenic Ministry of Culture, in Athens. The system enables the user to make various complex queries and draw information on:

- spatial and descriptive data for the Dodecanese, stored into the system and organised into thematic fields (layers) which can be combined, such as the seismic epicentres, the climatic data, the erosion levels, the settlements location etc.
- data related to the vulnerability of the 31 castles and particularly their structural characteristics and pathology
- the General Risk Index, deriving from the interrelation of a particular risk factor index and the vulnerability index of each castle.

5.3 THE STRUCTURE OF THE DODECANESE RISK MAP

The design and implementation of the Dodecanese Risk Map was undertaken by an interdisciplinary team, in collaboration with the scientific personnel of the Hellenic Ministry of Culture and the Istituto Centrale per il Restauro. First, the team defined the characteristics of the system and the methodology to be followed regarding the identification, collection, processing and storing of information. Then, the team proceeded with the creation of the Risk Map, in the following stages:

5.3.1 Data collection
A special "structural documentation and pathology card" was designed, in order to document the monuments' condition. The card was filled in situ, during the research undertaken on the 31 castles of the Hospitallers. Each card bears standardised information on the structural characteristics of each monument and includes text and photographic documentation on the particular damages and the deterioration caused to each castle. The deterioration and damages were typologically classified into 30 categories, in order to ensure uniformity.

At the same time, following extensive research, cartographic data for the Dodecanese area were collected from the relevant public authorities (topographical and geological data, administrative boundaries data etc.) together with other material regarding the various risks that affect the cultural heritage (geotectonic maps, climatic data, seismic risk zones etc.).

5.3.2 Analysis, unification and codification of information
During this phase of the project, the collected data was processed, in order to confront the problems of lack of homogeneity, as far as the scale and the reference system are concerned. Additionally, the information was converted into the appropriate form, so as to be entered into the system (scanning, georeference, codification). The current Geographical Information System operates on a 1:50.000 scale and the reference system is the Greek Geodetic Reference System '87.

5.3.3 Design of the Geographical Information System and the Relational Database
The Geographical Information System, which was designed according to the technical standards, set by the Hellenic Ministry of Culture (ARCView), while the Relational Database was based on Oracle.

5.3.4 Data entry
The basic spatial data (point, line, and polygon) were digitised and the rest of the descriptive information was organised in the Relational Data Base.

5.3.5 Organization and representation of thematic fields
Thematic layers (see Table 1) can be presented in numerous combinations, according to the user's preferences. It can make simple or more sophisticated queries through a "Query Builder". In the same time, he can decide upon the graphic presentation mode, by selecting the symbols, colour range etc.
Table 1: Organisation of information the form of thematic fields (layers)

<table>
<thead>
<tr>
<th>Islands</th>
<th>Contours</th>
<th>Erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil depth</td>
<td>Erosion</td>
<td></td>
</tr>
<tr>
<td>Contours</td>
<td>Erosion</td>
<td></td>
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<tr>
<td>Climatic data</td>
<td>Seismic epicentres</td>
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<tr>
<td>Erosion</td>
<td>Seismic epicentres</td>
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<td>Erosion points</td>
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<td>Seismic epicentres</td>
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<td>Human activity on natural ecosystems</td>
<td>Castles' network</td>
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5.3.6 Development of an application for the interconnection of all data. The General Risk Index

At this final stage, a new Database was designed, on Oracle as well, containing all the information initially collected on the structural characteristics and the pathology of the 31 castles. Then, a special application was developed, offering the possibility to interconnect all data incorporated into the system.

5.3.7 Design of a METADATA base for the documentation of the system's resources

Since the Risk Map is a dynamic application that requires continuous enrichment and updating, a third Database (METADATA) was created for the documentation of the resources used. The new Database provides information on the origin of the data, the date and mode of their acquisition, the scale and date of their production.

6 CONCLUSIONS

Sustainable conservation and effective management of cultural heritage demands a combination of scientific, architectural, historic and cultural knowledge and experience of the monument under observation. An integrated documentation protocol should be able to respond to the necessity of performing inspection, diagnosis and intervention works, leading to knowledge based decision making procedures. It has become obvious that there exists no established unified documentation procedure for cultural heritage [11]. Even within a single country there are great variations in the systems of compiling and managing data from monuments and historic buildings. In general, the responsibility of collecting data depends on the administrative structure in each country. New guidelines for monument documentation need to be widely applicable to the variety and the particularity of cultural heritage, selecting and integrating common criteria that formulate a dynamic archive, incorporating and supplying with information on the monument, during its entire life-time [12]. The vital stage is the inclusion of all existing data concerning special building documentation, materials and building's structure, environmental factors, degradation mechanisms, diagnosis techniques and methods and intervention works. In fact, they should not be limited to simply record information and risks associated with environmental dangers, human impact and natural hazards affecting the static/structural state of the
monument, but should include other factors such as the
conservation state of the materials (i.e. not only the
static/structural aspects of the building), the importance
and distribution of cultural heritage, the impact factor
of the hazards present, various socioeconomic parameters
e.g. Obviously, these factors cover different scales of
the problem, the macro scale, the mezzo scale and the micro
scale through a Standardized Diagnostic Study
Methodology [13].

It should also conform to the following requirements [1]:

- Observance of the deontology of international
conventions that demand the preservation and
presentation of historic, sentimental virtues and the
architecture of monuments, while preserving the
authentic materials, forms and structures.
- Serviceability of the conservation interventions and
restorations (so that the building can accept safely the
new uses and face the earthquake risk)
- Compatibility of the materials and conservation
interventions with authentic materials, the building
and its environment
- Sustainability (Increase of lifetime, protection of the
environment and energy savings, minimization of
environmental impact on the monument)

Therefore an upgraded methodology for monument
documentation should not be a simple integration of
existing projects methods and tools; instead it should
build upon current experiences and existing knowledge,
enscaping all potential data regarding the monument.
Such a unified methodology for monument
documentation offers:

a) Standard documentation procedures applying same
methods and tools providing with comparable data on
the condition of Cultural Heritage among different
administrative services or countries,

b) Standardized outputs and clearly defined database
entry without any further need for definition

c) Application of a unified documentation terminology,


to avoid overlapping and duplication.

In this context, the development of recommendations is a
vital step in establishing a guideline for monument
documentation aspiring to become a useful tool for
strategic planning and intervention regarding preventive
conservation, restoration and promotion of the
monuments. It also aspires to constitute a common
reference point for both regional and central agencies of
the Hellenic Ministry of Culture and the other authorities
responsible for the management of cultural heritage

ACKNOWLEDGEMENT

We acknowledge the contributions from The National
Archive of Monuments, Hellenic Ministry of Culture and
Tourism, the Acropolis Restoration Service, Hellenic
Ministry of Culture and Tourism, the General
Directorate of Museum Studies and Cultural Buildings,
Hellenic Ministry of Culture and Tourism, the
Directorate of Byzantine and Post Byzantine
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THE ITALIAN CENTRAL INSTITUTE FOR CATALOGUING AND DOCUMENTATION STANDARDS

Emanuele Piaia

ABSTRACT: The Central Institute for Cataloguing and Documentation (ICCD) is an important Institute under the Ministry for Cultural Heritage and Activities (MiBAC) which defines the standards and tools for the Cataloguing and Documentation of the Italian cultural heritage. The SIGEC is the Italian national standard for cataloguing the cultural heritage, which is managed by the ICCD. The system has been developed with the goal of creating a national standard that can guarantee the uniformity of the information regarding the correct usage, sharing and storage.

KEYWORDS: SIGEC, ICCD, Cultural Heritage, Assessment

1 INTRODUCTION

The Central Institute for Cataloguing and Documentation (ICCD) is an important Institute under the Ministry for Cultural Heritage and Activities (MiBAC) which defines the standards and tools for the Cataloguing and Documentation of the Italian cultural heritage. The ICCD assumes responsibility for the coordination of research activities to define cataloguing standards for various types of cultural heritage, in the archaeological, environmental-architectural, historical, art and ethno- anthropological spheres.

The cataloguing standards consist of regulations, specific standards and support tools (glossaries, lists of values) and a set of rules and methodological guidelines to be followed for acquisition of information on properties and for the production of the pertinent documentation, with the objective of recording the data according to consistent, nationally-shared criteria.

The quality of the cataloguing is maintained by the assignment of national codes in order to create a national standard process that is called “General Information System of Cataloguing” (SIGEC).

The ICCD has taken part to the constitution of mixed State-Regional cataloguing centres for training the cataloguers, based on the specific institutional agreement between the Ministry of Cultural Heritage and the Regions.

2 ITALIAN REGULATION FOR CATALOGUING CULTURAL HERITAGE

The regulations for cataloguing cultural heritage concern the layouts of:
- the catalogue cards;
- the authority files;
- the layouts of the cards for multimedia entities.

The catalogue cards are descriptive models which in an organised manner collect the information on the heritage, according to a cognitive standard which guides the cataloguer. At the same time, it checks and codes the acquisition of the data according to precise criteria. The ICCD has publicised different cataloguing card models in relation to the different types of heritage. Each catalogue card is accompanied by rules explaining in detail how to compile the various fields.

In detail, the Catalogue cards are organised on the basis of the various fields of discipline: archaeological heritage, environmental and architectural heritage, and ethno-anthropological heritage, artistic and historical heritage. Each card is made up of the layout (the structure of the data) and the relevant rules and checks for compiling the fields, in which are detailed indications on the compilation of each field.

The authority files are checked archives, which concern “entities” (such as authors, bibliography, etc.) in relation to the cultural heritage. The information on each entity is recorded in the appropriate model (the authority file cards) that has a same structure of the catalogue card.

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The authority files are used as a support for the standardisation of catalogued data and constitute the self-consistent databases (databases of authors, of bibliographies, etc.), parallel and interrelated with the principal database concerning cultural heritage. The cards for multimedia entities are modelled for the description and the management of information which concern the different types of multimedia documents such as: photographs, technical designs, audio, video, archived collections, etc. This data accompany the catalogue cards, to complete and enrich the knowledge of cultural heritage and has a structure and rules for compilation similar to those of the catalogue card.

3 SIGEC - GENERAL INFORMATION SYSTEM FOR CATALOGUING

The Italian national standard for cataloguing the cultural heritage is the SIGEC: General Information System for Cataloguing.

The Central Institute manages the SIGEC for Cataloguing and Documentation that is responsible for the acquisition and integrated management of knowledge of Italian cultural heritage. The system has been developed with the goal of creating a national standard that can guarantee the uniformity of the information regarding the correct usage, sharing and storage. The structure of SIGEC is of modular construction, with specific components for the management of different typologies of information – alphanumeric, multimedia, geographic - necessary for the identification of the different heritage and their correct documentation, in turn essential tools for the guardianship and security of the said heritage.

The functions defined in the System permit the integration in one unique context of all the cognitive data of the cultural heritage. They allow the re-composition of the original article of the cultural and environmental heritage, which due to the specific operational requirements linked to cataloguing, has been analysed in a fractured manner, often on the basis of different administrations’ areas of competency.

3.1 STRUCTURE OF THE SIGEC

The General Information System for Cataloguing is structured on three distinct levels:

1. “Independent cataloguing units”, activity of research and acquisition (data-entry) of the cognitive data on the heritage;
2. “Bodies in charge of cataloguing”, control of the completeness and the scientific correctness of the data, then transmission to the ICCD;
3. “ICCD central system”, management, process and update of the regulations, the vocabulary and the glossary for checking as well as the flow of information throughout the entire system.

The data which passes all scientific and formal checking procedures at the various operative levels, is then made available for public access by means of a specific module in SIGEC, the “Users lower system”, this guarantees a respect for the rights of intellectual property, privacy and the necessary measures for the security of heritage, in such a way as to satisfy the requirements of diverse users.

In order to respond to the needs of the users that are responsible for the cataloguing, the SIGEC has created an integrated model that regional Directorates (with coordination of the local Superintendence) have to integrate within their structures. This type of organisation guarantees to all users the availability of centralised support structures that will provide, instead, the necessary technical-operational assistance lightening the load at a central level.

The services offered by the SIGEC hubs installed at the regional Directorates will be usable by all the subjects that operate in fields of competency by means of a WEB interface. This will have two advantages:

- a progressive and significant increase in information relating to the cataloguing on cards of cultural heritage, through a feed of controlled, standardized and presented information on a single centralised database (at regional level);
- the possibility of sharing efficiently the catalogued information between all interested bodies, easing the work of managing heritage and programming conservation and guardianship projects.
3.2 INTEGRATION WITH GEOGRAPHIC INFORMATION SYSTEM

The SIGEC has created a specific data-structure for acquisition and management of geographical information that is connected to GIS functions. This function allows the identifications of the position of the specific cultural heritage in the territory, at the same time create and complete the catalogue card that describes the immovable gods (with photographs, surveys, archive documents, bibliography, etc.). The possibility of integrating the cataloguing data with the geographic information allows the highlighting of the relations existing between the different typologies of heritage and relations with the environmental and human elements. The result of the complete framework can be utilised for various needs: the territorial planning, the statistical analysis, research, teaching and tourism.

![Example of SIGEC data-sheet concerning the cultural heritage analysed.](image)

4 CONCLUSIONS

Today, thanks to the SIGEC and following the national standards is simpler cataloguing the cultural heritage. Diffused on the national territory and used by public institutions to different levels, it allows to consult and to create catalographic cards, but also to verify its exactness of the contents. The quality of the system is manifested by the elevated number of catalographic cards picked (2,000,000) that they describe different typologies of cultural goods distributed on the Italian territory.

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INFORMATION SYSTEMS (IS) ON CULTURAL (BUILT) HERITAGE IN ISRAEL

Anna Lobovikov-Katz, Tali Chitaiad

ABSTRACT: This document is written for the European project on Cultural Heritage Identity Card (EU CHIC) supported by the 7th Framework Programme of the European Union. It surveys existing information sources, databases and systems related to cultural (built) heritage in Israel.

KEYWORDS: information systems, cultural heritage, documentation

1 INTRODUCTION

In recent decades conservation of cultural heritage including documentation, research and practice has undergone impressive developments worldwide. Israel joined this development about two decades ago, and continually improves upon its accomplishments: In 1984 The Society for Preservation of Israel Historic Sites was founded. In 1991, an amendment (no. 31) to the Law of Building and Planning “a plan for preservation of cultural heritage sites” was enacted.

The basic information system used in Israel is called the Site Card. As Bar-Am [1] explains, it is a document, which records the physical, cultural, and historic characteristics of a historic site, beyond and above its identification in order to provide information about its historic significance and its physical condition. This information may help the municipalities to decide on the level of preservation and of its urgency. If no preservation activity is being done the card serves as part of a database of historic sites in Israel, and as a basis for further research and documentation (i.e., a complete site file).

There are three variants of site cards, which are in use by the entities below:

- Israel Antiquities Authority (IAA; for monuments dated before 1700);
- The Society for Preservation of Israel Heritage Sites (SPIHS; for monuments dated since the 18th century)
- Municipalities (through their preservation committees, for sites under their jurisdiction)

Each entity has its list of sites for preservation. It is then decided upon different criteria which sites/areas will be surveyed. Within this survey, buildings/sites receive their site cards. When possible, a site is further researched and receives a complete site file.

The Municipalities’ cards and the SPIHS’ card have similar basis and are most commonly used. There might be cases where both the IAA and the SPIHS are surveying a site, e.g. part of a building was built before 1700, and part is from the 19th century.

Additionally, The Israel Nature and Parks Authority (INPA) documents protected nature reserves and parks. The INPA uses a detailed site file on the reserves/parks (200 page-long documents), which is required by law. As part of this file, each site has an “identification card” summarizing the information on the site.

Finally, concurrently, there is an attempt by the Department of Planning in the Ministry of Interior [2] to standardize the site card system in order to have one card used by all entities. Having one identical card for all would help in creating a future national data base; and in computerizing the system and making it accessible to everyone online.

The Department of Planning in the Ministry of Interior promotes preservation of sites and buildings through the activity of the “State Preservation Team”. Its activities include preparation of a national database on preservation, legislation, research, promotion of the interaction between the various relevant bodies, organization of professional seminars, etc.

2 ISRAEL ANTIQUITIES AUTHORITY

The history of the IAA is overviewed at length on its website [3] (www.antiquities.org.il) which chronicles its development: The Department of Antiquities of the State of Israel was founded on July 26, 1948. Its activities are
based on British Mandate Antiquities ordinances, which were superseded by the Law of Antiquities passed by the Israeli Parliament, The Knesset in 1978, originally under the Ministry of Labour and Construction; in August 1955 it was transferred to the Ministry of Education and Culture.

The Antiquities Law was enacted to protect the antiquities of the country, i.e., any object, which was made by man before 1700 CE, or any zoological or botanical remains from before the year 1300 CE. The Law of the Israel Antiquities Authority states that the IAA is responsible for all the antiquities of the country, including underwater finds. The IAA is authorized to excavate, preserve, conserve and administrate antiquities when necessary. With the passage of The Antiquities Authority Law on Sept. 1, 1989 the department became an independent government authority. The Law defined the duties and responsibilities of the new authority. In April 1990 the Israel Antiquities Authority came into existence, with support of the Minister of Education.

2.1 THE IAA CONSERVATION DEPARTMENT

The IAA Conservation Department was established in 1988. The aim of the department, published on the departments’ webpage [4] is to preserve the built cultural heritage in Israel. It is charged with preserving the archaeological and cultural heritage values of the country through recognition of the importance and contribution of every culture in Israel.

The IAA Conservation Department acts in accordance with a conservation policy that outlines the principals and decision-making methods pertaining to the conservation of heritage sites. This is specified in a scheme of guidelines and standards defining the framework of conservation work subject to the Law of Antiquities. The current policy was formulated based on the Conservation Charter of 1997 and international accords, among them the Charter of Venice (1964), Charter of Burra (1999) and the Principals for Conserving Heritage Sites in China (2002), as well as based on the accumulated experience and the research that has been conducted by the Conservation Department and the Israel Antiquities Authority.

2.2 ARCHAEOLOGICAL SURVEY OF ISRAEL

Dagan [5] provides an excellent overview of the “Archaeological Survey of Israel” which was established in 1964 as an association. The survey teams collected large amounts of new information about remnants of the past scattered throughout the country. With the establishment of the Israel Antiquities Authority, the Surveys Branch of the Excavations and Surveys Department took responsibility for conducting surveys.

According to the IAA website:

“The purpose of the Archaeological Survey of Israel is to conduct a comprehensive survey of antiquities and historic sites, including their being mapped, measured, photographed and scoured for related material. The decision (regarding) which areas to survey first is based on infrastructure development plans. The survey must precede any infrastructure development and the antiquities mapped before they are destroyed.

Each survey map covers an area of 10 x 10 km, on a scale of 1:20,000. The maps are published in book form including: an index of site names on the map, their location and characteristics, description of the remains and artefacts, historic periods, illustrations (alphabetical index of site names, index of sites listed by period, bibliographical references, map of general locations and English site name).

The sites on the map are presented separately, in geographical order from north to south and from west to east. Their names are usually the names appearing in the Register of Monuments and Archaeological Sites, (Hebrew) published in the Government Register no. 1091, 18 May 1964 plus corrections and additions from 1964 to 1998. Other site names derived from the British Survey Reports of Western Eretz-Israel (Conder and Kitchener 1881-1883), and from names given during the British Mandate (1940).

The Survey Archives has a file on each surveyed site, containing a detailed report, drawings, photos, negatives, a list of finds that were transferred to the IAA storerooms, and more. The files are open for study in accord with provisions of the Freedom of Information Law and IAA Archives regulations.

The survey has already covered close to 25% of the total area of Israel. Twenty-five maps have been completed and await publication, another 30 are in preparation, and 38 have already been published.

The Archaeological Survey provides important information about archaeological sites in Israel. The abundance of data accumulated in the IAA Archives in the last 100 years (including the British Mandate Archives) has resulted in a reorganization of the data base for all archaeological sites in Israel.

To reorganize the material, the IAA has taken two steps.

A. Integration of a new central computer program (GIS):

- Data entry of sites and unification of information in a database.
- Transfer of scientific data gathered by inspectors (GPS data) for surveyed sites, archaeological excavations, exploratory excavations, etc. to a listing of sites, or to a concentration of special information (e.g. a map of sites where infrastructure development is planned).

B. Preparation of a map of selected sites in Israel:

- Centralization of information from the regions.
- Incorporation of the information into regional maps.
- Production of a map presenting sites and including information and text. [5]

2.3 THE IAA SITE CARD

The IAA collects data on sites/monuments to provide an overall assessment on sites/monuments in view of future urban planning which might involve the sites’ preservation. (Each card ends with an assessment of the site/monument it describes).

The point of view of the site card is mainly architectural as architects are the ones to survey the sites. The card is very detailed and is 7-pages long. When needed the architect surveyors are assisted by historic and
engineering knowledge, and base their review on their observations together with prior information collected in the IAA (e.g., site maps, photos, etc.) The monument card, which is being used in Jerusalem, is different than the card that’s used for the rest of Israel. The future goal is to digitize these cards using GIS tools.

The IAA Site Card: p. 1 and 2 (Figure 1), contain

External description:
- uses of the site (historic and current)—each floor is surveyed for its use; urban location; level of ground floor; number of floors; number of entries to the building cluster; the type of yard of the cluster; number of entries to the building; the type of yard of the building; structure: materials in use; the type of the facades; the roof.

The IAA Site Card: p. 3 and 4 (Figure 2), contain

Elements and details:
- windows details; grates; doors details; balconies; stairs; railings; eaves; lighting; appliances; special details;
- conservation targeted items.

The IAA Site Card: p. 5 and 6 contain

Internal Description:
- site plan; walls; ceilings; inner windows details; inner doors details; stairs; flooring; decorations; conservation-targeted items;

Architectural Problems:
- additions (of any sort); destruction; various elements of the building; openings; various building equipment (e.g. post box); infrastructure;

Historic Information:
- monument map; short historic description;

Physical and Engineering Problems:
- dangerous building; dangerous element; mechanic damage; deterioration; other; quality of construction; way the building is kept;

Overall Evaluation of the Site:
- relation to the surroundings; potential for additions; score of the site’s importance; overall evaluation.

The Society for Preservation of Israel Heritage Sites (SPIHS) was established in 1984 for the purpose of locating, restoring and preserving heritage sites in Israel. In 1991, an amendment (no. 31) to the Law of Building and Planning “a plan for preservation of cultural heritage sites” was enacted. SPIHS identifies and restores major heritage sites, associated with Israel’s rebirth since the 18th century.

As published on its website [6] SPIHS is devoted to:
- Preventing the destruction of Israel’s National Heritage Sites
- Increasing public awareness of the importance of heritage preservation
- Restoring and preserving heritage sites
- Encouraging special educational programs, including lectures, tours and seminars
- Encouraging urban planning related to heritage sites

The SPIHS works in collaboration with the municipalities to locate and preserve historic sites. It
provides professional guidance to the municipalities committees for preservation. Most of the historic sites are in the jurisdiction of the municipalities, and therefore it is the municipality’s responsibility to preserve those sites. However, it may be the case that the SPIHS makes the surveys, and in a few cases the SPIHS may do the preservation works. (More about the municipalities’ work see below).

THE SPIHS SITE CARD

In 1999 SPIHS published a set of instructions, written by Bar-Am [1] recommending a very detailed site card. However, in actuality, the site card which is being used is less detailed.

Figure 3: The Society for Preservation of Israel Heritage Sites Site Card, p. 1

The SPIHS Site Card p. 1 and 2 (Figure 3), contains:

- site information: site number; site classification; level of preservation; name of the site; address; region/plot number; building file number; current use; current ownership; year of building; original use; architect; original owner; map of the site and the surrounding area; photo/ drawing; valid plans; is there a demolition plan; valid site designation; construction rights; construction restrictions; height restrictions;
- description of the site;
- the significance of the site and the reasons for its preservation;
- description of the physical condition of the site;
- preservation recommendations;
- use recommandation;
- comment.

4 MUNICIPALITIES

The municipalities run committees for preservation of cultural heritage sites. These committees are responsible for providing preservation instructions and guidelines for buildings included in the city’s list of preservation. These committees include a representative of the SPIHS as they work collaboratively. To exemplify the work of the municipalities, below is a short chronological description of the preservation processes in the city of Haifa.

The Committee for Preservation of Cultural Heritage Sites in Haifa operates under the Department for Long Term Planning. In February 1979 the Council for A Beautiful Israel published a list of 160 buildings for conservation in Haifa. In 1980 this list was endorsed by the Committee for Preservation of Cultural Heritage Sites of the Haifa Municipality to serve as the basis for a larger list of sites. In 1984 the Haifa municipality’s Department published a larger list including 249 sites for Long Term Planning. In 1991 the Committee endorsed this list. In 1991, with the amendment of the Planning Law (see introduction), the Municipality made preparation to enlist the sites as required by the new law. In 1994 a detailed survey on the Bat Galim neighbourhood was made including the preparation of site cards for each site there. Kolodni [7] points out that in 1997 the list of sites for preservation was updated and computerized; listing were updated through location of the sites with land register identification (plot number, cadastral territory); addresses; building files, and additions of new sites. In 2004 another survey [8] (of the cluster Nathanson-Ha’meganim in downtown Haifa) was done.

THE MUNICIPALITIES SITE CARDS (HAIFA)

The municipalities’ site cards are quite similar to the SPIHS’ site card and there are a few variants used by the various municipalities. The municipalities collect data for the database of the city’s Cultural Heritage sites designated for preservation (for the use of professionals and citizens). In addition, architects are required to file a detailed building survey which includes a site card, when they plan future urban development. Collecting the data for the site card is made through integration of (1) data obtained from the building file (taken from municipality files), (2) archival research and (3) site work which includes observations, photos, sketches, area maps from GIS system and historic maps. A future goal is the digitalization of the site cards and the provision of accessibility through the internet. Currently, only the list of sites for preservation is computerized.

The Haifa Municipality Site Card p.1 contains:

- site number; site classification; level of preservation; site name; address; region/plot number; building file number (municipal); current use; current owner; year of construction; original use; architect; original owner; map of the site and the surrounding area; photo / drawing.
The Haifa Municipality Site Card, p.2 contains:

- valid town plans; is the site intended for demolition according to the town plans; valid use; construction right; construction restrictions; height restrictions;
- description of the site;
- the significance of the site and the reasons for its preservation;
- description of the physical condition of the site;
- preservation recommendations;
- use recommendation;
- comments.

5 THE ISRAEL NATURE AND PARKS AUTHORITY

The Israel Nature and Parks Authority (INPA) [9] is the governmental organization responsible for the protection of nature, landscape and heritage in Israel. As published on its website www.parks.org.il, the INPA has three main goals:

1. Protection of biodiversity, ecosystems and landscapes in national parks, nature reserves and open spaces.
2. Protection of heritage sites in national parks and nature reserves and fostering them for the benefit of visitors.
3. Education to instil the values of protection of nature, landscape and heritage sites and to increase public awareness of these issues.

In August 1963, a law was passed establishing the National Parks and Nature Reserves Authority, two separate government bodies. These two bodies were unified in 1998 to become the Israel Nature and Parks Authority (INPA).

Despite the serious problems facing, as well as the dearth of land and water resources, the INPA has made some remarkable achievements. As of May 2007, 190 nature reserves and 66 national parks have been officially declared covering an area of approximately 20 percent of Israel’s land mass. Additional 200 nature reserves and national parks are in various stages of the declaration process.

The INPA’s involvement in the Protection of Heritage Sites:

In 1972 the United Nations Educational, Cultural, and Scientific Organization (UNESCO), endorsed a charter to protect cultural and natural sites of global importance. It requires identifying and conserving these significant places. In 2001 UNESCO inscribed Masada as a World Heritage Site. In 2005, the Biblical Tells – the national parks of Tel Megiddo, Tel Hazor and Tel Be’er Sheva were inscribed. In 2006 the Incense Route and the Nabatean cities in Avdat, Shivta, Halutza and Mamshit national parks were also inscribed. Among the sites INPA is currently working toward inscribing are the Canaanite gate at Tel Dan (considered the oldest preserved arch in the world), Beit She’an National Park, and the Hula Valley, a site of global importance for bird migration.

Tools for Protecting Nature and Heritage:

The INPA conducts surveys and studies to assess the status of flora and fauna throughout the country. Each year a count is made of gazelles, aquatic birds and raptors, and other animals, and INPA field personnel take samples of wild plants for assessment. At INPA’s Adullam reserve, an ecological research station is maintained for long-term studies. It is connected to a network of international stations.

5.1 THE INPA SITE FILE

The INPA Site File (required by law for each and every reserve/park) is a comprehensive document, based on the on-site existing findings, and the analysis and assessments of the site’s potential for preserving values.
of nature, landscape, and heritage within it. Following these assessments, instructions for management and development are prepared. The goals of the Site File are to produce a program for the operation of the reserve/park, which will provide the best solution for maintaining and achieving the goals of the reserve/park. It contains the following subjects:

- The objective of the reserve/park
- Physical and statutory description
- Values of nature, landscape, and heritage — on-site findings and functioning
- Management and operation
- Organization
- Education and training – publicity and marketing
- Management program – principles
- Instructions for the program execution
- Appendices: maps, sketches, regulations, list of species, level of vulnerability, others
- Bibliography, references, resources

A reserve/park Identification Card summarizes the site information (Figure 6).

5.2 THE INPA IDENTIFICATION CARD

Figure 6 (below) of the INPA Identification Card (Hebrew) contains the following data:

1. Reserve/park name;
2. Statutory description;
3. Size of the reserve;
4. The objective of the reserve/park;
5. Values of nature, landscape, and heritage;
6. Principles of management and operation;
7. Guidelines for development;
8. Guidelines for monitoring;
9. Threats;
10. Is there a reserve/park file (date).

6 CONCLUSIONS

As the basic unit for collecting data on historic sites Israel uses three main variants of Site Card, each belongs to the entity documenting them (IAA, SPIHS and the municipalities). Additionally, the INPA uses a detailed Site File summarized by an Identification Card. Long-term plans include standardization on the national level and computerization of the Site Cards, in order to build a national data base which will be accessible to all. Since the initiation of this review a significant progress has been made by the Department of Planning of the Ministry of Interior, and the results of this are anticipated to be introduced soon.

ACKNOWLEDGEMENTS

We would like to take this opportunity to thank the Israel Antiquities Authority (Conservation Department), Society for Preservation of Israel Heritage Sites, Haifa Municipality (Conservation Unit), the Israel Nature and the Parks Authority (INPA), and the Department of Planning of the Ministry of Interior for their contribution to this review.
VISUAL INSPECTION APPLIED TO CULTURAL HERITAGE

Jacques Akerboom

ABSTRACT: This document contains a description of the Dutch Monumentenwacht method for visual non-destructive inspection of and minor repairs on objects of cultural heritage (e.g. built heritage, historic interiors and archaeological sites).

KEYWORDS: Preventive maintenance, Monumentenwacht, Visual inspection.

1 INTRODUCTION

The visual non-destructive inspection of cultural heritage is defined as the surveying of an object of cultural significance without employing invasive scanning methods or advanced technologies such as radar, audio or heat-measuring techniques, etc.

It primarily involves the visual observation of shortcomings and identifying the proper conclusions based on this. Additionally, other simple techniques such as tapping, feeling and measuring for moisture or cracks may be applied, while maintaining the principle of non-destructive inspection.

A crack in the outer wall of a monument may indicate problems with the building’s foundations, but this would not be the only explanation. It is therefore critical that the individual carrying out the inspection has been trained to recognise situations and draw accurate conclusions based on these.

For objects of modest proportions, such as items of furniture, paintings or sculptures, which are located in easily-accessible positions, a visual inspection is a simple task to carry out...

Monumental buildings, on the other hand, require an entirely different approach and many areas will only be accessible by climbing.

The following description of visual inspections chiefly involves the inspection of monumental buildings.

2 VISUAL INSPECTION–FIRST STAGE

The visual inspection of a monument should be seen as the first step in a maintenance, restoration or improvement process – in short, the preservation of a monument. The aim of the visual inspection may be twofold.

Firstly, there is the “one-off” inspection, occurring for example after calamities such as earthquakes or floods. In such an event, the visual inspection is the first step in ascertaining the level of damage, what additional investigations need to be carried out and the measures to be taken in order to prevent further damage.

Secondly, there is the regular maintenance inspection, to occur once or twice a year for larger monuments. This will be part of a structured plan to keep the monument in a state-of-the-art condition. The upkeep costs for a monument that is regularly inspected as well as frequently undergoing maintenance work will – certainly in the long term – work out considerably lower than those of a monument that is only sporadically maintained.

Regular inspection can help prevent major disasters, for instance as a result of long-term leakages; such
difficulties are quickly identified and remedied during an inspection. The deterioration of a monument actually begins the day after the restoration is completed; a tennis ball blocking up a gutter may result in substantial damage. In this context, the adage ‘prevention is better than cure’ is definitely applicable.

Figure 2: Visual inspection of the interior of a Dutch windmill.

In addition, more serious damage can also be prevented as a result of regular inspections. The outcome of a visual inspection consists in an observation report containing recommendations for further steps to be taken and improvements to the monument. An added advantage is that minor maintenance tasks can be carried out in situ during the inspection itself, naturally on the condition that those performing the inspection have been adequately trained for this. The observation report may also include directions for carrying out well-considered maintenance or restoration work on the monument.

An initial visual inspection will in many cases give cause for a more in-depth investigation employing modern surveying methods and technologies. Moreover, the inspection report may serve as a basis for further repairs, temporary protective measures, reconstructions and designs or for academic purposes. It is therefore very important that the report contains information that can be used at various levels. Administrators and politicians will require (often statistical) data which they can use to further refine their policies and the cash flows that go with them, whereas architects, designers and maintenance workers will need to be able to find technical information in the report that will enable them to prepare and perform sensible restoration and maintenance activities. Experts in more in-depth inspection techniques will need to be able to draw conclusions from it regarding which of the more technologically-complex methods available are required in addition to the visual inspection. It has been common practice in the Netherlands and Belgium (Flanders) for specialists to carry out visual inspections of historical interiors, archaeological sites and even mobile heritage sites (ships) for some time now.

3 THE INSPECTION

For larger monuments a visual inspection is generally carried out by two inspectors, which is necessitated by safety concerns. For smaller and more easily-accessible buildings such as residences, farms etc., and a single inspector is often sufficient. The inspectors are provided with an inspection box complete with state-of-the-art tools, climbing equipment and materials for carrying out their inspection work and making minor repairs. Naturally, the safety of the inspectors is of paramount importance during the visual inspection as well. They are trained to recognise unsafe situations and take steps to remedy them.

A very useful tool when carrying out the inspections is the MDDS (Monument Damage Diagnostic System) programme developed several years ago by the Dutch Organisation for Applied Scientific Research, TNO. It is a visual damage atlas that is very well suited to serve as a back-up to the inspector when making a diagnosis. In the time since its inception, this system has grown into a sort of standard and is soon to undergo further development.

The initial inspection of a monument lasts the longest. The inspectors must get to know all aspects of the building through and through and provide a complete assessment from which statistical data can be generated. Supplemental inspections require less time.

Figure 3: Demonstration inspection of the Schönbrunn castle in Vienna (2011).

In the Netherlands, inspection costs can be kept to a minimum for owners, thanks to financial support from both the national government as the provincial governments. The data from an inspection is stored in a database to be consulted again at a later date, and also used for other purposes, subject to the restrictions imposed by privacy legislation.

4 CONTINUAL TRAINING

The individual performing the visual inspection of a monument must be somewhat of a “jack-of-all-trades”. Not only are they expected to do their work in the most inaccessible places, they must also possess up-to-date
professional-level knowledge of a large number of materials, building methods and technologies. This requires those involved to be in continual training. The inspector must also have a thorough professional knowledge of building materials in order to be able to assess the quality of (and any defects in) materials such as natural stone, wood, stained glass, lead, copper, iron and paintwork.

Figure 4: Inspection of an industrial monument.

They must also be able to track down and describe structural problems and identify how best to proceed towards a solution, to provide guidance for specialists conducting more advanced investigations of the building afterwards. Furthermore, this method of inspection can have huge advantages on the financial side, as the following specialists can carry out a more directed investigation instead of having to conduct another inspection to assess the full extent of the problem. The inspector should also be aware of the possibilities available for more advanced investigation techniques to enable them to evaluate what supplementary inspections are possible and necessary while carrying out their own examination.

5 THE MONUMENTENWACHT

There are now organisations working in many countries that specialise in the field of visual monument inspection. This development began in the 1970s in the Netherlands, when Walter Kramer, an architect for the Dutch National Trust, came to the conclusion that a restoration cycle of between twenty-five to fifty years should be maintained for monumental buildings, particularly the larger ones. This invariably involved major government subsidy. If a monument, he reasoned, can be kept in good technical condition through regular maintenance once it has been restored, then a new restoration, while it remains inevitably, can be postponed for a significant amount of time, and this would save a lot of (state) funds.

This concept, though simple in nature, turned out to be a masterstroke in practice. Not long after that, interest in the Monumentenwacht formula began to arise in other countries as well. Today there are more or less comparable organisations working in Belgium (Flanders), Germany, Hungary, Denmark and England. A growing number of European countries, including France, Italy, Spain and Scotland, are interested in starting up similar organisations.

The Dutch Monumentenwacht is an independent and impartial organisation that primarily works for the owner of a monument. It is due to this independence and impartiality that the Monumentenwacht’s view is often used as a starting point in legal disputes over the performance of restoration work. The Monumentenwacht’s activities are collectively financed in the Netherlands by both the national and provincial authorities as well as the owners of the monuments themselves.

The Monumentenwacht method has been a component of the national monument policy in the Netherlands for some years now. The central government has been channelling extra funds into resolving the shortfall in monument restorations over the past few years. The condition for receiving a restoration subsidy is that the monument must not have undergone any major restoration work for a period of fifty to eighty years. This makes it necessary to draw up a thorough maintenance plan, linked to an annual visual inspection of the building by the Dutch Monumentenwacht. It is also possible to receive a contribution from the authorities towards the monument’s annual maintenance costs. As a result of this government policy, it is expected that from 2013 the upkeep of the Dutch cultural heritage will require even less money than in the past, as maintenance is quite simply cheaper than restoration.

6 THE INSPECTION REPORT

Examples of visual inspection reports as employed by the Monumentenwacht in the Netherlands have been included as supplement 1 and 2. The first page of the report contains all the relevant information about the monument and its owner. Beneath that is listed which (minor) maintenance activities were performed during the inspection and the inspector advice is regarding the remaining maintenance work and supplementary inspections that will need to be carried out. Each piece of advice references the relevant section in the main body of the report. All subsequent pages of the report are laid out as follows. On the left-hand side of the page (Section), the building is divided up into its separate structural components.
In the middle section (Rating) each component is listed along with its overall technical quality. The classifications used here are G (good), R (reasonable), M (moderate) and S (severe).

The right-hand side of the page (Explanation/Advice) contains a further description of the inspector’s findings for each component during the inspection, as well as the advice they provide to the owner of the monument on how to further improve it. The report as a whole is supported by photos and drawings.

There is currently a new generation of inspection report in development based on a database structure. This will make it possible to, e.g., generate statistical data in addition to the technical report. The authorities will be able to use this information to gauge the need for maintenance on the various monumental buildings, so that the total amount required for maintenance work in any given year can be determined.

7 CONCLUSIONS

Visual inspection is a first step in the restoration and maintenance process of cultural heritage objects. Performing a visual inspection of a monument requires the inspector to be skilled in a variety of fields. Inspectors will therefore need to receive continual training.

Regular and systematic maintenance prevents the need for restoration. Maintenance is cheaper than restoration. The Dutch Monumentenwacht model can serve as a basis for the development of similar organisations in other countries.

MDDS is a useful tool when carrying out visual inspections.

REFERENCES


SUPPLEMENT 1.

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Algemeen
Het functioneren van het maalwerk en de mechanische onderdelen zijn door ons niet gecontroleerd. Tijdens de inspectie is één eind van de buitenroede (met van Busscheuzen) van dichtbij geïnspecteerd, de overige einden zijn op afstand met een verrekijker geïnspecteerd.

Aanbouwelen werkzaamheden in volgorde van werkzaamheid onderdelen

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SUPPLEMENT 2

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* G = goed; M = matig; V = slecht

SUPPLEMENT 3

2.3

**LOODAANSLUITINGEN**

b. Veel voorkomend probleem bij lakschroeven: na aanloop van de klokletten, vooral bij stabië te daklatten.

Deze lakschroeven dienen altijd een lakschroef met een afdekking van minstens 10 mm te dragen. De schroefdraad van de klokletten moet minstens 30 mm lopen. De schroefdraad moet een afdekking van minstens 10 mm dragen. De klokletten moeten op elke 30 cm van elkaar worden geplaatst. De klokletten moeten op elke 30 cm van elkaar worden geplaatst.
ABSTRACT: Polish mandatory standards, systems and structures of database and of responsible bodies on protection and documentation of architectural heritage are described in the article starting from the short historical background. The most common instrument of registration and protection of monuments - The Monuments Register, and the National Inventory of Monuments - The Monuments Record are presented here. There are some information about definitions and forms of the immovable monuments database (among others: database of historic parks, cemetery cards and portfolio-planning). Some projects connected with preservation and documentation of cultural heritage in Poland are briefly described: Care of the Monuments and Culture Heritage (2004-2013); Strategies of Ministry of Culture and National Heritage (2009-2020) (among others: INSPIRE; Digitalization of Archival and Documentation Resources Project) and other initiatives: Contemporary Documentation of the Immovable Archeological Monuments; Documentation of Orthodox Churches, The Register of the Historical Monuments of Warsaw (SEZAM); CARARE and others.

KEYWORDS: Documentation, registration, archive, database, methodologies, protection, architectural heritage, systems, projects, strategies, digitalisation.

1 INTRODUCTION

The role of documentation in cultural heritage preservation was always important but it has appeared to be extremely important in time of changes (war, cataclysm, revolutions etc.). Today we face a number of challenges: demography changes, climate changes, technological changes, economical changes, and globalization. Alain Touraine, the Nestor of French sociology, writes in his latest book *Apres la crise* (after the crisis) that the public no longer exists in the meaning of being a whole, homogeneous organism, linked together in the name of interests of classes or groups [1]. The only platform that determines the individual and collective identity today is culture and they are of strategic importance. We need to support, develop and protect them. Well organized, professional systems of documentation and recording data are needed to do it properly.

2 HISTORICAL BACKGROUND

History of Poland can explain Polish system and structure of bodies responsible for documentation and recording data on architectural heritage. After the centuries of experiences the concepts of the monument’s protection seemed to be established in last decade of 18th century. But it was hard time for Poland as it was a period of political collapse - the partition by Austria, Russia and Prussia. First decades of the 19th century brought earliest systematic, although informal, heritage inventories in Polish lands. Three different administrations implemented three different approaches. The origins of what later became the Polish modern conservation survey took place in one of them - Galicia. A few years later the Society for Preservation of Monuments of Antiquity was constituted in Warsaw starting documentation program, which resulted in a huge photographic collection (negative and prints). After regaining independence in 1918, Regency Council formed an act, which established conservation service represented in all provinces by state conservation officers. The decree covered all objects of arts and culture heritage listed in an inventory. It was the first monument register in Poland, with an open access for all users and people interested in it [2]. To establish the criteria of historical, aesthetical and artistic values they based on Alois Riegl theory. The President of Polish Republic as a new Decree on Monuments Protection constituted legal principles for the next thirty-four years in 1928. In 1929 it was time to start working on the first national inventory of monuments from the 10th century till the second part of 19th century. It was coordinated by the new established position of the General Conservator
of Historical Monuments. During the short inter-war period (1919-1939) a list of the most important buildings was prepared (photographic documentation and measurements), most of them by Central Office for Monuments Surveying (Centralne Biuro Inwentaryzacji Zabytków). From a distance we can describe it as a modern and complex treatment of assorted questions relating to protection. It was planned to publish 362 volumes describing all objects built between mid 10th and mid 19th century. However, only four of them were completed because of the war. During The Second World War fortunately documentation survived becoming a basis for the similar activities of the post-war period.

Since 1944 the High Office for Museums and Monuments Protection with the department of Office of Conservator General had got responsibility for both documentation and conservation of monuments. In 1961 a separate Centre for Monuments Recording (Ośrodek Dokumentacji Zabytków) was formed for collecting monuments documentation provided by state conservation officers representing all provinces. In the late 1950s comprehensive survey of monuments was organized with the effect of identifying 36,262 objects. The post-war survey included not only “small architecture” but also vernacular and industrial buildings, divided into four categories. The data were collected in a form of “green cards” with basic address information, brief historic outline, level of preservation, schematic ground-floor plan, and at least one photograph. This was A4-sized card of green, paper with 37 spaces to fill on both sides. The oldest cards date from the 1950s.

But the classification of immovable monuments was not finalized until 1964, when the main register of monuments and buildings sharing into the five categories was published. To the category nr 0 they classified only 52 object of the “most important artistic, historic, science significance, in the world wide scale treated as the Historical Monuments”. To manage documentation process, in the 1970s, Officers for Monuments Studies and Documentation (Biura Badań i Dokumentacji Zabytków) were established.

Such form appeared to be not subsequent for conservation practice. The new record layout was created in the mid 1970s and amended in 1983—commonly known as a “white card”. In comparison to the “green card” the size was doubled (four A4 pages). The number of spaces to fill was reduced to 27. This template with minor changes has remained in use until present as a system of heritage recording and protection database in a form of paper fiches (which are changed into digital form). The form of ‘white cards” is compatible with “Data Core Index on Architectural Heritage” recommended by the Council of Europe in 1992.

Figure 2. The example of the White Card of Monument Object with a few annexes (Town Hall in Byczyna). Source: NID

3 POLISH SYSTEM AND STRUCTURE

Management of the Heritage Register is determined according to The Act on the Protection of the Cultural Heritage and Museums, February 1962, amended on 30 May 1989 and again on 19 July 1990, confirmed by the New Heritage Act in 2003 (Ustawa z dnia 23.07.2003 r. o ochronie zabytków i opiece nad zabytkami, Dziennik Ustaw, no. 162, pos.1568) and subsequent changes (from 2004 y. No.96, pos.959, No.238, pos.2390, from 2006 y. No.50, pos.362, No.126, pos.875, from 2007 y. No.192, pos.1394, from 2009 y. No.31, pos.206, No.97, pos.804, from 2010 y. Nr 75, pos. 474.). The act took under protection all single and group items, all sites, belonging to the cultural architectural, urban, and archeological and landscape heritage. The act defines and determines among others definitions of the subjects subscribed (monument, movable and immovable heritage, conservation treatment, restoration treatment, archeological treatment, conservation research, cultural landscape and many others (Article.2); heritage protection and care (Article. 4, 5, 6); rules and methodology of heritage protection (chapter 2) and many others. Articles from 21 to 24 are dedicated to the monuments record. According to the art. 21. Monuments Record is the basement for preparing the Projects of Protection the Monuments by provinces, districts and communes. According to the Article 22.1. Conservator General manages the National Inventory of Historical Monuments (National Monuments Record) in a form of record cards (which are kept in National Heritage Board of Poland) [3].
Local administrations of all levels are responsible for the heritage protection and documentation. Among other duties (regulation through the urban planning, controlling building activities in designated conservation zones), they are obliged to keep and manage listing (so-called “record”) of the whole heritage scope without the registered monuments status (which are the responsibility of the State Conservation Service), and located within the administration’s jurisdiction. Province Conservation Officers of Monuments manages the provincial monuments record and the village mayor, mayor and president of the city manage communal record of monuments – all documents are in a form of cards. One of the most important responsibilities of the Province Conservation Officers is issuing formal decisions about inclusions and exclusions from the registers of monuments (see below). They are also responsible for maintenance of these registers, and verification and upgrading in particular.

The heritage documentation has become a subject of the Decision of Minister of Culture of September 2000 (Rozporządzenie Ministra Kultury i Dziedzictwa Narodowego z dnia 6 września 2000 r. w sprawie prowadzenia rejestru zabytków i centralnej ewidencji dóbr kultury, Dziennik Ustaw. No.86, pos.965), who defines the range and forms of monuments data recording.

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**Figure 3. Record Cards Index in National Heritage Board of Poland. Source: NID**

### 4 NATIONAL HERITAGE BOARD IN POLAND

Former institutions responsible for giving high leveled professional support to the register were: Centre of Monument Documentation and Centre for the Protection of Historical Landscape. In 2002 they were integrated into National Centre for Historical Monuments Studies and Documentation (Krajowy Ośrodek Badań i Dokumentacji Zabytków, www.kobidz.pl). In 2007 it became transformed into the National Heritage Board of Poland (NID). In January 2011 the name and statute has been changed by the Minister of Culture and National Heritage (www.mk.gov.pl) into Narodowy Instytut Dziedzictwa (www.nid.pl) (logo and English name remained the same). The main objective of the National Heritage Board of Poland is to implement the State’s policy concerning the protection of cultural heritage and its supervision through assuring the best and most comprehensive conditions for preserving it for future generations. The Board’s activities focus on: “gathering and disseminating information on heritage, setting standards for its protection and conservation to raise the social awareness on cultural heritage of Poland in order to save it for future generations in accordance with the strategy for sustainable development”.

#### General fields of their actions:
- documentation of the cultural heritage through registering the historical monuments – their values and condition they are in; archiving documental resources that relate to the protection of historical monuments;
- formation of the rules for the protection of historical monuments through recognizing the threats and elaborating the standards of conduct as well as the implementation of standards for conservation works;
- education and promotion of heritage, which means popularization of knowledge about historical monuments and formation of social conditions enabling the effective protection of them.

The Board manages the National Inventory of Historical Monuments, conducts verification of the register of monuments, leads digital information resources about tangible cultural heritage and establishes new methodological standards and techniques for documentation, research and conservation on monuments. Among others that state agency manages the program of the Minister of Culture and National Heritage, which supports projects of digitalization of monuments and museum objects. The Board’s aims and assignments are realized both in its headquarters in Warsaw and in the Regional Boards which are located in all the voivodeships. The Board cooperates with the state administration, local government units, non-government organizations, national, foreign and international cultural institutions, research centre, churches and religious unions, and the owners and users of historical monuments. The administration of the smallest territorial units is obliged to keep and manage listing (record) of the whole heritage scope without the registered monument status [4].

On a proposal from the Minister of Culture, the President of the Republic of Poland recognizes the most important buildings as “Monuments of History”. The list of such monuments can be destined to the World Heritage Committee in accordance with the International Convention concerning the Protection of the World Cultural and Natural Heritage (1972). The classification of architectural monuments established on cultural, historical and other values, was published in 1964 (Maliszewski, P., Spis zabytków architektury i budownictwa, Warszawa: BMOZ, 1964). There were five following grades:

0. Historical buildings and complexes of the highest artistic, historical and scientific interest.

I. Historical buildings and complexes of the national importance (well preserved and unchanged in the...
recent time)

II. Historical buildings and complexes of the regional importance (these may be buildings of the high historical values, thoroughly altered but with a high degree of authenticity)

III. Historical buildings and complexes of average, but undoubted importance (artistic, historical or scientific)

IV. Buildings that: a) could originally be included within higher grade, but their poor state prevents successful conservation; b) are of minor importance

The legal protection embraced grades 0-III only, while the grade IV buildings were subject to the conservation care until they’re excluding from the list.

In the mid of 70-ties, according to many bad experiences it was decided to leave the concept of classification [5].

5 MANDATORY STANDARDS

There are two levels of records of historical buildings in Poland: Rejestr Zabytków (the Monuments Register) and Ewidencja Zabytków (the Monuments Records), which are constantly upgraded.

5.1 THE MONUMENTS REGISTER

The most common and important instrument of registration and protection of monuments is Rejestr Zabytków (The Monuments Register). Administrative cases are in a competence of Regional Conservator (WKZ), who (on behalf of the owner, user or the Office) starts the procedure of registration. “The register of historical monuments is one of the statutory forms of protection, and daily praxis confirms that an unregistered object is deprived of all chances for effective conservation protection or for benefitting from financial aid provided by public funds. In this way, the register plays the role of the most important and, as daily activity demonstrates, sometimes the sole instrument for shaping the conservation policy” [6].

The first step is connected with gathering information, documentations, and visitations in situ, to confirm the value of the object for the cultural heritage. The issuing of a decision by WKZ, endowment of the register number and inclusion within the monuments register described in official books end the whole procedure.

These books have 200 numbered pages including following information (according to the decree Rozporządzenie Ministra Kultury i Dziedzictwa Narodowego z dnia 6 września 2000 r. w sprawie prowadzenia rejestru zabytków i centralnej ewidencji dóbr kultury, Dziennik Ustaw. No.86, pos.965):

The view of the card
- the register number (individual for each monument - immovable, movable and archeological) indicated by a capital letter (A,B,C) – for respectively;
- administrative decision’s information about the register (date, responsible body, decision number);
- the subject of protection;
- the range of protection;
- the location of the monument;
- the number of real-estate register (for immovable and archeological monuments);
- the cadastral number (for immovable and archeological monuments);
- the monument owner details;
- the monument user details;
- information on the administrative decision about removal from the register (date, responsible body, decision number);


5.2 THE MONUMENTS RECORD - NATIONAL INVENTORY OF HISTORICAL MONUMENTS

The Monuments Record is a systematic collection of data organized according to homogenous structure. It includes administrative and address data, brief description with historical merits defined, description of the object, measurements, scaled plans and basic photographic documentation. Records contain single architecture object, group of buildings, urban site, archeological site and ancient parks and cemeteries. In addition to the above requirements, the registered monuments documentation is to include copies of all legal and conservation decision, as well as the historic and graphic materials, or at least guidance on the reference material held elsewhere (Rozporządzenie... Dziennik Ustaw, no.86, pos. 965). The managing of the Monuments Record is an obligatory responsibility of
Province and Commune Conservation Offices.

Figure 6. The Monument Record example. Source: NID

As the information required to organize the Monument Record had been already acquired through the so-called “white cards”, they have remained the basic form of heritage documentation. The standard form of the “white card” are shared into such subjects: reference information; dates; authors; brief description of plans, facades and construction types; site plan; ground-floor plan (photocopies of original design held in the archive are optional); information on the state of the building (all changes should be notified and recorded) and general conservation guidance. The spaces to fill are as following:

1. **Object**: building name, type, use – present and previous;
2. **Date**: year or period of building the object;
3. **Locality**: village, town, etc.;
4. **Address**: street name, building number, number from the land-ownership register;
5. **Administration affiliation**: province and commune;
6. **Previous locality names**: the date of change (if possible), all customary locality names;
7. **Previous administration affiliation**: affiliation before 01.06.1975;
8. **Owner and his/her address**: details of property owners (institutions and individuals);
9. **User and his/her address**: details of property users (institutions and individuals);
10. **Monuments register**: number and date of inclusion (if applicable);
11. **Photographs, location plans, floor plans**: one or more photographs, showing the most representative view of the building; other pictures should document all facades, interesting interiors, architectural decoration and fixtures; orientation plan of the vicinity with the indicated building; location plans of the whole grounds belonging to the building North, linear scale and legend; accurate ground floor plan with general dimensions;
12. **Authors, building history, style definitions**: brief historical information about: 1. Author, executor and first owner, 2. History after 1945 with changes in ownership and use, 3. All building and conservation works until 1945;
13. **Description**: strictly done in the following order:
   13.1. Location: Precise location of the building referring to streets or other characteristic features; topographic and landscape features; fencing type;
   13.2. Materials, techniques and structure: walls (information on materials of window, door, etc.); floors and vaults; roof structure type and its characteristic elements; roofing materials; flooring materials; stairs; openings;
   13.3. Floor plan: general form description; number of aisles, bays, etc., wings, projections and outbuildings; other features;
   13.4. Shape: general description of the building; number of storey including basements and cellars; roof shape; wings, projections, towers, etc.;
   13.5. Facades: synthetic description of all facades including composition and architectural decoration;
   13.6. Interiors: short description of most important interiors, their arrangement and architectural decoration;
   13.7. Furnishing: fireplaces, stoves, wall paneling, stained-glass windows, etc.;
   13.8. Fixtures: heating, electric power, water supply, wastes water system;
14. **Building volume**: approximately volume calculated according to the building regulations;
15. **Usable floor-space**: usable area of all interiors including circulation area, basements and attics;
16. **Original use**: the use of the building immediately after its completion;
17. **Present use**: all the present uses of the building, also disuse of the building should be noted here;
18. **Building and conservation works**: all works done after 1945, including information about their range, period, executors, type and location of documentation;
19. **State of preservation**: current state of the building: its foundations, external walls, internal walls, vaults and floors, roof structure and material; furnishings, fixtures;
20. **Urgent conservation requirements**: basic guidance on building protection, also change of use if building is at present used inappropriately;
21. **Archives**: list of the archival material (not...
22. Bibliography: list of all reference material used during the documenting

23. Iconographic and photographic sources: list of the used materials (not obligatory)

24. Notes: all further information

25. Card done by: authors; full names and signatures and dates

26. Annotations on inspections and changes: all information on changes that occurred after the survey completion; inspectors names, dates of inspections

27. Appendices: number and type of attached inlets including the “green card”.

All the documents that are not included at the main form can be added as optional appendices in a form of separate inlets: additional illustrative material, continuation of building description, any additional information, further annotations on inspections and changes.

Fig. 8. The example of the Monument Record with photo annex. Source: NID

The same template is binding in a case of architectural complexes with exclusion of cemeteries for which separate recording are used. There are a number of institutions holding collections on the built heritage, which are not included within the mandatory documentation system (e.g. The Institute of the Arts, Polish Academy of Sciences, The Central Archives of Historical Records).

Fig. 9. The example of the Monument Record (in the paper form). Source: NID

The state of the records for 31.12.2008:

- 135,678 records of the architecture and building monuments
- 24,896 records of the cemeteries
- 8,921 records of parks and gardens
- 356,871 records of the movable objects
- 463,681 records of archeological monuments

5.3 IMMOVABLE MONUMENTS

According to Ustawa z dnia 23 lipca 2003 r. o ochronie zabytków i opiece nad zabytkami the architectural monuments that comes under care and protection besides their state of preservation (art. 6 ust. 1 pkt. 1), are the following ones:

a. cultural landscapes
b. urban groups, rural and building complexes
c. section of architecture and building
d. section of fortified building
e. technical objects
f. cemetery
g. parks, gardens and other forms of natural landscapes
h. historic monuments or activity of eminent persons or institutions

Fig. 10. The example of the card of technique monuments (fragment). Source: NID

In the Faculty of Register and Records of Monuments following documentations are stored:

- records of architectural and building monuments
- addresses cards of monuments
- records of monumental natural landscape

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2 About 650,000 – state of buildings in 80-ties in Poland – minimum of information + photo of the object – in the form of fish

3 Documentation standard of historical parks and gardens consists of a description and graphics. Descriptive part contains: basic administrative data object, the history of successive phase transition of space, analysis of the existing status and conservation proposals on how to protect them. Graphic shows the existing state, analysis of valuable compositing technique and protection zone. Condensed record
• records cards of cemetery
• urban binder (portfolio-planning)
• register cards of techniques monuments
• register cards of movable objects
• quantitative schedules

6 CULTURE PROJECT „CARE OF THE MONUMENTS AND CULTURAL HERITAGE” (2004-2013)

The plan is a part of National Strategy for Cultural Development for the period 2004-2013 complementary with National Strategy for Regional Development, National Strategy of Employment and for Human Resources Development, National Strategy of Rural Area Development, Government Economic Strategy “Enterprise-Development-Job” and through them in the National Development Planning (Rada Ministrow 14 stycznia 2004). The strategic aim of the project is to intensify the protection and popularization of cultural heritage, particularly complex improvement of immovable monuments. There are two priorities and five actions. The first action of the first priority is the improvement of institutions responsible for documentation of monuments: National Heritage Board of Poland and Regional Centre for Historical Monuments Studies and Documentation particularly in the field of (among others) systematic gathering of data of amount and kind of monuments in Poland, creation of internet database of monuments, digitalization of existing documentation, building of the strategy of the cultural heritage protection and popularization of the information of monuments via internet [7].

Figure 11. The example of the card of technique monuments with annexes. Source: NID

Figure 12. The example of the cemetery card. Source: NID

Figure 13. The example of the portfolio-planning card (complex of the Teutonic Order Castle). Source: NID

7 STRATEGY OF MINISTRY OF CULTURE AND NATIONAL HERITAGE - PERIOD 2009-2011

The project proclaims the effect of diagnosis the system of protection monuments in Poland, particularly the issues connected with the state of research on the cultural heritage, documentation resource and the most urgent needs of care. It is based on the following
priorities, which have not been completely realized till today, making out the crucial aims and main directions of action [8]:

- Access to the knowledge resources of the cultural heritage
- Valorization of cultural heritage resources
- Creation of substantial basement of heritage protection system
- Education

The first priority “Access to the knowledge resources of the cultural heritage” defines new form of organization and access to the actual and complete computer information system on the current state of the monument included within the central register. It should be done for conservation offices, institutions engaged in monuments protection and the broad range of persons who is interested in. Fundamental direction of activities contains the building of national database on monuments and digitalization of archival and documentation resources. The concept of the database came into being in accordance with the executed report (2008) of existing state, European standards, guiding principle and good practice, recommended by European Commission. Undertaking the action was necessary considering the duty of implementation European instruction INSPIRE. The creation of Internet national database about the monuments is planned as a basic tool for heritage protection services. The project is deemed to be a part of the research on the best methods for built heritage archive digitization, database creation, and providing online access:

- For all users: with general information on heritage related tourist attractions provided in the given region;
- For local authorities, academic institutions and heritage protection services: with more detailed information on heritage including ownership, investment recommendations, etc.;
- For Ministry of Culture and National Heritage, General Conservation Officer, Department of Heritage Protection, National Heritage Board of Poland, Provincial Conservation Officers, Provincial Heritage Protection Services, council conservators – full version.

Different methods of searching are established (full text, key words, GIS system, etc.).

7.1 DIGITALIZATION OF ARCHIVAL AND DOCUMENTATION RESOURCES – PROJECT (2009-2020)

The National Heritage Board of Poland manages the program of the Minister of Culture and National Heritage connected with digitalization of monuments and museum objects as a part of the “Project of digitalization of cultural heritage, collection, storage and access of digital object in Poland”. The digital archival resources and database on monuments becomes the excellent content-related instrument for realization individual strategic domain of NID and creation of the optimal condition of protection the cultural heritage in Poland. The Centre of Competence was constructed in a body of NID to execute the project, as well as National Digital Centre, National Library, National Audiovisual Institute. The number of documents (inventory - 5 656 100 pages; “big-format “ documents - 22 500) becomes a challenge.

In connection with the provisions of the "Program of digitalization of cultural goods and the collection, storage, and sharing of digital objects in Poland 2009-2020", Minister of Culture and National Heritage has entrusted the National Heritage Institute as the Centre of Competence in the area of digitalization of monuments and museum collections (among other institutions: National Digital Archive, National Library, The National Institute of Audio-Visual). Centres of Competence are the leading institutions in the area to provide a model for other institutions. NID manages priority 2. - the program: "Digital resources” - "Digitalization of monuments and museum collections”.

7.2 INSPIRE

NID was also indicated by the Ministry of Culture and National Heritage as one of the institution responsible for the preparation of the assumptions and the practical implementation of GIS databases within the framework of the obligations laid down in the Law of the infrastructure for spatial information, 4 March 2010 (according to the directive of the European Parliament and of the Council of Europe – INSPIRE (Infrastructure for Spatial and Information In Europe). The aim of the directive is to develop databases, GIS, making available such data using network services (websites) in order to organize, spread, and give a free access to the data representing the public register (together with defining the restrictions on access to those data). The timetable includes: preparation of the metadata for the data associated with the representation of monuments and archeological sites; development of a profile of the network services; running a central server data, sharing information about the location of monuments; complete verification of the register of monuments and provide full information about the monuments registered on the network; provide the services for collection and transformation to a full degree of interoperability of the data. The end of the project is planning for the last decade of 2012.

8 OTHER INITIATIVES

8.1 CONTEMPORARY DOCUMENTATION OF THE IMMOVABLE ARCHEOLOGICAL MONUMENTS

Fort St. Lawrence in Stara Łomża: an example of a comprehensive documentation of one of the most important archaeological sites in the Podlaskie Province, because of their unique features and the risk connected with building’s plans. Chronology of the object specified during the excavations conducted in the eighties of last century: between the eleventh century and the beginning of the twelfth to the fourteenth century. The castle probably performed the function of the centre of territorial authority. Series of photographs were taken from the air and geodetic measurements using GPS
RTK, designed to create an advanced three-dimensional and photogrammetric documentation were made. MD Studio Fotografia Techniczna made it in the cooperation with the staff of NID.

Figure 14. 3D models, orthophotomaps, virtual panorama, geodetic measurements using GPS RTK. Source: NID

8.2 INVENTORY PROGRAMS

8.2.1 Documentation of orthodox churches
The Inventory of Historic Monuments Group (a part of NID) focused its activity on the continuation the inventory program and create a new program: documentation of Orthodox Churches for entry on the UNESCO World Heritage List. The Inventory Program started in 2008 on the initiative and with the cooperation of KOBiDZ (NID) conservators and staff. The aim is the acquisition of photometric data of 168 objects throughout Poland and creation the archive data measuring the: 3D scan, floor plans, sections and orthophotomaps in some cases. The primary criterion was the devastation of monuments and a number of other factors (e.g. lack of basic documents, the threat of imminent destruction, uniqueness forms). For the implementation of the program they put into a practice studies, field measurements and photometric data gathering about the documenting structure.

8.2.2 The register of the historical monuments of Warsaw in the SEZAM system
In 2003 the Heritage Protection Department of the city of Warsaw brought to date the existing register of monuments of architecture in the Polish capital in a form of electronic database (7300 complexes and historical monuments). Each information file contains basic address data, historical data, time of origin, redesigning, architects, inclusion into a register of historical monuments, and at least one photograph. The structure of the document is based on SESAM system, slightly altered and as a shorter version implemented on-line (www.zabytki.um.warszawa.pl). Today the database is recorded in the SQL Server 2005, PostgreSQL 8xx system. At the same time, cooperation of the base and a Google map has been achieved. The data contained in particular documents and the whole system are verified and supplemented as part of the current work conducted at the Heritage Protection Department of the City of Warsaw [9].

Figure 15: Source: NID.

8.2.3 Project of a digital library – EUROPEANE – CARARE (connecting archaeology and architecture in europe)

KOBiDZ is a partner in CARARE project funded under the European Commission, which started on 1 February 2010 and will run for three years see: (www.carare.edu). It is designed to involve and support Europe's network of heritage agencies and organisations, archaeological museums and research institutions and specialist digital archives in:
- making the digital content for the archaeology and architectural heritage that they hold available through Europeana,
- aggregating content and delivering services,
- and enabling access to 3D and Virtual Reality content through Europeana.

CARARE is a Best Practice Network of organisations responsible for investigating, protecting, informing and promoting unique archaeological monuments, architecturally important buildings, historic town centres and industrial monuments of World, European and National heritage importance alongside the existing national, regional and local content providers. CARARE aims to enable 2D and 3D content for heritage places to be brought together in Europeana and new services for users [10].
9 CONCLUSIONS

Systematic collection and storage of data on immovable heritage objects and current methodologies and tools for data collection, new projects and assessment in Poland were presented here. It is an excellent starting point for the future development of methods and tools for collection and storing of data, required for evaluation of time-varying changes of heritage assets.

ACKNOWLEDGEMENT

Many thanks to: Jerzy Szalygin, the Manager of the Department of Register and Record of Monuments, National Heritage Board of Poland (NID); Agata Kłoczko, Department of Digitalization of Monuments and Museum Objects (NID); Karol Czajkowski, the Manager of the Monuments Inventory Control; Department of Digitalization of Monuments and Museum Objects, (NID), Marek Skłodowski, IPPT; prof. Iwona Szmelter, Academy of Fine Arts in Warsaw (AFA), Faculty of Conservation and Restoration of Works of Art

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PERPETUATE PROJECT: THE PROPOSAL OF A PERFORMANCE-BASED APPROACH TO EARTHQUAKE PROTECTION OF CULTURAL HERITAGE

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ABSTRACT: The paper describes the methodology proposed in the PERPETUATE Project (funded by the Seventh Framework Programme). The methodology proposed uses a displacement-based approach for the vulnerability evaluation and design of interventions. Particular attention is paid to interaction between structural elements and unmovable artistic assets. The procedure is based on the following steps: definition of performance limit states, specific for the cultural heritage assets (considering both structural and artistic assets); evaluation of seismic hazard and soil-foundation interactions; construction knowledge; development of structural models for the seismic analysis of masonry structures and artistic assets and design of interventions; application and validation of the methodology to case studies. Two main scales are considered: the seismic risk assessment at territorial scale and at the scale of single historic building or artistic assets. The final aim of the project is to develop European Guidelines for evaluation and mitigation of seismic risk to cultural heritage assets.

KEYWORDS: cultural heritage, earthquake protection, displacement-based approach

1 INTRODUCTION

PERPETUATE (www.perpetuate.eu) is a project funded by the Seventh Framework Programme (Theme ENV.2009.3.2.1.1) developed by a consortium which includes 6 Universities, 2 Public Institutions and 3 SMEs. In particular, 5 European Countries (France, Greece, Italy, Slovenia, United Kingdom) and 1 International Cooperation Partner Country (Algeria) are represented. The project will last from 2010 to 2012.

The driving ideas of the project are:

i) adoption of a performance-based approach for the evaluation of seismic safety of cultural assets and the design of strengthening interventions;

ii) identification of proper safety levels for cultural heritage, considering both conservation and safety issues;

iii) minimization of strengthening interventions through increasing knowledge and improving modelling tools.

The name of the project derives from the idea that preventive actions must be adopted in order to PERPETUATE the life of monuments in seismic areas, in due time, before an earthquake interrupts their life forever.

The final aim of PERPETUATE is the development of European Guidelines for evaluation and mitigation of seismic risk to cultural heritage assets. In particular, the Italian “Guidelines for the evaluation and mitigation of seismic risk to cultural heritage” [1] will be the framework for the drawing up of this document. Focusing the attention on masonry structures, the project will face the problem for both architectonic assets (historic buildings or parts of them) and artistic assets (frescos, stucco-works, statues, pinnacles…). Both seismic risk assessment at territorial scale, oriented to plan mitigation policies, and assessment of single cultural heritage assets, oriented to design suitable interventions, will be considered.

PERPETUATE methodology adopts a displacement-based approach. The use of safety verification in terms of displacement, rather than strength, suggests new strengthening strategies and helps in the comprehension...

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of the interaction between structural elements and unmovable artistic assets.

The procedure is based on the following fundamental steps: 1) definition of performance limit states, specific for the cultural heritage assets (both structural and artistic assets are considered); 2) evaluation of seismic hazard and soil-foundation interactions; 3) construction knowledge (non-destructive testing, material parameters, structural identification); 4) development of structural models for the seismic analysis of masonry structures and artistic assets and for the design of interventions; 5) application and validation of the methodology to case studies. Experimental campaigns (in situ and indoor), considering also shaking table tests, will be carried out in order to support the formulation and validate the models. In the following, the innovative contents concerning each step will be described.

2 DEFINITION OF PERFORMANCE LIMIT STATES FOR CULTURAL HERITAGE ASSETS

Many national and international technical rules and guidelines for the rehabilitation of existing buildings [2-6] have acknowledged the concepts of performance-based design. This approach allows the seismic design or upgrade of buildings with realistic risk estimation (safety of life, occupancy, economic loss). Since earthquake is a rare environmental action, it must define through a probabilistic approach (hazard scenario). Moreover, since it is impossible that ancient masonry constructions withstand without any damage to strong ground motions, the definition of proper performance levels is needed.

In FEMA documents [2], different rehabilitation objectives are identified, with various combinations of structural requirements and seismic action levels, divided into three categories (limited, basic safety, enhanced). In particular, four performance levels (operational performance, immediate occupancy, life safety, and collapse prevention) are defined which precise exceedance probability values in 50 years (50%, 20%, 10% and 2% respectively) correspond to.

In European codes, the concept of performance-based design is also present. In case of new buildings [4], two performance conditions are described: the damage limitation state and the ultimate limit state. These limit states are related to two different hazard levels: those related to an earthquake having probability of exceedance of 50% and 10% in 50 years, respectively. They may be set (using FEMA terminology) among the “limited objectives”; in fact, in the U.S. documents, the “basic safety objective” is reached only if also the collapse in case of the earthquake having probability of exceedance of 2% in 50 years is avoided. In case of existing buildings [5] three performance levels are considered; they are related to damage limitation, significant damage and near collapse conditions, which correspond to probabilities of exceedance of 20%, 10% and 2% in 50 years, respectively.

Even in Italy, the recent seismic decree [6] introduces performance-based design approach. In particular, in case of existing buildings, four performance levels are defined (corresponding to operational performance, damage limitation, life safety and collapse prevention conditions) which probabilities of exceedance are defined with reference to a reference life VR value. If a reference life VR of 50 years is considered, the values of 81%, 63%, 10% and 5% are obtained, respectively. In particular the reference life combines concepts associated to both the usable life (that is the time in which the building can be considered safe only assuring structural health monitoring and proper maintenance) and the use (occasional, frequent or frequent with crowding). The concept of reference life has been recently introduced in a new updated version of the Italian Guidelines [1]. The definition of a proper reference life is particularly important in case of cultural heritage assets since it is an efficient tool for timing mitigation strategies and balancing safety and conservation requirements keeping into account the cultural significance of assets.

Moreover, with respect to the case of ordinary unreinforced masonry buildings, in case of cultural heritage assets, also the damage induced in artistic assets has to be taken into account by introducing proper performance levels related to (i.e. in case of frescos or decorative elements attached to masonry panels).

Need of preservation of cultural heritage and recent improvements in seismic codes impose to focus the attention on feasible procedures for safety assessment and design of possible interventions. Although the documents afore mentioned point out the need for a quantitative evaluation in case of historic buildings, they do not propose a specific methodology. The Italian Guidelines [1] partially try to overcome this lack; however, they simply outline a conceptual approach to this problem, lacking in the definition of operative models and in the identification of specific limit states for cultural heritage. Thus, the identification and definition of reliable measures of limit state are needed and represent an open issue for cultural heritage assets (e.g. in the case of artistic assets like as frescos, stuccoworks ...).

In particular, among the seismic verification procedures proposed in the literature, the use of non linear static procedures, based on the evaluation of pushover curves (that is a force-displacement curve able to describe the overall inelastic response of the structure) is particularly encouraged. Performance levels (or limit states) may be defined on the pushover curve with reference to both structural elements and artistic assets. Once defined the earthquake hazard level, displacement demand may be then evaluated by referring to methods like as the Capacity Spectrum Method (as adopted in [7]), using an acceleration-displacement response spectrum properly reduced. Figure 1 summarizes, even in schematic way, this whole procedure.

In particular, in this context, PERPETUATE aims to define proper limit states for cultural heritage assets and the related reference seismic input, taking into account both human life safety and specific conservation requirements (aesthetics, serviceability, reparability,...).
The knowledge phase of an existing building (or artwork) plays a fundamental role in the assessment of its structural safety. Lacks in knowledge are usually considered as uncertainties affecting the modelling of the structure. Thus, a decreasing degree of knowledge imposes to consider increasing safety factors and, thus, lower conventional resistances. In general, this means that a maximization of the knowledge of the structure (in term of geometry, material properties …) may lead to a minimization of the interventions to guarantee acceptable safety levels. For ordinary buildings, the choice knowledge/interventions are purely economic (ratio between knowledge and intervention costs). For cultural assets, this choice should take into account also conservation requirements, which impose, as far is possible, a minimization of the interventions. For the achievement of all these data, an effective on-site testing campaign by means of application of different test methodologies as a combination of DT (destructive tests), MDT (minor destructive tests) and NDT (non-destructive tests) needs to be performed. From the results of recently carried EU research project ONSITEFORMASONRY [8], where a comprehensive set of Guidelines and Recommendations for the application of different test methodologies in evaluation of the state of the structure and material was made, in PERPETUATE an extension will be made to optimize developed methodologies regarding achieved confidence factor and their cost effectiveness and to propose new methods for structural identification.

### 4 CONSTRUCTION KNOWLEDGE

In order to evaluate the displacement demand through non linear static procedure, the pushover curve needs to be compared with the seismic demand, properly defined. Thus, probabilistic and deterministic methods to assess seismic hazard and ground motion characteristics have to be combined with specific models to account for local soil and site effects including topography, soil non-linearity, basin edge effects and other important parameters regarding “source” and “path” effects. A good knowledge about the complexity of surface geology and the complex nature of earthquake generation process has a crucial effect on the reliability of the hazard maps. In fact, numerous and substantial uncertainties characterise all steps of seismic hazard assessment, independently of the method used.

In this context, PERPETUATE aims to define Demand Spectra for different soil categories and seismic hazard appropriate for masonry historic buildings of various types. Indeed, it is well known that seismic input cannot be defined by a single parameter (e.g. peak ground acceleration, macro seismic intensity); in addition to acceleration-displacement response spectra (ADRS), other intensity measures will be evaluated (Arias intensity, Housner intensity, various duration measures, number of cycles of motion). The seismic input will be defined for longer return periods than those adopted by codes for new buildings because lower annual probabilities of exceedance are desired for cultural heritage assets. This input motion will be generally higher than code-defined input motions.

In particular, a comprehensive set of numerical, analytical and experimental studies to evaluate the role of the foundation compliance and associated soil-foundation interaction (SFI) and soil-foundation-structure interaction (SFSI) effects in the response of massive masonry structures (monuments, building aggregates in historical centres) and their vulnerability assessment will be provided. The aim is to develop an improved foundation model for the vulnerability assessment of classified masonry structures and monuments. The role of the foundation and SFSI effects will be studied both for seismic ground shaking and induced permanent ground deformations.

### 3 EVALUATION OF THE SEISMIC HAZARD OF SOIL-FOUNDATION INTERACTION

These limit states will be correlated to proper damage measures, specifically defined for the different cultural heritage assets, in order to allow safety verifications. As known, in case of masonry buildings damage measures are usually related to drift limits (shear deformation of masonry panels) or rotation limits (for out-of-plane mechanisms). In particular, at building scale, PERPETUATE intends to define damage measures for both single structural elements (i.e. piers, arches, vaults, domes) and the entire building; in this latter case, particular attention will be posed to the weight associated to the different failure mechanisms which may occur (i.e. in plane and out-of-plane) and to the number of elements which are involved. Moreover, at artworks scale, the more original contributions are oriented to definition of damage measures for decorative elements and drift limits for frescos or stuccos. The experimental campaigns specifically addressed to this aim will constitute a fundamental support.

**Figure 1: Performance levels definition on the pushover curve**

PERPETUATE intends to define damage measures for both single structural elements (i.e. piers, arches, vaults, domes) and the entire building; in this latter case, particular attention will be posed to the weight associated to the different failure mechanisms which may occur (i.e. in plane and out-of-plane) and to the number of elements which are involved. Moreover, at artworks scale, the more original contributions are oriented to definition of damage measures for decorative elements and drift limits for frescos or stuccos. The experimental campaigns specifically addressed to this aim will constitute a fundamental support.
5  STRUCTURAL MODELS FOR THE SEISMIC ANALYSIS AND FOR THE DESIGN OF INTERVENTION KNOWLEDGE

Starting from a literature review, the more suitable modelling strategies for the cultural heritage assets both for the analysis of buildings or architectonic elements and for artistic assets, will be identify and classified. The displacement-based approach for the seismic analysis requires the development of nonlinear static procedures (pushover), in order to evaluate the capacity curve and identify the performance point. After a classification of different types of buildings, architectonic elements and artistic assets, reliable innovative mechanical models will be developed, capable to describe the non linear behaviour of the assets under seismic actions, till to their collapse. As known, the idealisation of the structure at the building scale may be performed considering: a) meshing of the material continuum (Finite Element Models); b) subdivision into significant structural elements (Structural Elements Models); c) predefined collapse mechanisms of rigid blocks. In the first two approaches, the pushover curve may be obtained by finite element incremental static analyses, while in the third one; an incremental equilibrium limit analysis (kinematic approach) may be adopted, by considering a set of varied displacement configurations. All these modelling strategies will be considered. Moreover, seismic verification procedures will be established overcoming some of the open issues present in literature related to their application to masonry historical structures (e.g. the evaluation of the sensitivity of the verification procedure in terms of target displacement in presence of flexible floors; the correlation of the displacement capacity of the structure to predefined limit states in the case of FEM models). In case of the analysis of out-of-plane local mechanisms, also the amplification of motion due to their position in the main building will be taken into account.

Operative procedures, practical tips and clarifying examples will be provided. Moreover, the Soil Foundation Interaction results and the soil-foundation model will be included in the development of the general structural model.

Non linear models and modelling strategies developed will be used for the evaluation of effectiveness and reliability of the different interventions techniques, both traditional (like as insertion of tie-rods, new buttresses…) and much more innovative. In particular, the performance-based approach will be adopted in order to assess the effect on the displacement capacity of the structure (performance approach vs. strength approach). It is important to broaden the knowledge on modelling historical structures with new, innovative modelling tools because modern codes are prepared mostly for new structures. In fact, applying the same models and safety factors proposed for new structures to historical structures is usually inappropriate and leads to invasive interventions, in order to assure seismic safety of historical buildings, which are in collision with conservation requirements. Moreover, particular attention will be paid to the modelling of the cultural assets at different scales, in order to evaluate the effect of interventions not only on the structure of the building but also on the unmovable cultural assets present in it.

Finally, in addition to models applicable at scale of the single assets, innovative methodologies for the vulnerability evaluation on a large number of assets (buildings and artworks) will be developed in order to develop mitigation strategies at territorial scale, defining priorities of interventions and providing criteria for the budget optimization. In particular, such methodologies will be based on quick surveys and will be focused on simplified mechanical models or statistical models (derived by damage assessment data, obtained by previous earthquakes).

6  APPLICATION AND VALIDATION OF THE METHODOLOGY TO CASE STUDIES

All the contributions obtained by the previous steps will be collected and coordinated in order to define an integrate methodology, to be validated and applied to case study areas. An innovative contribution is the procedure for estimation of uncertainties, both aleatory (randomness) and epistemic (due to incomplete, vague or imprecise information). In particular, epistemic uncertainties in the field of earthquake risk assessment require the development of adequate tools, by the use of logic tree approach, in which expert judgement compensates for the incompleteness of existing information. The final result is a range of capacity curves associated with weights, and the choice of the fragility curve for the risk evaluation can be made by using the fuzzy set theory. The validation and demonstration of the proposed methodology will consider relevant case studies, selected to be representative of two scales of analysis considered (the territorial one and that of the single asset), in particular: the Citadel of Algiers; the historical centre of Rhodes; the Cathedral St. Nicholas in Ljubljana; Santa Maria Paganica church and Ardinghelli palace in the historical centre of L'Aquila (Italy) hit by the earthquake on 6th April 2009; the St. Pardo palace in the historical centre of L'Aquila (Italy) hit by the earthquake on 6th April 2009; the St. Pardo Cathedral in Larino (Molise Region, Italy). In particular, the Citadel of Algiers and the historical centre of Rhodes (both in the UNESCO list of the World Cultural Heritage) are made up of a complex aggregation of historical buildings, which represent a cultural heritage asset as a whole but also contain a wide number of single important monuments. For this reason, they are both an optimal example for the application of the methodology at the two different scales: a) an overall evaluation inside the historical centre (singling out of the cultural heritage assets at higher risk; proposal of a cost-efficient and reliable mitigation strategy); b) a detailed evaluation of the most significant monuments and artistic assets (proposal of strengthening interventions or of a structural health monitoring protocol).
ACKNOWLEDGEMENT

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 244229 (www.perpetuate.eu).

REFERENCES


ESTABLISHING CRITERIA FOR SELECTION OF EFFICIENT MTTs FOR EU-CHIC PROJECT

Emanuele Piaia,1 Marco Zuppiroli2

ABSTRACT: The main topic regards the development and definition of choice criteria and indicators of the main methods, tools and techniques (MTTs) used for collecting information to preventive conservation, monitoring and maintenance of European cultural heritage. In this context it is important to point out that not all “category of data” (as information regarding the cultural heritage) has the same level of importance in the different European countries and, furthermore, not all the MTTs have the same diffusion. The analysis of the questionnaires filled in by the various partners and subsequent evaluations taken from the collected data highlighted important results, aiming to identify which MTTs can be considered the most efficient in terms of cost, time and knowledge of use and which MTTs that you will need to promote in order to align the procedures for preventive conservation, monitoring and maintenance.

KEYWORDS: methods, tools, techniques, European cultural heritage, efficiency.

1 INTRODUCTION

The main research topic concerning task 3 of EU-CHIC project’s WP4, regarded the development and definition of choice criteria and indicators of the main methods, tools and techniques (MTTs) used for collecting information on European cultural heritage.

The following partners took part in this task:
- Fraunhofer (Germany);
- ITT - Technion Israel Institute of Technology (Israel);
- NTUA - National Technical University of Athens (Greece);
- IPPT PAN - Institute of Fundamental Technological Research Polish Academy of Sciences (Poland).

There were two main aims to be reached:
1. Development of criteria and indicators in order to define the most efficient MTTs regarding cultural heritage;
2. Identification of key players, i.e. main categories of professionals who take part in data collection and management.

With the aim of achieving these results, the Fraunhofer and the University of Ferrara research units, coordinated respectively of WP 4.2 and 4.3, have divided the work activity in two stages:

1. Data collection, by drawing up a questionnaire that was sent via email to the partners to be filled in;
2. Evaluation of the data collected.

2 DATA COLLECTION

The questionnaire drawn up and sent to the research partners was split into rows and columns whose white cells were to be exclusively filled in (see Table 1).

Some questionnaire information such as: Category of data (column A) and MTTs (column D) connect back to the results that emerged during WP 4.1, where the task leader, ITAM, through the analysis of other questionnaires filled in by the research partners, has identified the main tools (MTTs) that are most commonly used in Europe (see D.4.1).

Before drawing up the questionnaire, three different criteria were identified to classify and choose the most efficient MTTs:
- The level of difficulty of the MTTs in terms of time (Column H), i.e. whether the MTTs allows the data to be obtained quickly or not;
- The level of difficulty of the MTTs in terms of cost (Column I), i.e. whether the MTTs is expensive or not;
- The level of difficulty of the MTTs in terms of knowledge (Column J), i.e. if the use of the MTTs requires detailed technical knowledge or is easily applicable or usable by non-specialist people as well.

Based on these preambles and the objectives of WP 4.3, the focus of the questionnaire is represented by the questions posed in the central columns (H-I-J), where the respondents express their opinion by referring to each specific MTTs through three fixed answer possibilities on the specific level of difficulty:

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- Low;
- Medium;
- High.

Other important questions in the questionnaire (see Table 1) are as follows:
- Column B, is the category of data used in the country?
- Column C, is the category of data collected important for the cultural heritage identity card?
- Column E, is the MTTs used in the country?
- Column F, who is the technical figure that uses the MTTs in order to obtain the data?
- Column G, are there any guidelines for using the MTTs?
- Column K, are the MTTs needed for implementing and developing the identity card?
- Column L, who is responsible of the data?
- Column M, is there a database for data collection?
- Column N, can the data obtained be shared and made public?

In this context it is important to point out that not all the information inherent to the cultural heritage has the same level of importance in the different European countries and, furthermore, not all the MTTs identified are diffused in the same way.

This latter aspect is important as from the point of view of developing a single identity card for all European countries, it is fundamental that the data can be shared on a single platform. Finally, it is also necessary to classify which MTTs have widespread disclosure and with which it is possible to obtain the highest amount of information on the analysed asset.

At the end of the first stage of work, seven questionnaires were collected. The following countries have compiled the questionnaires:

- Germany;
- Greece;
- Israel;
- Italy;
- Norway;
- Poland;
- Slovenia.

3 DATA EVALUATION

The second stage of research regarded the evaluation of the data collected and, to give weight to the information previously collected, some of it was transformed into numerical values.

In particular, this transposition plays an important role in comparing the answers of the various countries to the questions on the levels of difficulty for use in terms of time, cost and knowledge of MTTs.

For this reason, the answers given by the respondents of the questionnaires were transformed as follows:
- Low level of difficulty = value of “0”;
- Medium level of difficulty = value of “0.5”;
- High level of difficulty = value of “1”.

This transposition of the information created a new database prepared by the group of the University of Ferrara, which became the basis for evaluating the data collected (see Table 2, 3 and 4).

This new database is based on the main structure of the original questionnaire used in the first stage of data collection but with the addition of some important columns that cross over and compare the different levels of difficulty through an arithmetic mean calculation described below.

In fact, the answers provided by each country were used to calculate the arithmetic mean difficulty value for each MTTs in obtaining the desired information.

Then, new tables were created for evaluating the data. The tables no longer refer to the sub-categories of data, i.e. the information relative to the cultural heritage as have happened up to now, but the MTTs. This aspect is important since it focuses on the method, tool or technique used in the analysis for obtaining different amounts of information.

The structure of these new tables is as follows:
- Column B shows the MTTs;
- Column D shows the information that can be obtained by using the MTTs (in some cases only one item of information can be obtained but more than one in others);
- Column E shows the arithmetic mean of the level of difficulty of use of the MTTs in terms of time;
- Column F shows the arithmetic mean of the level of difficulty of use of the MTTs in terms of cost;
- Column G shows the arithmetic mean of the level of difficulty of use of the MTTs in terms of knowledge (see Table 5).

By crossing all the mean data values for each indicator, this new table allows a general mean to be calculated for the level of difficulty of use of the MTTs (see blue cell). The final result of this analysis will be included in a scale of values where:
- 0-0.3 is a low level of difficulty;
- 0.3-0.7 is a medium level of difficulty;
- 0.7-1 is a high level of difficulty.

Taking into consideration the data collected through the answers to a particular question on the questionnaire, such as the need to include the specific MTT relative to each subcategory of data in the identity card, it is possible to define a series of values:
- Mean need: mean of the answers obtained using the filled-in questionnaire provided by each country;
- MTTs efficiency: as a product of the mean need and the resulting level of difficulty for each MTT relative to each subcategory of data.

The values identified through these relations were used to give weight to the efficiency (still referring to the time, cost and knowledge indicators) of the mean values previously calculated for each MTT selected (see red cell).

By proposing an efficiency evaluation of the MTTs, the second value (red cell) provides much more significant data than the first. Similarly to the previous evaluation (mean blue cell), also in this case the final result that measures the efficiency of the MTTs will be a value between:
- 0-0.5 which corresponds to a high level of efficiency;
- 0.5-1 which corresponds to a medium level of efficiency;
- > 1.0 that corresponds to a low level of efficiency.
4 RESULTS OF THE EVALUATION

The analysis of the questionnaires filled in by the various partners and subsequent evaluations taken from the collected data highlighted important results, aiming to identify:
- the most common European MTTs;
- which ones can be used to obtain more information on the cultural heritage analysed;
- which MTTs are easier to use;
- which MTTs can be considered the most efficient in terms of cost, time and knowledge of use.

5 CONCLUSIONS

The reading of the results that emerged from the analysis conducted shows that knowledge of European cultural historical heritage is undeniably connected with the use of specific methodologies, techniques and tools that over the years have become increasingly technologically advanced and widespread in all the countries.

As shown in the previous tables, in some cases through the use of a specific MTT, more information can be obtained on the cultural asset analysed, whereas in other cases, the tools or more simply the methods of analysis used aim to obtain one specific item of data.

Furthermore, on the European scene, there is substantial uniformity in the use of the MTTs even if, in some cases, with reference to particular tools like photo cameras, 3D laser scanning, etc., the level of difficulty declared reports a different level of implementation. Similarly, some countries can be considered to be at the forefront in methodological analysis of certain aspects that regulate the quality of conservation and maintenance of the asset.

An example of this is in Italy, where a method of risk analysis has been the subject of development work for a number of years.

The most efficient MTTs in terms of cost, time and knowledge (with index < 0.50) for collecting information of European cultural historical heritage, are described in the following table (see Table 6).

The most efficient methods contained in the table are set to the prevalent use of human capital and relatively inexpensive tools.

A brief summary of the results (in terms of MTT data collection, level of difficulty and level of efficiency) illustrates how “documentary archive research” is fundamental - with a low level of difficulty - for obtaining historical and technical information on the asset. Sub-categories of archive research like the analysis of “cartographic and topographic plans” and of “historical plans” can be considered important as other methodologies having the aim of obtaining data relative to geographical information, information on the landscape, anthropic impacts on the asset and improper uses.

The use of the “photographs” is also important. In all countries the personal digital camera has become the main tool for visually recording the state of conservation of the asset, the type of building and the landscape where it is set. In this context, a comparison of photographs taken in different years, allows the alterations of the asset to be easily highlighted. There are also advanced surveying techniques, such as “stereoscopy”, “photogrammetry” or “3D laser scanner”, which provide detailed information to be obtained. Unlike the use of most common tools, like the personal digital camera, which is immediate in providing results, require the participation of specialist technicians in order to obtain more detailed information.

Moreover many of MTTs imply an “inspection in situ” as only way for analyzing any kind of aspect findable directly on the tangible property, from “formal analysis” to “technical analysis”, from “structural assessment” to the highlighting of the presence of valuable finishes or details in the internal rooms. For the correct and appropriate protection and knowledge of the asset, the importance of using “monitoring stations” based on advanced “electronic tools” that can constantly monitor the building’s state of health, can also be underlined. But also in this field, the participation of specialist technicians is required.

The table has highlighted the efficiency and therefore the need to extend the focus to the context in which the property is set. The risk analysis methodology as a set of procedures for preventive conservation, monitoring and maintenance (“vulnerability”, “critical events hazard” and “risk assessment”) promoted by Italy, and partly adopted in other countries, shows that a knowledge of the site, of the climate and of the impact that humans can have on the property, constitute fundamental information that must in some way be monitored.

Finally, in some categories, different items of information are taken straight from other research institutions, and the task of directing the promotion and maintenance of the heritage lies in being able to read and compare that, also in order to assess the need of other particular MTTs.

Data collection, with the aim of obtaining complete knowledge of the historical heritage, involves many different people from very different disciplines, including specialist technicians who are exclusively familiar with the specific use of a particular tool. In many cases, the role of the architect is the most common. In others, technicians and professionals specializing in a certain work areas adopt the fundamental role. However, in this situation, the others must be organised by a leader, which is usually an architect too.

Furthermore, the subdivision of work over the last decade has led to the birth of new professional figures (building engineer, civil engineer, materials engineer, etc.) and to the conclusion that it is necessary to look more in detail into this aspect.

The analysis has demonstrated also that exist many inconsistencies among the different countries that regard the nomenclature and the training of professionals, in particular the technicians.

There are similar professionals for roles which differ greatly from one another, i.e. different names for overlapping professionals. In other words, the professional competence of a material engineer may be different in Italy and in Israel.

On the contrary, the aforementioned MTTs are now part of the market. Consequently, the technologies on which these tools are based are standardized in any country.
The protocols for the use of such instruments, instead, are only partially defined in international regulations. This is a key aspect for those who practise their profession in more than one country. Nowadays, in Europe, there are a number of relation difficulties which can be easily detected and which are due to the use of different MTTs to achieve the same objective or the use of the same MTTs with protocols characterized by major differences.

The most European efficient MTTs, in the above table, could be inserted in a shared platform aimed at collecting information regarding preventive conservation, monitoring and maintenance of world cultural historical heritage. This would be a platform based on well-defined shared protocols, which could be enriched by additional surveys, on a case by case basis, and which would allow the development of a critical framework to be interpreted and studied even in many different contexts.

A higher level of consistency among the professionals involved, each one in its own context, will represent the basis for the development of these protocols. This will allow a debate, also at an international level, on the most problematic operating cases.
Table 1: Questionnaire, that was sent via email to the partners to be filled in.

<table>
<thead>
<tr>
<th>Country and sub-category of country</th>
<th>MTTs</th>
<th>Difficulty level of using the test in terms of time (best: measured in 100% of the test)</th>
<th>Difficulty level of using the test in terms of time (best: measured in 100% of the test)</th>
<th>Difficulty level of using the test in terms of time (best: measured in 100% of the test)</th>
<th>Difficulty level of using the test in terms of time (best: measured in 100% of the test)</th>
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<th>Difficulty level of using the test in terms of time (best: measured in 100% of the test)</th>
<th>Difficulty level of using the test in terms of time (best: measured in 100% of the test)</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Level of difficulty of the MTTs, in terms of time.
Table 3: Level of difficulty of the MTTs, in terms of economic cost.

Table 4: Level of difficulty of the MTTs, in terms of knowledge.
Table 5: Evaluation of data.

<table>
<thead>
<tr>
<th>ID</th>
<th>MTTs</th>
<th>Level of difficulty of use of the MTTs</th>
<th>Level of efficiency of the MTTs</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Documentary archive research</td>
<td>0.39</td>
<td>0.40</td>
</tr>
<tr>
<td>02</td>
<td>Photographs</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td>04</td>
<td>Cartographic and topographic plans</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>05</td>
<td>Historical plans research</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>08</td>
<td>Visual inspection</td>
<td>0.40</td>
<td>0.40</td>
</tr>
<tr>
<td>09</td>
<td>Inspection in situ</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>10</td>
<td>Visual non-destructive inspection</td>
<td>0.49</td>
<td>0.49</td>
</tr>
<tr>
<td>12</td>
<td>Drawings</td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td>16</td>
<td>Formal analysis</td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td>17</td>
<td>Technical analysis</td>
<td>0.39</td>
<td>0.39</td>
</tr>
<tr>
<td>19</td>
<td>Georeferencing (GIS) of situation plans or maps</td>
<td>0.47</td>
<td>0.47</td>
</tr>
<tr>
<td>20</td>
<td>Structural documentation and pathology card</td>
<td>0.35</td>
<td>0.36</td>
</tr>
<tr>
<td>30</td>
<td>Structural assessment reports</td>
<td>0.40</td>
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<tr>
<td>31</td>
<td>Existing diagnostic surveys</td>
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<td>33</td>
<td>Non-destructive testing</td>
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<td>Condition assessment reports</td>
<td>0.42</td>
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<td>36</td>
<td>Sample testing</td>
<td>0.42</td>
<td>0.42</td>
</tr>
<tr>
<td>39</td>
<td>Vulnerability conservation state: structural, superficial, anthropic</td>
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<td>0.44</td>
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<td>Energy efficiency analysis</td>
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Table 6: The most efficient MTTs, in terms of cost, time and knowledge.
ABSTRACT: Increasingly advanced systems now enable us to have an essentially infinite amount of information in the palm of our hand, which is easy to consult and clear to use. It is absolutely essential to think of EU-CHIC as part of the new virtual specialties generated with the aid of “augmented reality” systems, developed for mobile devices like the latest generation smartphones. In Italy, the Ministry of Cultural Heritage and Activities has developed some apps that can be placed on an official level among the most important applications in this field. In this “app”, each cultural location is described through a sheet containing general access information and a rich gallery of pictures. The last application, which is the only one of its kind, enriches the i-MiBAC project, allowing virtual 3D contents to be viewed in real time on the display of the own mobile device.

KEYWORDS: augmented reality, mixed reality, mobile devices, and smart phones.

1 INTRODUCTION

An initial recognition of the tools available for providing information on the EU-CHIC introduces us to some brief considerations on potential shortcomings, both with reference to the categories of information identified and to the format that this information must/could have.

In fact, increasingly advanced systems now enable us to have an essentially infinite amount of information in the palm of our hand, which is easy to consult and clear to use. It is absolutely essential to think of EU-CHIC as part of the new virtual specialties generated with the aid of “augmented reality” systems, developed for mobile devices like the latest generation smartphones (Apple, Windows or Android OS), necessarily equipped with GPS for positioning, magnetometer (compass), webcam for viewing a video stream in real time and, obviously, an Internet connection system for receiving and sending data online. The mobile phone sets the reality in real time with which other levels of content can be overlapped, like EU-CHIC itself (virtual and multimedia elements, geo-localised data, etc.). Furthermore, any information levels, especially of a graphical nature (renders, building reconstructions and settings that no longer exist, designs never implemented, etc.), can be overlapped with the image of the real elements, to construct what is now called “mixed reality”.

Thanks to significant improvement in mobile technology, as of 2009 the increased reality reached the general public first as an actual augmented advertising campaign and now as an application for smartphones. In fact, you can now find information on the place where you are (like hotels, bars, restaurants, underground stations) but also look at photographs from social networks like Flickr or on-line resources like Wikipedia and overlap them with reality.

2 I-MIBAC – TOP 40 APPLICATION

In Italy, the Ministry of Cultural Heritage and Activities has developed some apps that can be placed on an official level among the most important applications in this field.

The “i-MiBAC – Top 40” [1] application (the first of a series of multi-theme, free, mobile phone applications on Italian cultural heritage), constitutes the first official application released by an Italian Ministry. The “i-MiBAC” project comes from an initiative of the General Management for organisation, general affairs, innovation, budget and staff and the General Management for the promotion of cultural heritage, in association with the Ministry of Tourism, and aims to promote and in particular develop art and culture through new communication tools.

Shortly, this will be followed by other applications dedicated to less visited places but just as worthy of note, the rescued heritage in Abruzzo, UNESCO sites and, why not, Italian sites that will be involved in EU-CHIC.

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In the “app”, each cultural location is described through a sheet containing general access information and a rich gallery of pictures. There are numerous sections on the utility of the application, extending its contents, many of which can also be consulted without an Internet connection:

- **Map**: mapping of all the museums and monuments indicated in the application and the relative connected cultural paths. It also shows the user’s position using GPS and points out any cultural locations nearby.
- **Museums and Monuments**: general access information; contacts, website, opening times, information on entry tickets and guided tours. There are short historical/critical sheets in this case on the museum collections and archaeological excavations and a selection of the pictures of the most representative works that can be viewed in detail. The contents are available due to the high quality iconographic apparatus provided by the Central Catalogue and Documentation Institution and the most important Italian photograph archives: Scala and Alinari archives.
- **Paths**: Thematic itineraries indicated by the editorial staff of Cultura Italia, with geo-referencing of places, pictures and short historical sheets about them.
- **Morphing**: Morphing of restorations and/or mutations over time of a selection of works of art.
- **Top Secret**: Video and photo gallery of the less accessible places to the public, around the Top 40, for further promotion of the unexplored heritage.
- **Audio**: A selection of pieces of music contextualised with respect to the selection of works.
- **News**: Events, programs and news acquired straight from the MiBAC site.
- **Tickets**: Possibility to book and purchase tickets for MiBAC sites from your own phone, up to 24 hours before entry. Once the purchase has been made, the user receives a bar code by email, which allows direct entry, avoiding queues.

### 3 I-MIBAC VOYAGER APPLICATION

With i-MiBAC Voyager [2], we will be able to make use of virtual 3D reconstructions in real time of settings, which are now remote in time while walking through the area of interest.

The new Voyager application, which is the only one of its kind, enriches the i-MiBAC project, allowing virtual 3D contents to be viewed in real time on the display of the mobile device and, with realistic photographic quality, the most important archaeological parks to be reconstructed in their period of greatest splendour. The application can be used in two ways, the first in situ, with GPS support, which aligns the virtual camera with that of the user in the real world. The second mode enables all the contents to be used sitting comfortably at home or wherever you may be. In this mode the virtual camera is controlled manually by the user through the interface buttons. i-MiBAC Voyager also uses GPS, the electronic compass and the terminal accelerometers, to recognise the user’s position and point of view, allowing very simple and intuitive navigation, without needing to use any keys.

All you need to do is point the i-Phone or i-Pad towards a monument to enjoy an “immersive” and unique experience. Using a software algorithm, the application can recognise any geo-referenced monument around your position. Through this technique, while you are observing a certain monument, you can listen to an audio...
guide in different languages, which offers all the historical information about it. The revolutionary and combined use of these devices and software algorithms represents a real evolution of navigation interfaces oriented towards the promotion of cultural heritage, providing a new system, that has never been used before, directed towards “immersive” and interactive simulation, making i-MiBAC Voyager an experience of virtual reality never tried before. In recommending the interest of these evolved systems within EU-CHIC, it will be necessary, in subsequent research, to understand whether it is possible to interface information on the asset considered to be important and already identified by research, with similar devices. The latter could constitute the first and main support of EU-CHIC that the monument could exhibit whenever requested by the user, whatever role the latter covers (from a tourist to an official, an architect to a historian). It appears clear from the start how the way of presenting the monument could lead to important benefits. Only in this way can the asset show itself independently whenever requested by the user, as well as the desired level of information about it, like a kind of “dress”.

4 CONCLUSION

The potential of the system that the MiBAC has sought to offer officially, on one hand consists of the overlapping skills of its physical reality – the material on the monument itself – with other essential levels of information, and on the other hand, the use of a hardware device already available to the user who would clearly be discouraged if a different device were required every time a different construction is presented.

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ABSTRACT: This document briefly describes the Slovenian Register of immovable cultural heritage which is central and official database of all immovable cultural heritage in Slovenia: the purpose and the basic concept of the Register, its development, the registration procedure, metadata structure of the Register data and the use of the Register.

KEYWORDS: immovable cultural heritage, register of cultural heritage, geographical information system

1 INTRODUCTION

The Register of immovable cultural heritage is a central official database of cultural heritage in the Republic of Slovenia. Its main purpose is providing information support to the implementation of cultural heritage protection. The Register is also used for presenting research, education, training and fostering public awareness of heritage.

Inscription in the Register extends to all types of immovable cultural heritage (archaeological, architectural, settlement, memorial and garden-architectural heritage, and cultural and historic landscapes) regardless of size, ownership or legal protection status. Within the registration procedure every heritage unit is given a unique Heritage Reference Number (HRN, EŠD in Slovenian language). The purpose of assigning the HRN is to create a unified identification system for the cultural heritage. The HRN is used in all procedures relating to heritage protection (from recording and documenting to the declaration of cultural monument, financing the conservation works, protection of heritage in planning procedures etc.). It is also used as a link between modules in the information system of cultural heritage, developed by the Ministry of Culture, and as a connection to other external information systems or databases.

The description in the Register contains basic information about the heritage unit. This includes details of its geo-location, and serves as the “identity card” of the heritage unit.

2 UPDATING OF THE REGISTER OF IMMOVABLE CULTURAL HERITAGE

The description in the Register contains basic information about the heritage unit. This includes details of its geo-location, and serves as the “identity card” of the heritage unit.

There are 28.809 units currently inscribed into the Register (2011) with 200 other units still in the registration procedure.

The Ministry of Culture manages the Register in cooperation with the Institute for the Protection of Cultural Heritage of Slovenia.
An initiative for inscription in the Register can be suggested to the Ministry by any natural or legal person, and the inscription proposal is prepared at the competent regional office of the Institute for the Protection of Cultural Heritage of Slovenia, in most cases at their own behest. The Ministry checks the quality of proposals and, on the basis of these proposals, officially inscribes units in the Register. Erasure of entries from the Register, or their modification, is undertaken in the same manner. Conservation specialists who work at the Institute for the Protection of Cultural Heritage of Slovenia prepare the proposals for inscription (or modification or erasure) of entries into the Register whilst also implementing different administrative and technical procedures of cultural heritage protection. The multipurpose database of the Register of immovable cultural heritage is an additional result of their regular work. In this way the costs for the database creation are minimised and the updating of the data and sustainability of the Register are guaranteed.

The guidelines for the data entry and the controlled vocabularies (on object types, dating periods, connected persons and their roles etc.) have been developed as a part of the management of the Register and are updated permanently. In this way, the Register helps to establish national standards and improve the quality of professional work in the filed of cultural heritage documentation.

3 A BRIEF HISTORY OF THE REGISTER OF IMMOVABLE CULTURAL HERITAGE

The development of the Register of immovable cultural heritage started in 1991. Its legal framework was defined in 1995 by the Regulation for the managing of central register of cultural and natural heritage (ULRS 26/1995). This regulation organised the compilation of the central register of cultural and natural heritage, but was never applied to the latter category.² It introduced the information support to the register management through a system of electronic forms, which permitted the formation of a single central register in the unified environment of the republic office (later Ministry of Culture) and regional offices of the Institute for the Protection of Cultural Heritage of Slovenia.

The experimental version of the Register was implemented in 1996. Some of the existing data sources (databases on heritage of special importance, legally protected cultural monuments and churches) had been converted to the Register database. The guidelines for data entry were also prepared, and training workshops for regional offices were organised at the same time. Since 1996 the registration procedures have been running on the basis of proposals made by the regional offices.

The system gradually developed but was supported by modern information technologies from the beginning. As an innovation at European level, in 1997 geographic information system technology was integrated into the Register.

The Register system was adapted in 2002 with the Regulation on the register of immovable cultural heritage (ULRS 25/2002). The compilation of the Register was confined to immovable cultural heritage and extended with additional data on dating. In addition to a collection of basic data, the regulation defined a collection of protection data (for cultural monuments only) and a collection of documents, although the basic concept of the Register, formed on the basis of the regulation in 1995, virtually remained unchanged.

The last major change was in 2009 with the Regulation on the register of cultural heritage (ULRS 66/2009). The Register of immovable cultural heritage was again extended with additional data (on the author) and adapted to the latest trends and standards in the digitisation of the cultural heritage, including the redefinition of the collection of documents into the presentation data. Using the concept and experience of the Register of immovable cultural heritage, the regulation defined the register of movable and intangible heritage, and these are still in the process of implementation.

4 THE DESCRIPTION OF THE CULTURAL HERITAGE UNIT

The aim of the Register is to collect basic structured information about all the heritage units in Slovenia and not to collect all the existing data about selected sets of heritage units. So the description of cultural heritage units in the Register is relatively simple, and has an identical metadata structure for all types of heritage. The Register consists of basic data, protection data and presentation data.

The basic data on the heritage unit contains:

- Identification (HRN, name of unit, synonyms of the name),
- Description (unit type code, unit size code, typological descriptors, short description),
- Dating,
- Location (settlement code, map references, description of location, approximate size of the land area, central point (geo-location¹, Gauss-Krüger coordinates, data on accuracy, data on the basis for data capture), area (geo-location, data on accuracy, data on the basis for data capture)),
- Author ⁴,
- Characteristic photograph (photograph, author of the photograph),
- Protection guidelines (category of protection guidelines, additional description of protection guidelines if existing),

² The register of natural values as well as other databases on nature protection and biodiversity is managed by the Environmental Agency of the Republic of Slovenia.

¹ The geo-location data (the central point and the area of the unit) is generally defined on at least a scale of 1:5000.

⁴ Data on author was introduced with the Regulation on the register of cultural heritage in 2009. Data is fully prepared but not yet implemented in the currently operating version of the Register.
− References to related units and registers,
− Responsibilities (conservation topics, regional office responsible for conservation),
− Data on access restriction,
− Data on registration, changes and de-registration,
− Remarks.

The protection data is collected for monuments only and contains:
− Identification (HRN),
− Documents on protection (proclamation act, type of proclamation (temporary / permanent)),
− Description of protection (scope of protection (monument / site), protection category (national / local significance), land registry data, geo-location of the monument, geo-location of the area of impact),
− Protection regime (protection regime of the monument, protection regime of the area of impact),
− Data on the owner of the monument,
− Additional data (data on management plan, data on pre-emptive right, data on the inventory of movable heritage which is an integral part of the monument, data on public access),
− Data on the beginning, changes and the end of proclamation,
− Remarks.

Protection data is regularly collected for new proclamation acts, but not all the protection data has been collected for older proclamation acts (prior to 2008 / 1999).

The presentation data includes additional data that illustrate the heritage in textual, graphic or other multimedia form. Data should contain metadata description according to Dublin Core metadata standard and references to registered heritage units. Contents which are important for the Register, and are financed from public funds, shall be provided to the Register regularly and free of charge. The module of presentation data has not yet been fully implemented.

The Register of immovable cultural heritage is compliant with the recommendations of the Council of Europe Core Data Index for architectural heritage (Rec. No. R (95)3) and Core Data Standard for Archaeological Monuments and Sites, which define the core data for documenting architectural and archaeological heritage.

5 ACCESSIBILITY AND USE OF THE REGISTER DATA

Data from the Register of immovable cultural heritage is publicly accessible. Public access is guaranteed via different web browsers.

The first web browser (http://rkd.situla.org) has been available to the public since 2003. It provides users with basic browsing and querying of the database without access to geo-located data.

Since 2008, the Register is available online via interactive map (http://giskd.situla.org), which allows viewing basic data from the Register on the map, and is intended for general public. In 2009, the interactive map was updated and supplemented with a part of a geo-referenced historical cadastre (from the first half of the 19th century), which allows direct comparison of the historical state of geographical space to the current situation. Also the timeline was added, which gives a better overview of the heritage in space and time. Since 2010, information on the interactive map has been linked with the selected digital documents (currently 20,000 photographs and field notes), which are also available in the European digital library Europeana (www.europeana.eu).

Figure 3: Web application http://giskd.situla.org; overview of cultural heritage on the timescale

Figure 4: Web application http://giskd.situla.org; links to selected digital documents

The system of legal regimes of protection of cultural heritage (http://evrd.situla.org) gives a different view on

5 According to the Cultural Heritage Protection Act (ULRS 16/2008) registered immovable heritage may be proclaimed a monument on account of its extraordinary significance for the State (monument of national significance), or its special significance for the region or municipality (monument of local significance). A monument of national significance shall be proclaimed by government act, and a monument of local significance by a decree by the representative body of the region or municipality.

6 With the exception of data on the owners of the heritage, or on the location of archaeological sites where a danger of unauthorised searches for archaeological remains exists, and other data the public accessibility of which might threaten the existence of the heritage in question.
the Register data. The Ministry of Culture set up a system in 2009 to help developers of spatial planning documents and other users to gain in one place an overview of all legal regimes that apply for the areas of cultural heritage. Data is connected with proclamation acts and an interactive Handbook of legal regimes. Digital geo-located data from the Register can also be obtained on the basis of special agreement. Users request it mainly for the integration of cultural heritage into spatial planning, and for different research purposes. The development of a special web service, for easier distribution of data to the users, is tested and will be available in 2012.

Data from the Register is often and successfully used in different analyses and projects of the Ministry of Culture, and the Institute for the Protection of Cultural Heritage of Slovenia (e.g. annual financial reports, analysis for the new real property tax system, study of the flood risk assessment of the immovable cultural heritage etc.).

Figure 5: Web application http://evrd.situla.org; description of the legal regime area and link to the proclamation act

6 CONCLUSIONS

Data from the Register (although basic and relatively simple) is daily used to support different administrative procedures for cultural heritage protection including issuing of urban planning guidelines. The Register web browsers are used by professionals and general public, the number of users is increasing. Different possibilities of use of the Register and a wide variety of users prove that the concept and management of the Register are successful.

REFERENCES

DIGITAL ARCHIVES FOR CULTURAL HERITAGE

Alexander Stenzer,¹ Claudia Woller², Burkhard Freitag³

ABSTRACT: The MonArch project [1] deals with archives of monumental buildings and archeological sites, which are invaluable for our cultural memory. It is a joint research effort of the Passau University and the University of Bamberg in cooperation with preservation agencies, cathedral works and other maintainers of monumental sites, both European and international. The MonArch Digital Archiving System is an information and documentation system developed within the project. The overall goal of the MonArch project is to define a methodology for making accessible, catalogue, inventory, digitally secure, and preserve the archives of monumental built heritage. To this end, indexing schemes have been designed and software tools have been developed for describing and storing the digitized archivals based on their structural position within a building or site and on a rich semantical description of their contents [2]. This paper gives an overview of the MonArch Digital Archiving System including its functions and features.

KEYWORDS: MonArch Project, Information and documentation system, Distributed archives, Long-term preservation, Digital libraries

1 INTRODUCTION

Despite their great cultural-historical importance, the situation of the archives attached to monumental buildings is often not satisfying:

Even if the archived documents have been digitized and are digitally stored, retrieval based on structural neighborhood or similarity is rarely possible. The only way to find the desired information is to sequentially scan the entire archive, which often means having to inspect thousands of physical documents.

The innovative idea of the MonArch project is to store digitized documents based on their structural and spatial position. Usually, documents stored in the archive of a building such as plans, drawings or measured data captured by a sensor have strong semantical ties to a certain part of the structure. The MonArch approach thus resembles a view on the set of documents as preferred by most practitioners.

Conventional archives have to deal with several other common problems digital archives can provide a solution for:

- The documents themselves are of value; frequent use may cause marks, wears and damages.
- Sometimes even inventory numbers are missing.
- Even if an archive is well organized, search queries are rather restricted and only possible along a single dimension of description.

Summing up, it can be stated that the current situation of conventional archives is mostly difficult and a lot of effort is needed to find the information one is looking for. Digital archiving systems, like MonArch, can make a contribution to improve the described situation above.

This paper is organized as follows. Section 2 gives an overview of the MonArch Digital Archiving System and its features. Information storage and retrieval are detailed in Section 3 and 4. In Section 5 the long-term preservation workflow is described. More information on the web-based architecture of the MonArch Digital Archiving System can be found in Section 6. Selected use cases as well as selected partners and users are

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addressed in Section 7 and 8. The paper concludes with a summary in Section 9.

2 MONARCH AT A GLANCE

2.1 MONARCH ARCHIVES

The MonArch Digital Archiving System is a metadata repository used for the spatial capture, semantical tagging, management and storage of digital documents.

It is an information and documentation system for storing and managing any type of document; all file formats are supported. For example, CAD documents, digital maps, text documents, audio and video files can be stored and semantically described. The MonArch archiving system combines semantical, relational and GIS functionality and supports a keyword search [3].

2.2 MONARCH FEATURES

The software has a client-server-architecture, which supports a multiuser-environment. In addition, a server-side user authentication and a local management of access rights are integrated in the MonArch system.

Standalone archives can be connected using a peer-to-peer-connection and can build a network of autonomous digital archives. This way, information distributed over more than one site can be retrieved by a single query.

The MonArch Digital Archiving System also provides an easy-to-use web access, which allows for reading access to existing MonArch archives via the Internet.

3 INFORMATION STORAGE

3.1 TYPES OF INFORMATION

In general, three different types of information can be stored in a digital MonArch archive:

- **Documents** like digitized maps, photographs, text documents but also climate data and stream-based data.
- **Metadata**, which can be manually attached by the user or extracted automatically. It is possible at any time to add new metadata or edit the metadata attached to a document.
- **Navigation maps**, i.e., digital graphics or pictures that can be used for visually navigating through the building or site. Navigation maps may contain any number of geometrical objects, representing e.g. walls, ground floor, windows, pillars etc.

3.2 SPATIAL REFERENCE

The structure of a building or site is represented in the MonArch Digital Archiving System simultaneously in two ways:

![Figure 1: Inserting any file type in the MonArch Digital Archiving System via drag & drop](image-url)
As a hierarchy of structural parts similar to a folder structure and graphically using digital drawings or plans as mentioned above (navigation maps).

The graphical geometrical objects are registered with the corresponding structural parts. As a result, both, the structural decomposition of the building and its graphical representation can be used to locate information. Inserting a digitized document into the MonArch Digital Archiving System implies assigning the document to the structure thus giving the document a spatial reference.

4 INFORMATION RETRIEVAL

4.1 ACCESS INFORMATION

The digital MonArch archives can be accessed from the office desktop, in a mobile environment or on location to look up relevant information, for example, about damages, used materials or former measures.

- The MonArch Client allows for reading and editing an archive.
- The MonArch Webclient supports reading access only.

The archiving system is a multiuser-environment allowing simultaneous access to a MonArch archive by multiple concurrent users.

4.2 SEARCH QUERIES

There are different ways to access the digitally archived information stored in a MonArch Digital Archiving System:

- Navigating through the building and selecting the structural part of interest (spatial selection).

Figure 2: A building’s structure represented in the MonArch Digital Archiving System

Figure 3: Multidimensional search queries in the MonArch Digital Archiving System
Selecting topics, which are relevant for the search. Typical topics would be, for example, the specific material used at this part of the building, e.g., marble or a specific damage located there (topical selection).

Using standard metadata for the search. For example, one can choose a certain file type and filter the set of relevant documents that way (use standard metadata).

Typing in a key word (keyword search).

The combination of the supported search strategies can be an effective and powerful tool to retrieve the desired information. The selection refines the search result, i.e., the set of relevant documents displayed.

5 PRESERVATION

The MonArch system is able to export the stored digital data together with their metadata. Important metadata like the spatial reference and the assigned topics are stored in a XMP file and, hence, preserved [4].

6 DISTRIBUTION

The web-based architecture of the MonArch Digital Archiving System offers the possibility to connect distributed MonArch archives via the Internet in different ways.

The base is usually a stand-alone archive, which is not connected to the outside world yet. The second possibility is to use Google Earth to connect existing archives [5] and thus providing a global overview of available MonArch archives.

As the most advanced scheme, a peer-to-peer connection between the digital archives even allows to retrieve information distributed over several archives.

7 SELECTED USE CASES

There is a large variety of ways to use MonArch archives:

Representing a single building like it is done for the cathedrals of Nuremberg St. Lorenz and St. Sebald. Monumental buildings like these are characterized by a deeply nested building structure and the existence of an interior and an outside section.

Representing a whole town like it is done in Bukhara, Uzbekistan, where the historic center including houses, mosques and fountains have been captured.

Representing archaeological sites like the Imperial Baths in Trier where the structure is more spacious and less regular as compared to a cathedral. For this reason, multiple elevation levels and a semantical layer structure are being used.

Representing moveable cultural heritage, like paintings, statues and furniture, using spatial information like structural assignment or geo-coordinates.

8 SELECTED PARTNERS AND USERS

Various preservation agencies, cathedral custodians, maintainers of monumental sites, archaeologists and others have contributed to the MonArch project. Selected partners and users are:

- Lutheran Parishes of St. Lawrence and St. Sebald, Nuremberg / Germany
- Cathedral St. Stephan, Passau / Germany
- Imperial Baths, Trier / Germany
- St. Kassian, Regensburg / Germany
- Francke Foundations, Halle / Germany
- Monuments and Context in Bukhara / Uzbekistan
9 CONCLUSIONS

In this paper the main features of the MonArch Digital Archiving System, an information and documentation system designed for the management, storage and retrieval of digital documents according to their semantics described by metadata and their structural position within the building under consideration, have been presented.

It has been shown how information storage (documents, metadata and navigation maps) including spatial references and information retrieval can be combined efficiently to develop a digital archiving system for cultural heritage that offers powerful functionality on the one hand, e.g., multidimensional search queries, and also supports the users as effective as possible in real-life workflows on the other one.

Another interesting workflow that has been designed concerns long-term preservation, which allows for exporting stored digital data together with their metadata and saving the objects of cultural value from a loss in this way. As a second interesting feature, distributed MonArch archives can be connected using the web-based architecture of the MonArch Digital Archiving System and share their content and also knowledge as a matter of fact.

Of course, the MonArch Digital Archiving System will be developed further. Currently, research is done towards the automatic extraction of metadata from documents and on the three-dimensional modeling of buildings and sites.

ACKNOWLEDGEMENT

The MonArch Project was supported by the Deutsche Bundesstiftung Umwelt (DBU) and has been funded by the Deutsche Forschungsgemeinschaft (DFG).

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Split, Croatia 2012
May 29 - June 1
International Conference on
Cultural Heritage Preservation
CULTURAL HERITAGE INFORMATION SYSTEMS. RESEARCH RESULTS FROM INTERVIEWS, WORKSHOPS, SURVEYS AND BIBLIOGRAPHIC STUDIES

Rand Eppich,1 Isabel Rodriguez-Maribona2, Alessandra Gandini3, Barbara Vodopivec4

ABSTRACT: Europe is diverse and complex – and its built cultural heritage reflects this. Millions of buildings, archaeological sites and city centres exist from Predjama Castle in Slovenia to the historic core of Edinburgh, Scotland. This is one of Europe’s many strengths; however this diversity and complexity make the management of information concerning these resources a difficult task. In order to better manage Europe’s Cultural Heritage it is necessary to understand the current state of information systems and how they are used. To meet these aims as well as those of the project three streams were researched. This research will allow a better understanding of how current systems are used, who uses them and how they function. This in turn will then allow for better final recommendations for improvement in the management of Cultural Heritage. The three streams are:

1) Government officials and decision makers who use information systems at the State, Regional and Local levels. This was accomplished through workshops, individual interviews and detailed questionnaires.

2) Professional end-users of information systems. This was done by developing and promoting an Internet survey.

3) Existing research. This was done through bibliographic research and compiling and editing several pre-existing bibliographies.

This paper will describe the methodology of obtaining information from each stream and the final results and conclusions.

KEYWORDS: user needs, user survey, information systems, databases, professional users, bibliographic study

THEME: 1.1

1 INTRODUCTION

The aim of the EU-CHIC project is to develop a strategy and effective methods and tools to track environmental changes, “natural” deterioration processes and human interventions to Europe’s tangible Cultural Heritage, focused on monuments and structures. The final achievement of the EU-CHIC project, including dissemination activities, will be to provide new procedures, models and ideas for cultural heritage sustainable maintenance, preventive conservation, the rehabilitation as well as the standardization of criteria for future management and knowledge based decision making on these important assets. The main objective is to develop and test the guidelines, establishing the concept of European Cultural Heritage Identity Card, required for the efficient compilation and storage of data, pertinent to each monument under observation. More information can be found at www.eu-chic.eu.

2 METHODOLOGICAL APPROACH AND PRELIMINARY RESULTS

To meet the projects’ objectives a detailed research on how current cultural heritage documentation systems are used, who uses them and how they function was made. Three groups of potential EU-CHIC end-users were targeted by the research:

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• Government officials and decision makers who use information systems at the State, Regional and Local levels. This was accomplished through workshops, individual interviews and detailed questionnaires.
• Professional end-users of information systems. This was done by developing and promoting an Internet survey.
• Existing research – this was done through bibliographic research and compiling and editing several pre-existing bibliographies.

Preliminary results of each of three above mentioned research streams are given below.

2.1 GOVERNMENT OFFICIALS AND DECISION MAKERS

This was the first step in the research and the authors began by asking key questions:
How do European states, territories and cities currently manage risk to their cultural heritage? How do they collect, store, manage and use information concerning their historic places? Do they share commonalities in their methods and can they learn from one another concerning best management practices?

The objective of this research was to understand how those government agencies responsible manage and use their data, what tools they use and if they currently share data both horizontally and vertically between agencies. By understanding this, researchers can propose to policy makers, managers and information data specialists better ways to manage this risk, share data, improve their methods and avoid duplication of efforts.

Identification of key practices, methodologies and case studies was the next step. These key practices were analyzed and led to a summary of innovative and practical characteristics as well as areas of duplication and inefficient practices. Following are some of the results from this process.

Twenty-seven systems concerning cultural heritage were studied using a strict methodology and common vocabulary. Detailed data of each aspect were surveyed, analysed and then compared. Following are some interesting findings:

• The vast majority of information systems are implemented at the national level (70%).
• The longer an information system has been in existence the more data it contains on a greater number of Cultural Heritage Places; however this data is not necessarily more detailed.
• Accessibility to data remains a big question. Several of the systems studied are ‘mixed’ meaning some data is private and some data is public. Some Internet accessibility is available in only some of the systems (40%).
• Most systems are not fully computerized (80%) yet do undergo regular updates (again 80%).
• Location is a key factor with over half the systems surveyed utilizing a geographic information systems or some type of national code. This is important when designing a new system or in combining systems.
• State of conservation and legal descriptions including ownership, important issues, are somewhat addressed in many of the systems.
• For the ranking of data the most pronounced aspect is a well-described location (74%) However, risk prevention is considered in just over half (57%) and restoration activities are addressed in nine cases (30%). Surveys, structure and material are, for the most part, only superficially described.
• Several important conclusions from the Concentrated Consulting Workshop of 22 experts were: the importance of identifying end-users and purpose of a universal information system. Also debated were the findings in this report as well as an appropriate information hierarchy, timeframe, details including universal coding and an accessibility policy.

Figure 1: Data ranking of 27 analysed national systems (WP2 survey)

Figure 2: Both graphs present reached level of data processing, where 4 means very well described and 1 not considered.
It is well known that better access to information leads to better final decisions. Therefore, in order to know how and who the potential end-users were for such a pan-European information system an Internet survey was conducted. It can be found at www.surveymonkey/s/euchic. This survey was promoted through professional channels, the partners’ contacts and is semi-random in nature. It was deemed unnecessary to conduct a random survey as the current survey could reveal the needs of end-users sufficiently.

While the survey was conducted quite late in the schedule of the project and results are very preliminary nevertheless some interesting results have begun to appear. The survey will continue to run and collect data for several more months after this research. The paper will be updated to reflect more current data at the time of the Conference and publishing.

The questions were divided into three categories (All responses were kept confidential)
1) Background - in order to understand who was completing the survey.
2) Informational - to understand how the users are currently using data
3) Event – to gather data about how respondents viewed such a system and standardization of data, the importance of various types of data and feasibility.

Some samples of the questions asked include:

- **Background questions**
  1) What is your background?
     A) Engineer,  
     B) Architect,  
     C) Conservator,  
     D) Computer Scientist,  
     E) Public Administrator,  
     F) Site Manager,  
     G) Consultant,  
     H) Tour operator,  
     I) Public,  
     J) Other
  2) Are you responsible for the direct ‘hands-on’ management of cultural heritage? (This includes everything from a single monument to a cluster of monuments or region)  
     A) Yes,  
     B) No

- **Informational Questions**
  9) How do you currently manage the information concerning the places you work on or manage?  
     A) Paper files,  
     B) Local computer system,  
     C) Mixture of digital records and paper records,  
     D) Human knowledge and experience,  
     E) Data on the Internet  
     F) National online register
  10) Do you use an information system or database regularly?

- **Event Questions**
  17) If there were such a system who do you think would use it the most?  
     A) Regional government,  
     B) National government,  
     C) Consultants,  
     D) Tour operators,  
     E) Public

While very preliminary, the current findings are interesting and include:
1) The majority of users of information systems work across more than one European country.
2) Most of these users are in favour of better pan-European information systems and standards
3) The largest beneficiary to a Cultural Heritage Identity Card system would be the National governments of the individual states.

The current response rate is very low considering the survey was only launched late in the project. However it is essential to understand the professional end-user. The survey will continue to run through the project and these findings will be updated over time. These questions along with the other two streams of research will be used as justification for the EU CHIC project but also will feed into follow-up research and other such projects.

Other interesting responses include almost 72% of respondents work internationally (not only in one country of Europe) and almost 60% work throughout Europe on a regular basis.

### 2.3 EXISTING RESEARCH

There have been many research projects in this field as technology to record, document, monitor and manage cultural heritage has progressed. In order to understand the state of the field and past efforts the authors compiled a bibliography and researched other past projects as well as current projects.

The goal of compiling a bibliography is to understand the ‘state-of-the-art’ as well as the history of similar projects. The idea is not to create a complete in-depth reference but a working tool that can be added to.
changed and used during the EU-CHIC project - A tool that can inform the process of the EU-CHIC project. Just as information technology changes and advances so does the concept of a bibliography. Therefore a bibliography must be a living document; with elements added and subtracted on a regular basis by all partners in the project. Even though these changes have occurred the project bibliography is still essential. It provides the basis for research and informs the investigators. It also gives those who follow information in a neat and well packaged form, assisting them in the future. It will give them a ‘head start’ in their own work and inform them of the EU-CHIC project.

The development of a bibliography entails many stages. The first stage is a grand collection of material and information including previous bibliographies. Since there are so many references how does one select what to include? What is relevant? The answer is to collect materials wider than the stated scope – to keep in mind the objectives of the project but also not create artificial limits; otherwise important information may be overlooked. In this bibliography materials were selected from outside Europe as well as older information. These two areas outside the scope of the EU-CHIC project are important as many countries and regions are struggling with the same issues. In the second stage this collection then needs to be reviewed, sorted and analyzed for the stated purposes - narrowed down. The third and final stage is further review and detailed reading followed by abstraction and dissemination.

The bibliography is currently in the first stage and additional material will be added from all members of the consortium. For purpose of management it has been organized in to the following sections: Technology, Policy/Theory and Previous Bibliographies. These are not clear divisions but serve to help organize the mass of information available. To the future reader: Please if you have any additional texts please notify the project organizers and these references will be placed into the bibliography. Caveats include a heavy dependence upon English as most technology material is in this language and every effort was made to ensure complete data although some dates and titles are missing. Books, academic publications, periodicals, on-line information, unpublished thesis, trade publications and personal contacts are included, yet always with an eye on the validity of the source.

3 CONCLUSIONS

Basic aim of the research activities presented here and carried out in the framework of the EU-CHIC project was to better understand the current state of information systems and how they are used. While the survey on existing documentation systems in European and neighbouring countries has been already made and analysed, the end-users survey and existing research overview are still ongoing. However, authors expect, that in the following few weeks’ survey will provide firm arguments and directions on how to align the methodology of the EU-CHIC system in order to meet end-user needs. End-users survey is also used as a toll to activate and approach the EU-CHIC Advisory Network, and then to examine and analyse the reaction of the targeted audience (ministries, companies, local authorities etc.). In addition, survey results will offer well-founded arguments and guidance in elaborating potential future research priorities of the field, in particular, through devising a common Meta data baseline approach or how cultural heritage standards, and related survey and data gathering processes, could be considerably influenced by the EU-CHIC findings.
INTEGRATED DOCUMENTATION PROTOCOLS ABLE TO SUPPORT DECISION MAKING PROCESS IN CULTURAL HERITAGE PROTECTION

Anastasia Koussi1, Maria Karoglou2, Kyriakos Labropoulos3, Asterios Bakolas4, Antonia Moropoulou5

ABSTRACT: Documentation on cultural heritage assets is an indispensable part of the overall monument protection. Sustainable conservation and management is not possible to achieve in the absence of a detailed record that helps identify a monument's history, architectural attributes, preservation state and its possible alterations during its entire lifetime. This complete record of data is built upon certain documentation procedures, encompassing all parameters regarding a monument/building, upgrading the current documentation methodologies and corresponding to criteria and indicators for risk assessment as well as advanced diagnostics and data management. The integrated documentation protocols developed can constitute a solid basis for any knowledge-based decision making process on determining priorities of Cultural Heritage protection.

KEYWORDS: cultural heritage, monument documentation, risk indicators, decision support

THEME 1.1

1 INTRODUCTION

Monuments preservation depends highly on compilation, exploitation and management of data relating to a monument's entire lifetime. This process is often proven to be difficult and complicated to achieve due to the great variety of existing available information, regarding both the building and the possible solutions of conservation materials and interventions, taking into consideration other parameters as well (economic, social etc), affecting the decision making and depending on different weight factors each time. In this framework, the EU-CHIC project [1] has been initiated introducing the concept of the “Cultural Heritage Identity Card”, setting up a new methodology for integrated documentation and storage of information on immovable heritage objects across European and neighbouring countries. This concept can be used as an essential background for the knowledge-based decision making procedures on determining priorities of Cultural Heritage protection.

2 INTEGRATED DOCUMENTATION PROTOCOLS

2.1 BASIC STRATEGY

It has become obvious that there exists no established unified documentation procedure for cultural heritage. The aim was to develop criteria and a methodology for the creation of a model system for integrated documentation, considering indicative parameters of data documentation, implementing national, European and international regulations. The intention was to evaluate successful and promising models and tools and to advance to the development of a common pan-European methodology governed by the existing European standards and codes.
2.2 DOCUMENTATION METHODOLOGIES UNDER CONSIDERATION

During the first stage of this work a survey was conducted upon the existing documentation protocols in the sector of cultural heritage protection in European and neighbouring countries. The aim was to assess the current state-of-the-art in this field, evaluating the existing documentation methodologies employed and learning from them, in order to achieve a more integrated and general approach. Twenty-three information systems regarding documentation and risk assessment methodologies for cultural heritage from eleven European countries were studied and analysed (Belgium, Czech Republic, Germany, Greece, Italy, Luxemburg, Malta, Poland, Portugal, Slovenia, Spain) and Israel. Data about cultural heritage, managed and presented by many bodies, were also surveyed providing with the international perspective, coordination of activities and standardisation. Some of the well recognised approaches are the Core Data Index to Historic Buildings and Monuments of the Architectural Heritage, the UNESCO’s World Heritage List, the European Heritage Network, the Council of Europe, ICOMOS, the Getty Conservation Institute and RecorDIM [2].

All these methodologies have been compared concerning materials’ and structural aspects, architectural, historic and aesthetic value, current state of preservation, conservation interventions etc, all aiming to document the complete history of the monument in order to draw conclusions concerning the best way to develop a hypothetically optimal procedure. In order for any new protocol for monument documentation to be effective and widely applicable it should conform to existing European Policies, standards and Directives. The main EC Policies and Directives, among those applicable to cultural heritage protection and management, with an impact on documentation are also studied and processed for the harmonisation of existing criteria and indicators of existing European standards.

Given the fact that definition of terms is a long-lasting pan-European problem due to culture, language etc, the introduction of a glossary of terms providing with common terminology was considered to be a necessary supplement to the integrated documentation protocols.

2.3 RECOMMENDATIONS FOR THE COMPILATION OF THE INTEGRATED DOCUMENTATION PROTOCOLS

The second stage of this report comprises the suggestions for the creation of integrated documentation protocols, which will provide new documentation procedures, advancing the data level in comparison to the current documentation methodologies, providing with criteria and indicators for risk assessment responding to advanced diagnostics and data management [3,4]. The selected criteria encompass all potential factors affecting the building such as a monuments history, architectural attributes, preservation state and its possible alteration during.

An integrated documentation protocol for every building should be a dynamic archive incorporating and supplying with information on the building, during its entire life-time such as [5-8]:
- Specialized building documentation
- Building materials and structural documentation
- Diagnosis techniques, methods and results documentation
- Materials and structure degradation mechanisms (decay & damage) documentation
- Environmental factors, human impact & socioeconomic parameters documentation
- Intervention works & their assessment documentation

Due to the great variety of information included, the data are organized in three levels: essential, needed and optional. Such an integrated protocol will contain basic information about the asset as well as necessary data for decision making.

2.4 SERVING THE NEED FOR DECISION MAKING SUPPORT IN CULTURAL HERITAGE

All conservation works require data availability for proper exploitation and management that can facilitate the decision making process. At the heart of this system lies the monument documentation that registers various types of monument data and can be used as a background for decision making support, providing with the criteria and parameters that enable the selection in conservation problems and help prioritize the monuments’ needs.

It becomes obvious that an intelligent decision making mechanism should be based upon multiple criteria evaluation (Multiple Criteria Decision Making) provided by the monuments documentation protocol, in order to result in the need for conservation activities. The integrated documentation protocols developed can subsequently be complemented dynamically, according to necessity of performing inspection, diagnosis and intervention works, recording and making available all data corresponding to the selected criteria that participate actively in monuments conservation decision making process, leading to knowledge-based decision making procedures.

3 CONCLUSIONS

Integrated documentation of an asset of cultural heritage is a prerequisite in any process of protection and conservation. The lack of a common methodology to document the cultural heritage that covers the overall needs of any monument or building, leads to unilateral or incomplete recording of data relating to monuments. During this process information obtained is not available for use and exploitation having not followed a standard methodology, terminology and particular methods and tools of collection, nor is it harmonised with European standards and codes. New recommendations for monument documentation need to be widely applicable to the variety and the particularity of cultural heritage, selecting and integrating common criteria that formulate
a dynamic archive, incorporating and supplying with information on the monument, during its entire life-time. Therefore an upgraded methodology for monument documentation should provide with new documentation procedures, advancing the data level in comparison to the current documentation methodologies, providing with criteria and indicators for risk assessment responding to advanced diagnostics and data management, standard documentation procedures applying same methods and tools, standardized outputs and clearly defined database entry without any further need for definition and application of a unified documentation terminology.

The proposed integrated documentation protocols serve the need to feed decision making support systems and can become a useful tool for conservation, management, strategic planning and promotion of cultural heritage.

REFERENCES

MODELS OF CREATING DOCUMENTATION IN FUNCTION OF THE RESTORATION OF DUBROVNIK

Ivanka Jemo¹, Amalija Pavlić²

ABSTRACT: Institute for the restoration of Dubrovnik leads the complex processes of reconstruction of cultural monuments in the historic centre of Dubrovnik for the last 30 years. This resulted in a significant amount of different documents. Preparation of monuments for the reconstruction includes various interdisciplinary researches. Documentation can be divided into several categories: studies, plans, architectural surveys, cultural and historical research, archeology, projects, GIS etc. Production of proper documentation is an essential precondition of any intervention in the architectual heritage. That is preliminary phase that precedes reconstruction. Various documentation has to be prepared in accordance with the scope and complexity of the renovation project. Each monument is specific for its problems and needs, therefore a phase of documentation must include different professions, as well as legal obligations, which are necessary in the reconstruction process.

KEYWORDS: documentation, preparation, reconstruction, heritage, restoration, renewal

THEME 1.1

1 INTRODUCTION

Historic centre of Dubrovnik, the City within the city walls with its nearest suburbs - Dubrovnik's urban whole was put on the UNESCO World Heritage List in 1979, as an urban complex. In the same year after, the earthquake on 15. April, the Institute for the restoration of Dubrovnik was established as specialized institution for organization and coordination of the restoration of the damaged monuments.

The systematic and long-planned restoration of monuments in Dubrovnik was also based on a special law – The law for restoration of endangered historic centre of Dubrovnik, which was introduced in 1986. It is unique law in Republic Croatia which declares the restoration of Historic centre of Dubrovnik as activity of specific common interest, and which has to be under specific professional and common supervision.

The Institute continuously functioned from 1979. till the times of the war aggression on Dubrovnik in 1991/92, when it took the complex task of renewal of the City from war damages, that additionally endangered buildings previously damaged in an earthquake.

The renewal as a concept has not been explicitly defined in Croatian constructing regulations, because it means simultaneous executing several different activities on immoveable cultural asset, with the purpose of its revitalization and reinforcement. That is set of different activities that always accompany a significant intervention in cultural property.

The preparatory is the first and very important stage of reconstruction process. It includes detailed documentation of the cultural heritage: architectural survey, archival research, conservation and restoration research, studies of the physical structure, stability and resistance to earthquakes, geotechnical testing of the foundation soil, the definition of the conservation guidelines, other specific studies etc. All that precedes the preparation of various phases of project documentation for reconstruction (specific requirements for every object, depending on the type and the scope of works). Each project is unique in reconstruction programme, because of historical complexity of the monument, new discoveries are possible, and that can even change historical picture of the origin and development of the City.

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2 SPECIFIC RESEARCH ON THE LEVEL OF URBAN AREA

After the earthquake of 1979, the goal was to revitalize urban functions and make infrastructure reconstruction through structural renewal of damaged buildings. Numerous studies and plans were made at that time. After the Homeland war surveys and studies were continuously carried out.

2.1 DOCUMENTING OF THE CURRENT CONDITION OF THE MONUMENT – THE FIRST STEP IN PREVENTIVE CONSERVATION

Record of the current state of the monument is the basis for making a variety of research, analysis and projects. Architectural surveys of the current condition are the only appropriate documents to make a replica or reconstruction of a collapsed building (in a case of natural disaster – Dubrovnik is area of high seismic risk). Institute has developed methodology for architectural surveys through the years. After the pause during the war in 1991, according to the Program, architectural drawings were made every year for a few blocks. Basic surveys of the City, whose making began in 1979, was completed in 2005. Surveys are stored in two sets of bound copies of blueprints and matrix on foil. Because of the new technical possibilities of storing the documents in digital form, as well as changes on the buildings that happened through the period of time, since 1996 the complementation and digitizing of the architectural surveys has began.

By the end of 2011 about 40% of the buildings were transferred into drawings in a digital form. The requirement of accurate geodetic data, that has to be included into architectural survey of buildings, initiated the implementation of pilot project of geographic information system of the city centre of Dubrovnik. The Institute still actively uses this approach. The Institute created documenting of war damage on stone sculptures, facades, fountains and sidewalks immediately after the destructions. Recording accompanied by photographs created exceptional documentary record of damage made by shelling soon after it ended. Because of methods adopted for reconstruction, that archive of damages is only evidence on how some parts of the City were damaged during the aggression of 1991.

After the war, the detailed architectural documentation of damaged and burnt buildings was prepared as the basis for their restoration. That included 11 burnt and highly damaged buildings and 19 locations with badly damaged stone sculpture – staircases, church and house facades, fountains and cloisters.

2.2 CULTURAL AND HISTORICAL RESEARCH

Based on experience acquired on the first 10 priority reconstruction projects after the earthquake of 1979, the Expert advisory committee established a model for performing preparatory works for the restoration of monuments. Architectural survey of the existing state is the first phase of making documentation. It also contains archival research on the object. At this stage, conservatory instructions for necessary test excavations, as well as archaeological research in object and around it, are given. Preliminary conservation studies and investigative research probes were required for all buildings and urban areas in the Reconstruction programme of the Institute until 1990. The necessary archaeological research has been preformed during the construction works, because the remains of the previous phases of the City exist below the foundations. Reports of these studies are individually archived with each object. Institute possesses 57 conservation studies made for buildings in historic core and wider area, according to the Program of rehabilitation after the earthquake.

2.3 RECONSTRUCTION PROJECTS

The reconstruction after earthquake predicted reinforcement and repairs of the damaged structural system of the monuments and included their complete revitalization and purification of the recent, inadequate interventions. It often required change of use of some buildings, because they could not be restored to their original residential purpose. That complex process of rehabilitation of the monument required creating of projects in phases.

Based on architectural survey and conservation studies, future usage of the object was specified with preliminary design. Next phases of project documentation solved reinforcement of the building, installations, as well as obtaining building permits and were basis for execution of the works. The change of use of some residential buildings increased amount of spaces used for public purposes. City gained scientific library, public library, 7 museums and other public spaces. Simultaneously the housing for tenants who wanted to permanently move out of the historic City centre was built in the near town areas. Dwellers who wanted to come back after the restoration works were given replacement apartments into the City. Three groups of specific projects for reconstruction were made after the war:

- Project documentation for the burnt palaces was made in all phases to the detailed projects for the permit and performing of works.
- Documentation for reconstruction of damaged stone facades; pavements and fountains included detailed architectural surveys, photo documentation and bill for reconstruction. Since the reconstruction was limited, local department of conservation gave approval.
- Documentation for repair of damaged roofs included bill and photo documentation, while actual state was determined upon access with scaffolds. Roofs are usually returned into original state.

Projects of seismic reconstruction required special kind of documentation. They include works of injecting of external load-bearing walls and the installation of tie rods. Those works were made for blocks in which the inhabited buildings were most damaged in the earthquake. This structural repair approach has been carried out continuously since year 2000, as a
continuation of structural repair after the earthquake, and all necessary approvals, including building permits, have to be obtained.

Recently (for all capital projects – Bishop's palace, rector's palace, church of St. Blaise) an analysis of the resistance of the structure to various earthquake intensities were made, to get input parameters for the projects of constructive rehabilitation. Based on these findings, optimal recovery methods were found that minimally changed the structure of monument. New constructive renewal projects abandoned reinforced concrete slabs, and introduced new solutions. They are reversible and less aggressive to the monument's structure – usage of steel, wood, and carbon fibers.

Institute's archive possesses documentation for 49 restored buildings before 1991, 20 of which are the most important buildings in the City. After 1991, 9 construction projects for burned palaces, with all previous studies, were archived, as well as projects for renovation of palace on the Gundulić square, Bishop's palace, church of St. George on Pile, church of St. James on Višnjića, repair of facade of church of St. Ignatius, infrastructural project of historic sewage in Strossmayer street, reconstruction projects for public areas: holes on Bošković square, projects for reconstruction of war damaged stone-elements. In recent years a complete documentation for performing works was made for church of St. Cross on Upper Kono, church of St. Blaise.

2.4 UNREALISED RECONSTRUCTION PROJECTS

32 complete projects for reconstruction were made before war, but never realised. They included 14 buildings within the city walls that required reparation from serious damage caused by the earthquake.

An international architectural and urban public tender was conducted for archaeological site in Pustijerna, and the chosen works presented residential and urban area with 25 flats. Project for Archaeological museum and art centre were produced for devastated former monastery complex of St. Mary and former Government building. It has not been completed because of the associated archaeological research and the large number of dwellings.

Preparatory documentation, including restoration projects, was made for four summer residences in Rijeka Dubrovačka.

3 CONCLUSIONS

All described documentation is a great professional resource that is held by Institute. It is used in many ways: as documentation for current restoration projects, citizens use it for resolving property rights or adaptation of their housing. Students and experts of various fields use it for seminars, research etc. The quantity and variety of documentation requires a specific expert guidance that is the reason why the Institute has a technically educated employee. Great quantities of paper documents stored in three archives within the Institute require the fire detector sensor and the gas extinguish system that was installed to protect them.

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RECONSTRUCTION OF MONUMENTAL PAINTING OF THE CHURCH ON NEREDITSA HILL IN THE CITY NOVGOROD THE GREAT

Tatyana V. Laska, Irina V. Tcymbal, Yulia A. Petrova, Sergey V. Golubkov

ABSTRACT: There are many architectural monuments and old relics, the restoration of which is an unrealizable task. This may be due to the great amount of hard work to be done, complexity of the work, lack of information about the object and other reasons. In such cases, the virtual reconstruction is an effective tool.

KEYWORDS: Virtual, Reconstruction, Restoration, Monumental, Painting, Architectural, Cultural, Heritage

THEME 1.1

1 INTRODUCTION

Saint-Petersburg State University developed a method of restoration of partially or completely lost monumental paintings. As an example and a practical application of new technology there was completed the virtual reconstruction of fresco paintings of the Church of the Transfiguration of Our Saviour on Nereditsa Hill.

The church was almost completely destroyed during the Second World War. It appeared to be possible to reconstruct an architectural view of the church according to the old drawings, but rare frescos of the XIIth century had been irretrievably lost. The extant parts of frescoes consist of 325,000 pieces. Although they are being on restoration now, but this work is still far from completion. In this case the method of computer-based reconstruction is much more efficient, it helps us to avoid mistakes and find a compromise decision on the issue of reconstruction or restoration of the object.

2 THE NEREDITSA PROJECT

The “Nereditsa. Link of Times” research project currently takes place under development in the St. Petersburg State University. Major museums and cultural institutions, such as: the State Russian Museum, the State Historical and Architectural Reserve-Museum of Novgorod the Great, the Institute of History of Material Culture of RAS, and Ilya Repin St. Petersburg State Academic Institute Of Fine Arts, Sculpture and Architecture take part in this research.

The project is dedicated to a unique monument of ancient architecture and art, the Church of the Transfiguration of Our Saviour on Nereditsa Hill. In 1992 the Church of the Transfiguration of Our Saviour on Nereditsa Hill was included into the UNESCO World Heritage List, along with several other monuments of Novgorod the Great and its surroundings [1].

The Church on Nereditsa Hill is one of the most famous monuments of ancient Russian culture. It was built by Prince Yaroslav Vladimirovich’s order in 1198 and a year later, in 1199, its interior was decorated with fresco paintings. Exceptional art value, unusual unique iconography of monument has earned it a worldwide fame.

Figure 1: A three-dimensional model of the church Spas-na-Nereditse (virtual restoration, provided by department of information technologies in arts and humanitarian sciences SPbGU, completed by S.V. Shvemberger and E.V. Logdacheva in 2009).

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Like the Saint Sophia Cathedral, representing the XI century, and the St. George Cathedral of the St. George’s Monastery, representing the early XII century, the Church on Nereditsa Hill is considered to be a typological and stylistic architectural standard of the late XII century [2].

During the Second World War, the temple was almost destroyed. Only half of masonry and 15% of frescoes were preserved. According to old drawings it was possible to restore an upper part of walls, arches and dome, but the rare frescos which had covered the entire church until the twentieth century, have been irretrievably lost [3].

Archival material contains of:
- preserved fragments of frescoes;
- photos interior of the temple;
- detailed descriptions of the monument, made by experts from the State Historical and Architectural Reserve-Museum of Novgorod the Great and historians from Saint-Petersburg State University;
- copies of frescos, carefully preserved in the State Russian Museum.

In combination with modern technologies these materials provide a unique opportunity for a virtual revival of the lost masterpieces of ancient art-frescos of the Nereditsa Church.

The Church of the Transfiguration of Our Saviour on Nereditsa Hill has been an object of scientific art research at St. Petersburg State University for many years. As a result, a lot of research materials about the history of the church, its architectural features and frescos have been collected. Scientific research of this monument has been provided at the St. Petersburg State University, Novgorod State Museum, and State Russian Museum for several years.

Saint-Petersburg University and Russian Archaeological Society organized in 1910 the first expedition. After the architectural restoration in 1903-1904, a number of scholars, including M.I. Artamonov (M.I. Artamonov. 1939), turned to studying its paintings. After being almost destroyed by the Nazis, the Church was restored in 1958, and researcher’s attention was again focused mostly on the architecture [5].

Many thousands of fragments of frescos have been collected during restoration, architectural and archaeological work. At present, they are kept in museum collections. It does not seem possible to restore the fresco decoration in its original form [6]. But using methods of virtual restoration, we can achieve significant results in solving this problem. Three-dimensional graphics technology, art modelling and virtual reality provides artistic reconstruction of the lost (partially or completely) cultural heritage with any specific scientific precision.

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Documenting Hotel Palace in Portorož

Jon Grobovšek

ABSTRACT: All the activities throughout the recording of the existing state of Palace Hotel, that were needed because of the planned major interventions at the building and the surrounding area, are dating back to year 2004. Timetable of renovation has dictated the gradual implementation of the various stages of documentation. Methods of documenting and final results were harmonized between performers of measurements – Geodetic Institute of Slovenia, owner – Istrabenz Hoteli Portorož d.o.o., users of measurement results – Restoration Centre, architects – SVA Arhitekti and API, and building contractors – Kraški zidar before the start of the recording of the existing situation and during the implementation of interventions at the Palace. Handheld surveying, geodetic surveys and photogrammetric data capture were used for making plans of the state. For execution of specific part of recording, we chose the most suitable method. During the work we compared different methods and their results, and we constantly updated and coordinated them. Graphic documentation project of the Hotel Palace is the result of making graphic documentation of the culture monument with the participation of various professions and all those involved.

KEYWORDS: Cultural heritage, Hotel Palace, documenting, measurements, preventive recording, photogrammetry

THEME 1.1: Documenting cultural heritage – history and innovation

1 INTRODUCTION

Hotel Palace is one of the most important buildings in Portorož, whose appearance is dominating the close surroundings and is a strong emphasis in the panoramic view of Portorož. It was built in the early 20th century and was at that time one of the most beautiful hotel buildings on the Adriatic coast. In need of renovation hotel closed the door to visitors at the end of the last century. In 2003, the Istrabenz Hotels Portorož d.o.o., new owner of the Hotel Palace, began preparations for the reconstruction of the hotel. Owner planned different major interventions in the hotel complex. The main purpose was to preserve the image of the main building of Hotel Palace, building annex in which to install the accompanying programs and arrange the environment. Planned intervention in the entire complex conditioned extent and phases of documentation. Due to different customer’s requirements and conditions on the ground different methods of documenting have been used, of which results were mutually complementing. Quick response of the team for the implementation of measurements and data processing was important as well as preparedness for cooperation among all participants. The results of measurements were also used to control course of construction of new buildings. Renovation, reconstruction and extensions of Hotel Palace were completed in 2008. Documentation was not completed. Recording the existing situation and comparison of the situation before and after the procedure has not been performed. This remains to be done.

2 METHODS OF DOCUMENTATION

The first step to achieve the best results was the acquisition of existing plans. When reviewing the plans, the inconsistency was found regarding the existing situation. The extent and the course of documentation have been adjusted to these findings, intended interventions and the timetable. According to situation on the ground, the time available and the desired results of the investor specific methods of data capture and their final image were selected.

2.1 PHOTOGRAHMETRIC SURVEY

It was envisaged the demolition of some parts of the main building of Palace Hotel. For this reason was decided to perform preventive recording of the main
facade and the walls of important rooms. According to expressed needs of the investor, physical conditions in the vicinity of the building, the desired accuracy, and other requirements for measurements and obtaining accurate metric data on object, photogrammetry was selected as the most appropriate method. Results of the measurements were the architectural plans of facades, walls of selected rooms and simple surface 3D model of object and its surroundings (Figure 1).

Figure 1: Simple surface 3D model

2.2 GEODETIC AND HAND MEASUREMENTS
In the narrow space of the main staircase of Palace Hotel was not enough space to carry out the photogrammetric survey, therefore, geodetic and hand measurements were carried out. Geodetic measurements formed the base points of the walls of staircase. Details were supplemented with manual measurements. Accuracy was adjusted to produce plans in scale of 1:50. The geodetic control measurements of floor heights have been carried out. Deviations (up to 14 cm) in height between the existing old plans and the existing situation have been identified (Figure 2).

Figure 2: Comparison of heights of the existing situation and of old plans

2.3 ADDITIONAL MEASUREMENTS
Progression of the renovation work and planning of new interventions demanded more detailed plans. For the preparation of conservation restoration projects, it was necessary to complement the architectural plans of facades by more detailed hand measurements (Figure 3).

Figure 3: Photogrammetric plan – left, with hand measurements updated plan – right

This was followed by measuring the contours of the existing facade wall. The basis were photogrammetric measurements which were supplemented by geodetic measurements to control the movement of any facade during the construction and supplementary detailed hand measurements for the design of reconstruction interventions (Figure 4).

Figure 4: Sketch of additionally plotted contours of horizontal and vertical cuts

2.4 PREPARING FOR THE RESTORATION WORKS
An important part of documenting the current situation was probing plaster and stuccos as well as taking of samples. Restorers and conservators have reviewed the existing documentation and supplemented it with their findings. Additional measurements and thorough analysis of the materials and details were carried out (Figure 5).
For a better picture of the former splendor of the hotel Palace is gathering all available information crucial and essential basis for further research.

3 USING OF DOCUMENTATION

In the beginning, the documentation of hotel Palace was intended for collecting and preserving data on the current condition of hotel before reconstructive operations. During works was shown that range of measurements, harmonized with and ordered by the investor and carried out by Geodetic Institute of Slovenia, was indispensable, due to unforeseen events such as the destruction of the crystal hall ceiling. All further measurements were made on the basis of ongoing specific needs for complete graphic documentation. Comparison of existing plans to new survey results and additional control measurements have reduced the possibility of errors in course of design and appearance of unnecessary costs during the construction.

4 CONCLUSIONS

Experience in progressive updating of plans between works indicates that the final result is not optimal. Example of making graphic documentation of the hotel Palace confirms the fact that the architectural plans of the existing situation (including details), for monuments, buildings and areas of cultural heritage, should be made prior to negotiations and preparation of plans for intended intervention. The problem lies in the choice of methods, data acquisition and the possibility of re-interpretation the collected data. Some methods can not be repeated, results of others can be re-examined, re-processed or re-interpreted. Complementing of graphical documentation in such a complex procedure, as implemented on the Palace Hotel, is inevitable. Advantages of planned updating of the documentation are in faster acquisition of basic, rough plans, which are the basis for planning further work. In parallel, we can implement control over interventions, document the progress of works and where necessary perform additional research.

The final phase of the project of making graphic documentation on the works on the Hotel Palace is still open. Further measurements should be made of the new situation of Palace Hotel, annexes and landscaping. Only this would conclude documenting the reconstruction interventions on the object of cultural heritage hotel Palace in Portorož.

REFERENCES

METHODS, TOOLS AND TECHNIQUES APPLICABLE TO CULTURAL HERITAGE: AN EVALUATION APPROACH

Johanna Leissner¹, Constanze Fuhrmann², Emanuele Piaia³, Viktoria Piehl⁴, Jan Valek⁵, Marco Zuppiroli⁶

ABSTRACT: The following findings are based on research conducted within EU-CHIC Work Package 4, whose main objectives were to identify and evaluate existing methods, tools and techniques (MTTs) used for data collection on European cultural heritage. Building upon the work carried out during the work package, criteria and indicators were developed to assess the various MTTs currently been applied European wide. These allowed an analysis of the scope of information to be obtained by an individual MTT, the MTT’s key users, and the existence of standards for the use of an MTT. In addition, the efficiency of individual MTTs was determined, based on a set of criteria to measure their overall ‘level of difficulty’ in terms of time, financial resources and knowledge. Such an approach enabled the compilation of a ranking in terms of efficiency which has marked an important step towards integrating MTTs into the framework of the EU-CHIC identity card.

KEYWORDS: Methods, tools, techniques, data collection, cultural heritage, efficiency, evaluation, assessment

THEME 1.2

1 INTRODUCTION

The following findings are based on research conducted within the scope of EU-CHIC Work Package 4, whose main objectives were to identify and evaluate existing methods, tools and techniques (MTTs) used in Europe for collecting information on cultural heritage. Building upon the work carried out during the work package, criteria and indicators were developed to assess the various MTTs currently been applied European wide. These allowed an analysis of the scope of information to be obtained by an individual MTT, the MTT’s key users, and the existence of standards for the use of an MTT. While the scope of information has revealed the current documentation used in the various countries, the analysis of key users, and of existing standards has provided a vital insight into the professional profiles involved in heritage data management and the level of coherence in the data collection process. In addition, the efficiency of individual MTTs was determined, based on a set of criteria to measure their overall ‘level of difficulty’ in terms of time, financial resources and knowledge. Such an approach enabled the compilation of a ranking in terms of efficiency, which has marked an important step towards integrating MTTs into the framework of the EU-CHIC identity card on the basis of sound cost-benefit considerations.

In the context of the research, the terms ‘method’, ‘technique’ and ‘tool’ were defined to establish a common understanding of the terminology and to allow for a better evaluation:

1.1.1 Method
A method is a series of steps taken to perform a task. All useful and appropriate means (information / data / knowledge) that can be used to collect information about a cultural heritage item.
1.1.2 Tool
A tool is a device that can be used to produce an item or achieve a task. As an example, the tool ‘photograph’ is an important source for obtaining several types of information, such as a general description or historical development.

1.1.3 Technique
A technique is a procedure used to accomplish a specific activity or task. A technique is the way in which databases, and / or expert systems, are used to collect, store and share data.

2 ASSESSMENT OF EUROPEAN-WIDE USED METHOD, TECHNIQUES AND TOOLS (MTTs)

The evaluation process described on the following pages were preceded by an intensive research work, aiming at providing an overview of existing MTTs used for collecting data on monument documentation and risk assessment. This was done by collection information on national information systems (IS) from 11 European countries (Belgium, Czech Republic, Germany, Greece, Italy, Luxemburg, Malta, Poland, Portugal, Slovenia, Spain) and Israel and the MTTs associated with these systems. In order to compare the variety of different national systems and to provide some comparable basis for the existing variety of data managed by these IS, general categories and subcategories were proposed.

Criteria and indicators for the evaluation of the MTTs that are used for collecting information on European cultural heritage were then developed and defined. These were to address two main goals: firstly, an evaluation of the most efficient MTTs regarding cultural heritage, and secondly, the identification of the key users of MTTs.

2.1 ESTABLISHING CRITERIA FOR ASSESSMENT

To obtain reliable information on different usage patterns of the various MTTs and to assess their individual efficiency, a survey was conducted among the project partners by using a questionnaire which listed the MTTs used in 11 European countries and Israel and which were sorted according to general categories based on four main criteria described in the following:

2.1.1 Information to be obtained by MTTs
The individual MTTs were linked to the information categories that could be obtained by them. This linkage offered important insights into the various usage options of each individual MTT.

2.1.2 Key users of MTTs
In order to understand the usage, possibilities and limitations of the individual MTTs, it was crucial to determine who uses them. Therefore, the identification of the key users was an important aspect of the evaluation which is why the 1.) key technical users applying the MTTs and 2.) key players responsible for the storage of obtained information were established as two categories.

2.1.3 Existence of standards for MTTs use
An important aspect of the current usage patterns of individual MTTs is the existence of clear guidelines or standards. These ensure that MTTs are applied in a standardized way thus improving consistency of data collection, and allowing for a better comparison of data sets for individual heritage sites.

2.1.4 Difficulty level of MTTs
In order to determine the efficiency of individual MTTs a core set of three criteria were established, basing on the overall ‘level of difficulty’ in terms of time, financial resources and knowledge, as well as a marking scheme of the three parameters 1.) low, 2.) medium, and 3.) high to give evidence on the ease of use and the degree of accuracy. By providing such a quantitative framework for evaluating the cost of applying an individual MTT with regard to the time taken for its use, the economic cost associated with that use, and the degree of specialist knowledge necessary, a clear statement of the characteristic properties of all MTTs could be made.

Difficulty level of using the MTTs in terms of ‘time’
This criterion assesses whether the MTTs allow the data to be obtained quickly or not. Time is an important factor in the application of an individual MTT, which is correlated to efficiency (obtainable number of heritage data per time unit) and cost (consumed time/labour cost per set of obtained heritage data).

Difficulty level of using the MTTs tool in terms of ‘economic cost’
This criterion directly assesses the cost associated with the use of an individual MTT. Given that financial resources are usually finite, lower MTT costs are normally viewed as favourable.

Difficulty level of using the MTTs tool in terms of ‘knowledge’
This criterion assesses the degree of technical knowledge necessary to proficiently use a specific MTT.

2.1.5 Translation of criteria into questions
The questionnaire translated the developed criteria into the following set of questions (the indicated columns refer to the survey layout)Is the category of data used in the country?
- Is the category of data collected important for the cultural heritage identity card?
- Are the MTTs used in the country?
- Who is the technical figure that uses the MTTs in order to obtain the data?
- Are there any guidelines for using the MTTs?
- Difficulty level of using the MTTs in terms of time.
- Difficulty level of using the MTTs in terms of economic cost.
- Difficulty level of using the MTTs in terms of knowledge.
- Are the MTTs needed for implementing and developing the identity card?
- Who is responsible for the data?
- Is there a database for data collection?
- Can the data obtained be shared and made public?
Some of the categories such as the category of data and the listing of MTTs included the results from previous research work.

3 EVALUATION OF THE DATA COLLECTED

The determination of the efficiency of individual MTTs by establishing criteria and indicators for their selection has been one of the key evaluation objectives of the EU CHIC project. Therefore, special emphasis was laid on interpreting the three difficulty levels in terms of time, economic cost and knowledge. Against this background, answers given to these parameters were transformed into numerical values in order to create a valuation system for assessing the properties of the MTTs and therefore the most important MTT at the end.

By applying such a mathematical model, an overview of the level of difficulty in addition to the efficiency of the different MTTs could be gained as key result.

3.1 QUANTITATIVE EVALUATION OF THE OVERALL ‘LEVEL OF DIFFICULTY’

By providing a framework for evaluating the cost of applying an individual MTT with regard to the time taken for its use (the economic cost associated with that use) and the degree of specialist knowledge necessary, an overall ‘level of difficulty’ could be determined for each MTT. It offered important insights into the usability and the associated cost of each MTT (see figure 1 below):

<table>
<thead>
<tr>
<th>MTT</th>
<th>Overall level of difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photographs</td>
<td>0.14</td>
</tr>
<tr>
<td>Inspection in-situ</td>
<td>0.18</td>
</tr>
<tr>
<td>Cartographic and topographic plans</td>
<td>0.24</td>
</tr>
<tr>
<td>Existing diagnostic survey</td>
<td>0.28</td>
</tr>
<tr>
<td>Classification and condition</td>
<td>0.31</td>
</tr>
<tr>
<td>Risk maps</td>
<td>0.33</td>
</tr>
<tr>
<td>Sample testing</td>
<td>0.36</td>
</tr>
<tr>
<td>Management plans</td>
<td>0.37</td>
</tr>
<tr>
<td>Documentary archive research</td>
<td>0.39</td>
</tr>
<tr>
<td>Visual inspection</td>
<td>0.39</td>
</tr>
<tr>
<td>Drawings</td>
<td>0.39</td>
</tr>
<tr>
<td>Formal analysis</td>
<td>0.39</td>
</tr>
<tr>
<td>Technical analysis</td>
<td>0.39</td>
</tr>
<tr>
<td>Historical plans research</td>
<td>0.4</td>
</tr>
<tr>
<td>Photo X-Ray</td>
<td>0.53</td>
</tr>
<tr>
<td>Destructive testing</td>
<td>0.64</td>
</tr>
<tr>
<td>Photogrammetry – terrestrial and aerial</td>
<td>0.67</td>
</tr>
<tr>
<td>CAD – Drawings</td>
<td>0.67</td>
</tr>
<tr>
<td>Analysis – Maps of specific values</td>
<td>0.67</td>
</tr>
<tr>
<td>3D Laser scanner</td>
<td>1</td>
</tr>
<tr>
<td>Laser cleaning</td>
<td>1</td>
</tr>
<tr>
<td>Energy efficiency analysis</td>
<td>1</td>
</tr>
</tbody>
</table>

Figure 1: Selection of surveyed MTTs in terms of the overall level of difficulty value

3.2 QUANTITATIVE EVALUATION OF THE OVERALL ‘LEVEL OF EFFICIENCY’

The efficiency of an MTT had been defined as the product of the overall level of difficulty and its perceived relevance. This evaluation allows the surveyed MTTs to be ranked according to their level of efficiency. The following table illustrates this ranking to reveal the MTT “photograph” as the most effective, and the MTT “Ground Penetrating Radar” as the least efficient (see figure 2 below):

<table>
<thead>
<tr>
<th>MTT</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Photographs</td>
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</tr>
<tr>
<td>Classification and condition</td>
<td>0.31</td>
</tr>
<tr>
<td>Proper maintenance schedules</td>
<td>0.37</td>
</tr>
<tr>
<td>Management plans</td>
<td>0.37</td>
</tr>
<tr>
<td>Condition assessment report</td>
<td>0.37</td>
</tr>
<tr>
<td>Documentary archive research</td>
<td>0.4</td>
</tr>
<tr>
<td>Historical plans research</td>
<td>0.4</td>
</tr>
<tr>
<td>Risk assessment</td>
<td>0.47</td>
</tr>
<tr>
<td>Visual non-destructive inspection</td>
<td>0.49</td>
</tr>
<tr>
<td>Destructive testing</td>
<td>0.64</td>
</tr>
<tr>
<td>Dendrochronology</td>
<td>0.64</td>
</tr>
<tr>
<td>CAD - Drawings</td>
<td>0.67</td>
</tr>
<tr>
<td>Visual destructive inspection</td>
<td>0.68</td>
</tr>
<tr>
<td>Climatic data – monitoring of climate change</td>
<td>0.7</td>
</tr>
<tr>
<td>Stereoscopies/stereo photography</td>
<td>0.72</td>
</tr>
<tr>
<td>Survey and archaeological prospection</td>
<td>0.86</td>
</tr>
<tr>
<td>Station of monitoring in situ</td>
<td>0.97</td>
</tr>
<tr>
<td>Tachymetry</td>
<td>1</td>
</tr>
<tr>
<td>3D Laser scanner</td>
<td>1</td>
</tr>
<tr>
<td>GPR – Ground Penetrating Radar</td>
<td>6</td>
</tr>
</tbody>
</table>

Figure 2: Selection of surveyed MTTs in terms of level of efficiency

4 CONCLUSION

In conclusion, the quantitative evaluation of MTTs provides a useful approach on systematizing information and usage patterns which are related to European cultural heritage. With the help of this framework, insights and guidance on the crucial aspects of data collection could be gained. An overview on how the results were prepared and evaluated at the end is given below for the example ‘documentary archive research’.

Data collection in the field of heritage inevitably involves users with diverse educational backgrounds from many different disciplines. However, the analysis confirmed that architects are the principal key user group to apply MTTs, along with technicians and experts who emerge in playing a vital role. Increased grouping of interests within the different vocational fields over the last decade has also resulted in the creation of new professional roles such as building, civil and material
engineers. Following the research, this aspect needs to be taken into account in more detail.

MTTs: 09. Documentary archive research

The analysed results revealed that knowledge of cultural heritage is undeniably connected with the use of specific MTTs that have become increasingly technologically advanced and diffused. In most countries the recent use of digital cameras has become the most universal data collection tool. In this context, the comparison of photographs taken over different years allows for any alteration or change to the asset to be easily highlighted. In addition to the digital camera, which can produce immediate results for use by the individual taking the record, there are other photographic techniques such as “stereoscopy” or “terrestrial and air photogrammetry” that allows detailed information to be obtained regarding the precise analysis of contexts, such as the landscape where the asset is located. But, the participation of a specialist technician is required in this field.

The most advanced methods of obtaining data and information include the use of the “3D laser scanner” which, through a significant post-production stage, allows very high precision metric recording and three-dimensional modelling to be created.

There is substantial uniformity in the use of the MTTs even if different levels of implementation are reported. Some countries can be identified as being at the forefront in methodological analysis that positively impact on the quality of conservation and maintenance. Such an aspect of analysing the quality of the property and for assessment focus into the context within which the property is set.

In conclusion, it is important to point out that not all the cultural heritage information has the same level of importance in the various European countries. Furthermore, not all the identified MTTs were distributed in the same way. Against the background of developing a single identity card for use in all European countries, this awareness provides an important insight into attempting to fulfil the requirement that all the required data can be shared on one single platform.

ACKNOWLEDGEMENT

The project results summarised above based on the work undertaken within the scope of the work package 4 (WP4) of the EU-CHIC project. The following partners took part in these tasks:

- Fraunhofer-Gesellschaft (Germany)
- University of Ferrara research unit (Spain)
- Institute of Theoretical and Applied Mechanics, Academy of Sciences of Republic (Czech Republic)
- National Technical University of Athens (Greece)
- Labein-Tecnalia (Spain)
- Institute of Fundamental Technological Research Polish Academy of Sciences (Poland)
- Univerza v Ljubljiani (Slovenia)
- Technion Israel Institute of Technology (Israel)

REFERENCES


EUROPEAN PROTOCOLS FOR METHODS, TOOLS AND TECHNIQUES:
NEW STANDARD FOR 3D LASER SCANNER

Roberto Di Giulio¹, Marcello Balzani², Emanuele Piaia³, Marco Zuppiroli⁴

ABSTRACT: The Eu-CHIC project has demonstrated that there are several methods, tools and techniques used by the European countries in order to obtain specific data and information concerning the cultural heritage. Consequently, the technologies on which these tools are based are standardized in any country. Despite this, the protocols for the use of such instruments, instead, are only partially defined in international regulations. The aim of this paper is to examine the possibility to identify a protocol of use on important European tool as the 3D laser scanner.

KEYWORDS: Methods, Tools, Techniques, Cultural Heritage, 3D Laser Scanner

THEME 1.2

1 THE IMPORTANT ROLE AND QUALITY OF USE OF THE MTTs

The EU-CHIC project has demonstrated that there are several methods, tools and techniques used by the European countries in order to obtain specific data and information concerning the cultural heritage. Data and information of the cultural heritage that could be use for:
- Restoration works;
- Investigation of the structure and problem solving;
- Survey activities;
- Analyse of the building history;
- Evaluate the conservation state;
- Understanding characteristics and typologies;
- Knowledge of the material and its characteristics;
- Monitoring the risk assessment;
- Etc.

The analysis conducted shows that collecting information to preventive conservation, monitoring and maintenance of European cultural historical heritage is undeniably connected with the use of specific methods, tools and techniques (MTTs), that in recent years have become technologically advanced and diffuse in all countries.

In some cases thanks to the use of a specific MTT we can obtain several information concerning the cultural heritage. In other cases the MTT used is finalized to obtain specific information.

Furthermore, on the European scene, there is a substantial uniformity in the use of the MTTs, even if in some cases there are particular methods - such as 3D laser scanning - where the protocol used is different.

1.1 EXAMPLE OF EFFICIENT MTTs

The analyse conducted by the University of Ferrara group during the EU-CHIC project has allowed to determine the most efficient MTTs in terms of cost, time and knowledge.

A brief summary of the results achieved (in terms of MTT data collection, level of difficulty and level of efficiency) illustrates how “documentary archive research” is fundamental for obtaining historical and technical information on the cultural heritage.

Sub-categories of documentary archive research like the analysis of “cartographic and topographic plans” and of “historical plans” can be considered important, as other MTTs, in order to obtain geographic, landscape information and anthropic impacts or improper use.

Using “photographs” is also important; in fact, in all countries the personal digital camera has become the main tool to record the cultural heritage conservation. In this context, a comparison of historical photographs,
taken in different periods, can show the alterations of the building.

There are also advanced surveying techniques that are diffuse in the Europe countries, such as “stereoscopy”, “photogrammetry” or “3D laser scanning”.

These advanced MTTs, like others, require the participation of specialist technicians in order to obtain more detailed information.

Moreover many of MTTs imply an “inspection in situ” as only way for analysing any kind of aspect findable directly on the tangible property (e.g. formal, technical and structural analysis).

For the correct and appropriate protection and knowledge of the cultural heritage it can be highlighted the importance of using “monitoring stations” based on advanced “electronic tools” that can constantly monitor the building’s state. But also in this case, the participation of specialist technicians is required.

1.2 KEY-PLAYER AND STANDARD USE OF THE MTTs

Another important aspect concerns the use of the MTTs that involves many different operators from very different disciplines, including specialist technicians who are exclusively familiar with the specific use of a particular tool.

In many cases, the role of the architect is the most common. In others, technicians and professionals specializing in specific surveying activities have a fundamental role. However an architect usually holds the leadership in a survey. Furthermore, during the last decade, new professional figures have emerged (building/civil/materials engineer, etc.).

The analysis conducted has demonstrated also that exist many inconsistencies, among the different countries, that regard the nomenclature and the training of the technicians. For example there are similar profession for aim and role that have different titles.

On the contrary, the aforementioned MTTs are now part of the market. Consequently, the tool’s technologies are standardized in any country. Despite this, the protocols for the use of such instruments, instead, are only partially defined in international regulations. Nowadays, in Europe, there are several MTTs used in different ways and with different protocols and standard in order to obtain the same information.

The most efficient European MTTs recognized during this research could be inserted in a shared platform aimed at collecting information regarding preventive conservation, monitoring and maintenance of world cultural heritage.

This would be a platform based on well-defined shared protocols, which could allow the development of a critical analysis in many different contexts.

One of the most important result emerged from the research is the absence of one commune standard that can be implemented for the use of the tools and data storing.

For this reason the aim of this paper is to examine the possibility to identify a protocol of use of important European tool as well as the 3D laser scanner. This result will be obtained with the analysis of several case studies.

2 THE THREE-DIMENSIONAL SURVEYING

The technological evolution of the automatic survey system represent an important innovation element that consent the introduction of the morphology metric system as an essential support for the construction of the three-dimensional database.

This typology of database represents the basis of geometric memory archive of the architecture that can be used for research goals by the art and architecture historian, but can also be used for preservation, restoration and environmental protection of the cultural heritage.

In fact, thanks to the use of laser scanner technology we can obtain a large number of information, such as geometric, typology and stylistic description of the building.

2.1 THE 3D LASER SCANNER PROTOCOL

The purpose of the EU-CHIC research was to outline the European state of the art of: systems, methods, tools, techniques and kinds of analysis used to obtain the necessary information in order to develop a cultural heritage identity card that can be shared by a large number of European people (technical and otherwise).

In this context a discussion regarding specific problematic aspects related with the use of 3D laser scanner, in several European countries, developed both from the heterogeneous disciplinary framework and from the project requirements.

The level of difficulty of 3D laser scanner tool, measured in the three ways of: time, economic cost and required degree of knowledge is very high. For this specific reason it is necessary to pay attention to the method used to acquire the surveying data.

This method has to be systematic and efficient in order to avoid inaccuracy, inconsistency, and human error. The main problems connected with the efficiency of this survey method are:

- Access to all areas of survey;
- Target position;
- Availability of the hardware storage capacity for large amount of information acquired during the survey;
- Post-processing of the acquired data;
- Establishment of a database organized by individual architectural elements integrated with a description of additional data;
- Concept of open data packet;
- Management of the outgoing flow of information (by server infrastructure);
- Management of the flow of feedback information (complete with the cad drawings);
- Editing of the final drawings delivered.

Before developing the standard operating procedure and performing it, it’s necessary to answer the following questions:
1. When, where, how and by whom the three-dimensional metric model (derived from 3D laser scanning) can and should be used?
2. What degree of flexibility should be considered acceptable within this operation?
3. Do you think that the data packet obtained from 3D laser scanning should be updated over time?
4. What degree of precision and accuracy should be perceived in order to grant a good and usable result?

CONCLUSIONS

In this context it becomes essential to establish a European standard use of the 3D laser scanner. Protocol and standard of use that will be share, to the all Countries and applicable during the survey of different typologies of cultural heritage.

REFERENCES


ABSTRACT: The following paper will show some of the unique projects and outstanding technical achievements in 3D spatial data acquisition and imaging. With the use of sophisticated 3D laser scanning systems, we will show a short summary of years of experience in cultural heritage virtual preservation. From the Palaeolithic caves to the medieval churches, our cultural heritage is now recorded better than ever, giving us the opportunity of better understanding of the past environments.

KEYWORDS: 3D laser scanning, architecture, archaeology, statues, reconstruction

1 INTRODUCTION

The need for faster, more detailed, precise and accurate representations of the spaces and objects as virtual reality became a great challenge in the development of spatial data acquisition systems. The following paper will show some of the unique projects and outstanding technical achievements in 3D spatial data acquisition and imaging. Our project samples are related to the use of sophisticated 3D laser scanning systems – Optech ILRIS 3D, Z+F Imager 5006i and Z-scanner 800. Using the technology of long and mid range 3D laser scanning, we are concentrated in the full virtual preservation of various historical buildings and archaeological sites. On the other hand, 3D micro scanning has been of great value in reconstructing broken pieces of architectural elements, statues and even pottery fins from archaeological excavations. Examples shown here are a short abstract of years of experience in cultural heritage virtual preservation.

2 LONG AND MID RANGE 3D LASER SCANNING

2.1 WHERE NEANDERTHALS LIVED

As a result of new 3D laser scanning technology we created a project related to a valuable archaeological site of the cave Vindija. The raw precise model of the exterior and interior of the cave has a multifunctional purpose. First of all there was an immediate need for preserving the cave from future devastation. From an architectural point of view some elements of construction had to be fitted into this natural site. For instance, a protective rail fence had to be designed. Geologists, archaeologists, architects and speleologists were just some of the experts that gained interest in this detailed 3D model. Periodical 3D scanning and analysis of the same cross sections can show what is happening to the cave in geological and geographical sense.

2.2 MEDIEVAL PUZZLE

During two seasons of archaeological excavations (2007 – 2008.) on the southern plateau of the parish church of the Blessed Virgin Mary, the ruins of two earlier

Figure 1: 3D model of cave Vindija interior
churches were discovered. The massive foundations of both churches were heavily destroyed as a result of geotectonic disturbances. The older church (mid-13th century) was destroyed only a century after it was dedicated, due to the earlier mentioned geotectonic disturbances. However, the Paulines decided to build another church on the same ground. During the 15th century, the church sustained great damage, again as a result of geotectonic disturbances. Yet again, a new church (the one currently standing), with a monastery complex was built using the foundations of the two previous churches for support. Since the foundations were greatly damaged and shifted towards the southern and eastern slopes of the plateau, reassembling for proper interpretation was needed.

Laser scanning has been shown to be the only method possible for the precise reconstruction of the damaged foundation problem of the churches. This method helped reconstruct this medieval puzzle with its outstanding characteristics and versatility. It helped in proving the geometrical facts of two historical churches and bringing the broken pieces of history back together.

2.3 SURVEYING ARCHAEOLOGICAL EXCAVATIONS IN AQUAE IASAE

In 2011, the thermal pool at the Forum of Aquae Iasae (today Varazdinske Toplice) was pumped out to reveal magnificent archaeological findings, from coins to statues. Since the pool was to be filled back with thermal water, 3D laser scanning monitoring of the archaeological excavations was the best solution for preserving immobile finds. Walls, wooden pillars and the complete architecture of the pool are now virtually available at any time for scientists to explore.

3 3D MICROSCANNING

3.1 APOLLO BACK ON HIS FEET

During archaeological excavations of the pool in Aquae Iasae, among other finds, the fragments of the statue of Apollo were found. Seven pieces that were excavated were scanned with a micro scanner just a few days after the find and immediately virtually pieced together. A very quick reconstruction with no mechanical impact on the pieces enables us to preliminary represent the finds in an attractive way, providing a new aspect of museum presentation.

4 CONCLUSIONS

Both laser scanner instruments and 3D data software are in continuous development. The technology is still new and it takes time to educate and encourage the market to accept the new dimensions of 3D laser scanning data representation and collect the benefits, both economic and practical. The samples used in this article are real projects that show that the market is ready, followed by fact that all the deliverables were well accepted and made significant push in comparison to conventional
surveying methods. After long and exhaustive development in innovative data processing methods, constant hardware, software and system investment, experience showed that clients recognize the benefits while the types of project repeat. Because of its technological characteristics and benefits it marks a new era in an important segment of 3D spatial data management.

ACKNOWLEDGEMENT

The hardware and software systems and data used for this article were provided thanks to the partner companies Vektra d.o.o. and Geo3d. d.o.o. from Varaždin.

REFERENCES

IN-SITU TESTING OF HISTORICAL MONUMENTS-RECENT IZIIS EXPERIENCE

Lidija Krstevska¹, Ljubomir Tashkov²

ABSTRACT: Presented will be the methodology for experimental in-situ testing of dynamic characteristics of historical monuments by ambient vibration testing method. Natural frequencies, mode shapes and damping coefficients should be known for verification of the numerical models to be used in the analyses for evaluation of the seismic stability of a monument. Test results obtained for selected representative historical monuments tested in the frame of recent scientific project realized in IZIIS will be presented.

KEYWORDS: ambient vibrations, natural frequencies, mode shapes, damping

THEME 1.2

1 INTRODUCTION

Historical monuments are structures for which several important aspects should be considered in evaluation of their seismic stability. One of them is definition of the actual state of a monument in respect to its dynamic characteristics performed by experimental in-situ testing. The Institute of Earthquake Engineering and Engineering Seismology-IZIIS from Skopje has great experience in this field and in this paper presented are the results for several representative monuments tested in the frame of recent scientific international projects.

2 IN-SITU TESTING BY AMBIENT VIBRATION TESTING METHOD

The ambient vibration testing method is based on recording and processing of the structural response to wind and other ambient excitations. The advantages of the method is the light equipment easy for transportation and management and the fact that it doesn't affect normal functioning of the structure i.e. can be applied on structure in use. The test set-up - number and position of measured points on the structure should be done very carefully, taking into account the actual state of the monument. IZIIS' equipment consists of Ranger seismometers and/or broad band accelerometers as sensors, special software for on-line data processing and presentation of the time history records together with thr Fourier amplitude spectra of the response. Post-processing and analysis of the recorded micro-vibrations is done by ARTeMIS software having possibilities for very good graphical presentation of the obtained data.

3 SELECTED CASE STUDIES

3.1 THE CHURCH OF ST. MARY PERIVLEPTOS IN OHRID

The church of St. Mary Perivleptos is one of the most beautiful churches in Ohrid, dating from the year 1295, Figure 1. The church was tested by ambient vibration method and to obtain the dynamic characteristics 18 points were measured located on the roof, tambour, windows, beams and ground floor in both orthogonal directions. The spectral density curves and peak-picking of the dominant frequencies are presented in Figure 2. The dominant frequencies are well expressed - the resonant frequency in transversal direction is 5.08Hz, in longitudinal direction is 6.45 Hz and for torsion it is f=7.6 Hz. The first mode shape in transversal direction is given in Figure 3.

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Email: taskov@pluto.iziis.ukim.edu.mk
3.2 BEYLERBEYI PALACE IN ISTANBUL

Beylerbeyi Palace is built between 1861 and 1865 and it is used as a museum, attracting many people because of the historical importance and charming architectural features, Figure 4. The structure is mainly made of masonry walls and timber slabs. For definition of its dynamic characteristics ambient vibration measurements were performed in 24 points, namely in six points at four different levels - basement, first level, second level and level of the roof. Dominating frequencies are presented in Figure 5. The results of the experimental study have been used to tune the numerical model of the structure.

3.3 THE OLD BRIDGE IN MOSTAR

The reconstructed Old bridge in Mostar, Figure 6, was tested in 2007. The measurement of ambient vibrations was performed in 22 points of the bridge. The resonant frequencies and mode shapes for this respective monument were defined in transversal, longitudinal and vertical direction, Figure 7. The test results were further used for verification of the mathematical model used for detailed analysis of its seismic stability.

3.4 SIDONI PALACE IN CASTELNUOVO, ITALY

The measurements of this impressive monumental masonry building, Figure 8, have been performed in May 2010, within the scientific cooperation between IZIIS, University St. "Cyril and Methodius", Skopje, Macedonia, the University of Naples “Federico II” and the University in L’Aquila, Italy, for evaluation of seismic stability of this respective monument damaged during the earthquake in 2009. The peak-picking of the dominating frequencies of the monument is given in Figure 9, while the mode shape at a frequency of 5.08 Hz in transversal direction is presented in Figure 10.
4 CONCLUSIONS

Dynamic properties of the structure - the natural (resonant) frequencies, mode shapes, and damping capacity should be considered as one of the main aspects in evaluation of the seismic stability. Definition of the actual state of a monument, in respect to its dynamic characteristics, should be performed by experimental in-situ testing. These characteristics should be further used for verification of the numerical models used for analytical investigation of the seismic stability of the tested historical monuments, for increasing the reliability of the numerical approach and for correct implementation of retrofitting intervention, if any.

REFERENCES


AMBIENT VIBRATION SURVEY OF HISTORICAL MONUMENTS IN ABRUZZO REGION DAMAGED DURING THE L’ AQUILA EARTHQUAKE 2009

Ljubomir Tashkov1, Lidija Krstevska2, Gianfranco De Matteis3

ABSTRACT: The present paper provides the main results of the experimental measurements carried out for the purpose of detecting the main natural frequencies and mode shapes of three churches by means of ambient vibration tests. The studied buildings belong to the historical centre of Goriano Sicoli, a town placed in the Aquila Earthquake crater, which were seriously damaged due to the seismic event of 06.04.2009. In the first part the tested buildings are described and the main collapse mechanisms provoked by the earthquake, as well as the provisional structures which have been installed, are shown. Successively, the implemented tests and the main obtained outcomes are presented and discussed.

KEYWORDS: Ambient vibration technique, dynamic properties of historical monuments, in situ measurements, natural frequencies, mode shapes, damping

THEME 1.2

1 INTRODUCTION 123

The seismic event that took place on 06.04.2009 (3.32 a.m. local time) in the district of L’Aquila showed the high vulnerability of the existing buildings belonging to the historical centers of Italian cities. This outcome could be dated back to the medieval period and is usually referred to masonry buildings characterized by poor construction materials and scarce construction techniques. Many buildings stroked by the earthquake were used for religious rituals and were very valuable from both artistic and monumental point of view. The severe damages developed made them unusable (GRM, 2009).

After a year a huge debate is still focused on the possible recovering this type of buildings by proper structural interventions or proceed their reconstruction by using different structural systems based on application of new technologies.

2 THE STUDIED BUILDINGS

2.1 SANTA GEMMA CHURCH

Santa Gemma church (fig.1) was built between the sixteenth and seventieth century and rebuilt over the years on a site upon which initially was placed an old church devoted to St. John the Baptist.

Figure 1: St. Gemma church before the L’Aquila earthquake

The façade, constructed in the late eighteenth century, has a central part crowned with a tympanum and is higher than the lateral ones on its sides. The central nave, preceded by a space of transverse width equal to the one
of entrance facade, is covered by a barrel vault with lunettes supported by cross section masonry column connected by arches, while the lateral naves present characteristics elliptical vaults on arches constrained by ties.

2.2 SAN FRANCESCO CHURCH
In the same area of St. Gemma church is placed St. Francesco church, a masonry building perhaps dating from the twelfth century. It is probably the most ancient building in Goriano Scoli, but it has to be considered that during the successive centuries, it has been subjected to numerous changes and expansion so to include the old monastery. Currently, the church consists of a single nave, a small house that develops in longitudinal direction. The interior is empty, with a timber truss, supporting the wooden roof with two pitches, which ends on a R.C. beam built after the 1984 earthquake and placed on top of the masonry wall (fig.2). On the right side of the main façade there is a more recent building that is connected to the church by weak elements that, although not effective under a severe earthquake may influence the church response under ambient vibrations.

Figure 2: The interior of St. Francesco church

2.3 SANTA MARIA NOVA CHURCH
St. Maria Nova church (fig. 3) is the biggest religious building in Goriano Scoli. It is a Romanic church built in the fifteenth century on the surrounding wall of an ancient castle, some of its masonry elements belong to the present structure.

Figure 3: Santa Maria Nova church

The main facade of the simple flat smooth surface has a central part crowned with a small typanum. The plan shows three naves. In the lateral naves, sail vaults are present, whereas, in the central one, welsh barrel vault can be observed. Arches constrained by ties in both longitudinal and transversal direction support vaults.

3 DYNAMIC CHARACTERISTICS OF THE TESTED STRUCTURES

3.1 SANTA GEMMA CHURCH
This church was heavily damaged and it was dangerous to enter and to put the instruments from internal side. Therefore, an auto-crane with basket has been used to put the seismometers on the windows frames. The spectral density curves are presented on fig. 4. The dominant frequencies of the church are given in Table1.

Table 1 Dominant frequencies and damping coefficients of St. Gemma church

<table>
<thead>
<tr>
<th>Mode</th>
<th>Frequency (Hz)</th>
<th>Damping (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.402</td>
<td>1.42</td>
</tr>
<tr>
<td>2</td>
<td>3.027</td>
<td>1.34</td>
</tr>
<tr>
<td>3</td>
<td>3.652</td>
<td>1.07</td>
</tr>
</tbody>
</table>

Figure 4: Spectral density curves of Santa Gemma Church

3.2 SANTA MARIA NOVA CHURCH
The damage to the church was visible from the internal side mostly on the vaults. The measuring points were located inside the church near the windows. The spectral density curves are presented on fig. 5. The dominant frequencies of the church are given in Table 2.

Table 2 Dominant frequencies and damping coefficients of St. Maria Nova Church

<table>
<thead>
<tr>
<th>Mode</th>
<th>Frequency (Hz)</th>
<th>Damping (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.246</td>
<td>3.15</td>
</tr>
<tr>
<td>2</td>
<td>3.711</td>
<td>2.55</td>
</tr>
<tr>
<td>3</td>
<td>4.509</td>
<td>2.55</td>
</tr>
</tbody>
</table>
3.3 SAN FRANCESCO CHURCH

The damage to the church is slight. The measuring points were located inside the church near the windows. The spectral density curves are presented in fig. 6. The dominant frequencies of the church are given in Table 3.

Table 3 Dominant frequencies and damping coefficients of St. Francesco Church

<table>
<thead>
<tr>
<th>Mode</th>
<th>Frequency (Hz)</th>
<th>Damping (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.98</td>
<td>2.47</td>
</tr>
<tr>
<td>2</td>
<td>6.25</td>
<td>2.77</td>
</tr>
<tr>
<td>3</td>
<td>9.47</td>
<td>5.29</td>
</tr>
</tbody>
</table>

4 CONCLUSIONS

The ambient vibration measurements of selected historical buildings-churches in Goriano Sicoli, Italy, were performed in rather difficult working conditions. Out of 3, two churches were heavily damaged, with many cracks visible from the external and internal side. It was obvious that the initial stiffness of the structures was decreased during the earthquake. The measured resonant frequencies show the actual stiffness of the damaged structures. The stiffness degradation is difficult to be defined the moment because of lack of measurements before the earthquake. In that respect, the obtained data should be carefully analyzed from the aspect of dominant frequencies, mode shapes and damping. These data could also be used as referent ones for the data which will be obtained by measurements after repair and strengthening of the churches.

REFERENCES

INTEGRATION OF STRUCTURAL AND ENERGETIC NON DESTRUCTIVE DIAGNOSTICS: DYNAMICS OF AIR FLUXES BY IR THERMOGRAPHY

Camilla Colla¹, Veronica Corradetti²

ABSTRACT: Historical buildings represent an important part of the Cultural Heritage and they sum up to more than half of the buildings present in Europe. Those structures are often characterized by structural and energetic deficiencies because of the poor or lack of maintenance. NDT can provide a great aid to the knowledge of the building. Numerical evaluations need great deal of precise experimental data. In addition, about techniques applicable with energetic aims and there is no experience of possible limitations when applying them on historic buildings where the uncertainties are many more. In an effort to further develop existing diagnostic techniques and testing procedures, in this work an IR thermography experimental application is outlined for the purpose of dynamically tracing air movements in an indoors environment. By using paper stripes hanging from the ceiling, it was possible to survey the air temperature at different heights, in different climatic conditions and to obtain horizontal and vertical temperature maps of high precision.

KEYWORDS: Structural diagnostic, energetic diagnostic, historic building, IR thermography, air fluxes

THEME 1.2

1 INTRODUCTION

Historical buildings represent an important part of the Cultural Heritage and they characterize in a unique and un-reproducible manner the societies to which they belong. They sum up to more than half of the buildings present both in Europe and in Italy. Thus to safeguard this richness it is a duty of each citizen.

Those structures are often characterized by structural and energetic deficiencies because of the poor or lack of maintenance in the course of the years and the difficulty in doing interventions on listed buildings subjected to strict constraints.

Nonetheless, it is necessary to carry out analyses and interventions so that the high inefficiency and decay, which distinguish these buildings, prevent from transforming them in a real threat for society and the environment around them.

To preserve this heritage it is necessary to apply proper interventions in order to avoid provoking additional damage and decay. Procedures and tools for structural diagnostic, by employing NDT, can provide a great aid to the knowledge of the building in a non-invasive way and to designing a proper intervention.

Instead, the techniques for energetic diagnostic are still limited in number and rather complex to apply, so that the picture of the energetic consumption and problematic of the building are in great part derived from calculations on the values of electric power and fuel consumption or are simulated through modelling, for example energy losses through thermal bridges (windows, beam ends, ceilings, building envelope) or modelling of air dynamic inside the building. Nonetheless, these numerical evaluations need great deal of precise experimental data in order to output realistic and predictive values useful for designating the current health conditions or the hoped improvements to be gained with the refurbishment interventions. Input data are needed about the structural and energetic characteristics of the environment, the materials, the volumes and geometry of the building and its technological solutions. Even when such data would be available (collected on site or extracted from data bank), the complexity of the real phenomena have so far underlined the approximations and uncertainties of the calculations and of modelling procedure: collecting data can still be very costing and high consuming because of the many parameters involved, while the software for fluid/thermal dynamics do not possess the required sensitivity.

In addition, the available diagnostic techniques applicable on site with energetic aim are currently

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applied on new buildings and there is no experience of possible limitations and problematic in applying them on historic or high-value buildings where the uncertainties and unknown parameters are many more (Figure 1).

Figure 1: Hand-held anemometer for detecting main points of air losses during blower door test in a historic building

2 AIMS OF THE WORKS

The current research is highlighting on one side the need for extending the testing aims of available techniques to energetic problems, on the other to integrate energetic and structural diagnostic of the buildings in a holistic viewpoint.

To these aims the EC finances research projects such as ENCULT on Efficient Energy in European Cultural Buildings, which, by identifying very diverse case studies throughout Europe, intent to investigate problematic of diagnose and interventions, specifically for historic buildings of different age, materials and construction technologies. It is intended to highlight what the deficiencies hidden in historic buildings are, which on one side, may offer still a very pleasant living environment, on the other require updating of heating/cooling, lighting, insulating systems because of the changed life- and working-stiles of the inhabitant or users.

In an effort to further develop existing diagnostic techniques and testing procedures, in this work an IR thermography experimental application is outlined for the purpose of dynamically tracing air movements in an indoors environment.

3 DESCRIPTION OF THE CASE OBJECT

Palazzina della Viola is a self-contained, isolated building from the beginning of ‘500 in Bologna (Figure 2). Born as a hunting hut, it was a light structure with thin masonry walls, open towards its environment with porches at the ground floor and loggias at the upper level. As these open spaces where closed by large windows in historic time, the indoors microclimate - also decorated by impressive frescoes - has changed dramatically creating a green-house effect.

In particular, the loggia on the façade, with its South-East exposure can heat the air significantly and these create air-flows between the rooms.

Figure 2: Main façade of Palazzina della Viola, Bologna

4 EXPERIMENTAL PROCEDURE

The testing question was if it is possible to visualize these air movements with sufficient precision so as to eliminate the need for dynamic air simulation, and what non-destructive testing technique could be feasible for this task.

The monitoring of convective air fluxes has been carried out by means of an IR thermo camera in the large main hall (13.5 x 8.6 m in plane, by 6 m in high) and made possible by the installation of paper stripes hanging from the ceiling and reaching the floor (Figure 3). IR thermography can survey in a contactless way and map the IR radiation emitted by bodies. This radiation is function of the superficial temperature of the body and allows to measure in real-time the temperature gradient between points in the field of view of the equipment.

Figure 3: Thermo gram overlapped on to visible image: readings of air temperatures from paper stripes

The employed thermo-camera allows recording simultaneously thermo-grams and photographs: the visual image has a larger field of view than the IR map. The temperature of bodies with low emissivity (such as air) cannot be measured by infrared thus in order to measure the air temperature, thin paper stripes were used because they take rapidly the temperature of the air and
the emissivity of white paper is known. Thus, the paper emitted infrared radiation represents that of the air.

5 CONCLUSIONS

It was so possible to survey the air temperature at different heights, in different climatic conditions and to obtain horizontal and vertical temperature maps of high precision. These temperature sections show a higher sensitivity then it would have been possible to simulate by the most common commercial software for thermal fluid dynamics. The infrared output has been later verified by using coloured smoke, which has made visible the real movement of the air fluxes (Figure 4).

![Figure 4: Coloured smoke used to visualize the air fluxes movements](image)

ACKNOWLEDGEMENT

The work was financed through EC funding from the 7th FP, 3-year research project 3ENCULT, project grant 260162.

REFERENCES

MEASURING OF MOVEMENTS OF MEDIEVAL PANEL PAINTINGS FOR HANDLING AND TRANSPORT

Ingrid Hopfner

ABSTRACT: In the last century (unfortunately) panel painting got so called cradle on the rear side of the paintings, after they have been thinned from a former thickness of about 30mm to about 4-12mm, in order to keep these panel paintings in a plane shape – but with the negative consequence of cracks or deformations. In order to avoid further destruction of these paintings (washboard effect) and to give them a stability while hanging in surroundings with changing micro climate or while manipulation or transporting them, a support has to be mounted on the rear side of the paintings to give hold to these very delicate paintings, especially, when transporting. To know the strength of the rear support system it is inevitable to measure movements and force of pressure the wood panel is producing during change of relative humidity while hanging or transportation or manipulation, as well as change in temperature and rel. humidity of the ambient, the paintings are exposed.

KEYWORDS: Panel painting, cradle, measuring devices, data logger, support system for transport

THEME 1.3

1 INTRODUCTION

For panel paintings it is of highest interest the kind of movements and stress these highly precious paintings are exposed during transport in trucks or planes, despite (theoretical) best (and very expensive) packing units and during manipulation, especially concerning movements and pressure of the panel, while moving. Therefore measuring of movements is necessary in order to offer the paintings an appropriate support system in the right strength. During transport, measuring of temperature and rel. humidity is standard.

In the course of a present research work of the Kunsthistorische Museum, Vienna, these measurements are executed after finding right specific measuring devices and measuring methods, to find best possible support for thinned panel paintings.

The results of the measurements are of highest interest for all restorers, national or international, working on this field of panel paintings because of the high value of these unique historic artifacts.

2 THE SUPPORT PANEL

Figures in most cases, the static capacity of the thinned panel is insufficient after removing the cradle, and stabilization by an auxiliary support system is necessary.

Figure 1: View to Perugino’s panel painting with historic cradle on the back, not yet restored

The support panel of the Perugino is made of an aluminium-resin compound material. The connection to the wooden panel consists off a number off connecting supporting units that are in equilibrium in neutral position. In contrast with the earlier rigid cradles, the connection between the wooden panel and the secondary support is flexible; in connection with the adjustment screws, it allows reregulated movement of the panel in both concave and convex tendencies.

These supporting units are fixed to the wood panel in a completely reversible way by means of a thin wooden veneer, Beva film, and Velcro fastening and if necessary.

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they may be exchanged with minimum stress to the painting. The aluminium rear panel has rectangular openings to give access to the reverse of the panel. It is not in direct contact with the original panel and therefore allows for equal climatic conditions on both sides of the painting. For maximum stabilisation of the climatic conditions and as a general protection, the painting got a glass “show case”.

CONCLUSIONS

In order to know size, strength and dimension of a supporting system for thinned, unstable historic panel paintings, to give them enough hold for hanging and manipulation and possibility for movements due to changes in relative humidity and for movements and treating during shipments, it is very important to research and measure with a very small, mobile data logger and suitable sensors, to trace movements and forces of movements of historic painted wood panels to know the counter pressure, which has to be mounted with springs, in order to give the picture enough hold for hanging and manipulation to avoid further damages and to give enough room for movements due to climate changes, i.e. changes in relative humidity. Supporting system and measuring devices always should be separate systems. Especially on shipment it is very important to know climate and movements in transport boxes of panel paintings during transport.

ACKNOWLEDGEMENT

The author is grateful to “Kunsthistorisches Museum”, Vienna, for the financial support of the described research work.

REFERENCES


CRITERIA AND INDICATORS FOR RISK ASSESSMENT: A EUROPEAN OVERVIEW

Marta Quaranta¹, Rocco Mazzeo¹, Silvia Prati¹, Giorgia Sciutto¹, Gabriele Bitelli², Luca Vittuari³

ABSTRACT: The present contribution is based on the work carried out within the work package focused on the identification and analysis of existing directives for risk assessment and evaluation. The final aim is to establish indicators to be included into the final model of a European Cultural Heritage Identity Card (EU-CHIC). It has emerged how, currently, there are several regional or national projects aiming at registering, monitoring and preserving the immovable Cultural Heritage. The most complete risk assessment methodologies have been developed in those countries where the risks are highly relevant and seriously endangers built heritage. These results however reflect single country situations, while it seems that there is a need to develop guidelines to be globally accepted and shared within a larger European perspective. In Europe, several projects and tools are already available to the identification of natural hazards. It is worth mentioning the availability of maps addressing specific risks and hazards and their graphical distribution, which were developed by the European Spatial Planning Observation Network (ESPON). The results achieved by ESPON might be considered in conjunction with those obtained by research projects (Noah’s Arc, Climate for Culture, PERPETUATE, FIRESENSE, etc.) to provide a better understanding of the impact of climate change on cultural heritage and to determine risk priorities at a country and regional level. As far as risk assessment methodologies are considered, local and national projects have developed best practices which are discussed in details.

KEYWORDS: heritage, risk assessment, hazard, vulnerability

THEME 1.3

1 INTRODUCTION
The identification and analysis of risks is one of the greatest needs for Cultural Heritage preservation. It is of the outmost importance that the integration between the material, structural and historical documentation aspects is taken into consideration in order to identify the required levels of protection for historic buildings depending on the most frequent local risks (earthquakes, floods landslide, fire, storms...). The present contribution is based on the work carried out within the work package focused on the identification and analysis of existing directives for risk assessment and evaluation. The final aim is to establish indicators to be included into the final model of a Cultural Heritage Identity Card (CHIC).

The development of guidelines for the cultural heritage documentation is the final aim of the project. Within this context, the risk assessment and preparedness should be based on common principles in order to guide stakeholders to effective and appropriate definition of measures of interventions.

2 METHODOLOGY
The methodology employed to achieve the tasks foreseen within the work package is based on the following points:
1. Survey on existing European projects focused on risk assessment
2. Identification of risk assessment methodologies currently adopted in Europe through the development of a Questionnaire;
3. Identification and proposal of risk indicators to be included into the final CHIC card.

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The results obtained are analysed and discussed in the following paragraphs.

3 RESULTS

Survey on existing European projects focused on risk assessment

We have carried out a review of a number of European projects (11 - see Table 1), which have been recently funded by the European Union.

It has been found that scientific efforts of research institutions among Europe has focused on the development of more efficient and reliable monitoring systems (SMooHS), climate change modelling (Noah’s Arc, Climate for Culture) and damage functions (CULT-STRAT, MULTI-ASSESS) to evaluate the impact of pollutants and the effect of climate change on cultural heritage materials.

All these projects should raise the awareness of decision makers about the need to urgently take actions and the EUCHIC project might be the proper tool to foster and promote synergies among different projects.

Identification of risk assessment methodologies currently adopted in Europe

The fulfilment of the abovementioned points was conducted through the development of a questionnaire in order to perform a survey among CHIC partner, making use of the wide network created by the project itself.

The identification of risk assessment methodologies currently adopted in Europe were identified through the development of a survey template.

The results of the survey evidences the presence of three approaches, which can, at a first stage, be related to geographical location of countries according to the following scheme:

- **Northern Europe** (Belgium, Norway)
  - Condition survey based on standards, detection of defects and definition of urgency of intervention. No risk assessments as risks are extremely rare (Belgium);
- **Southern Europe** (Italy, Greece)
  - Definition of possible measures as a consequence of visual inspection: complex evaluation of risk based on analysis of hazards and individual vulnerability (state of conservation) of building;
- **Eastern Europe** (Poland)
  - Risk management through plans (regulated by national law).

Identification and proposal of risk indicators to be included into the final CHIC card

The proposal of risk indicators to be included into the final model is based on assessment criteria, which were identified as the following:

1. **Cultural Heritage distribution in each country**
   - Typically, Information Systems make use of GIS (Geographical Information System) for the localization of cultural heritage items on the territory.
2. **Identification of HAZARD (geographic location)**
   - According to the Risk Map, hazard may be defined as the function that indicates the level of aggressiveness of a given territorial area, irrespective of the presence or not of the item [6].

It is worth mentioning that the availability of tools for the identification of natural hazard, which were developed by the European Spatial Planning Observation Network (ESPON) are available and can be consulted on line: www.espon.eu. The maps produced address specific risks and hazards and represent them graphically. Moreover, the results achieved by ESPON might be considered in conjunction with those obtained by research projects (Noah’s Arc and Climate for Culture) to provide a better understanding of the impact of climate change on cultural heritage and to identify risk priorities at a country and regional level.

3. **Harmfulness of HAZARDS to Cultural Heritage: definition of VULNERABILITY (through Standardized condition surveys)**

   Once the hazard have been identified and localized, it is necessary to define a function that indicates the level of exposure of a given item to the aggressiveness of territorial environmental factors. This is the definition of vulnerability according to the RISK MAP.

   As it is very well described within the Risk Map project, it is of the outmost importance, when evaluating the overall risk, to precisely describe the actual condition of a building/site. It means that an accurate diagnostic condition survey needs to be performed through a standardized methodology.

   Relevant efforts have been spent within this field which result in the development of a new European standard, the CEN/TC 346- Conservation of Cultural Property, which is currently being evaluated.

   On the basis of the survey, three approaches have been reported:
   - A. vulnerability datasheets (conservation state) for archaeological site and historical building/ monuments and vulnerability datasheets specific to seismic risk (Italy);
   - B. monitoring of building condition to define the urgency of intervention (Belgium);
   - C. vulnerability index defined for each monument (Greece).

4. **Risk evaluation (function of hazard and vulnerability)**

   In general terms, risk is defined as a function of hazard and vulnerability. In particular, the Italian Risk Map, has adopted and adapted this concept to the CH management. It highlights relationships between territorial dangers (or hazards) and the risk that a monument is subjected to.

5. **Definition of risk indicators**

   The definition of indicators for risk assessment is a complex procedure as numerous and differentiated inputs must be considered.

   Risk Indicators may be understood as any observable or measurable characteristics of the system or its constituents containing information about the risk. If the system representation has been performed appropriately, risk indicators will in general be available for what concerns the exposure to the system, the vulnerability of the system and the robustness of the system [12].

   According to the results obtained through the survey and to the RISK MAP project, the following indicators can be proposed:
A. Static structural domain
- ESPON European-level hazard maps/RISK MAP / COST C26/ PERPETUATE

B. Environment domain
- blackening index
- erosion index
- physical stress

C. Weather/climate domain
- NOAH’S ARC/Climate for Culture outputs: climate maps, heritage climate maps, damage maps, risk maps

D. Human impact domain
  monitoring demography, number of visitors, thefts, vandalism, terrorism, neglecting.

4 CONCLUSIONS

Among the data so far obtained, three current projects have been considered as the most meaningful for EU-CHIC and have been therefore discussed in details. In particular, it has been proposed the methodology employed by the Italian project “Risk Map”, which combined external sources and factors of hazard with the individual vulnerability of items.

On a European scale, the ESPON project has produced European level maps of hazard that can be very useful for an effective evaluation of sources of hazard and for their prioritization within each country.

Specifically, concerning risk assessments, it has emerged that three approaches do exist:
1. In situ visual inspection and evaluation of single cultural heritage item vulnerability based on a standardized methodology;
2. Complex evaluation of risk, based upon a precise definition of hazard and vulnerability
3. Definition of management plans regulated by national laws.

Those countries where natural hazards are mostly relevant have developed territorial information system that gives scientific and administrative support to state and regional bodies in charge of protecting the cultural heritage.

A lack in these systems has been determined in the way how vulnerability of single items is evaluated. In order to overcome this problem, it might be proposed a development of a Standardized Diagnostic Survey.

ACKNOWLEDGEMENTS

We are grateful to colleagues and partners of the EU-CHIC project. In particular, we kindly acknowledge Ingval Maxwell (Scotland, UK), Emanuele Piaia, Marco Zappirol and Roberto Di Giulio (UNIFE), Jan Valek and Jiri Blaha (ITAM), Constanze Fuhrmann and Johanna Leissner (Fraunhofer), Anastasia Kioussi and Antonia Moropoulou (NTUA).

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17. http://wwwfiresense.eu/;
Table 1: Overview of methodologies evaluated on the basis of hazard, vulnerability and risk.

<table>
<thead>
<tr>
<th>Project / Tool</th>
<th>Title</th>
<th>Funding source</th>
<th>Outcome</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEN standard 346</td>
<td>European Spatial Planning Observation Network</td>
<td>European Commission</td>
<td>Guidelines for condition survey of Immovable heritage</td>
<td>EU</td>
</tr>
<tr>
<td>ESPON</td>
<td>RISK MAP</td>
<td>Private organization</td>
<td>Objective monitoring of buildings to prevent deterioration</td>
<td>NL</td>
</tr>
<tr>
<td>Monumentenwatch</td>
<td>Information system created by the Istituto Centrale per Il Restauro for protecting, safeguarding and preserving the cultural heritage</td>
<td>MiBAC (Italian Ministero per i Beni e le Attività Culturali), IsCR (Italian Istituto Superiore per la Conservazione ed il restauro), Research Institutions</td>
<td>Hazard maps, cultural heritage distribution, vulnerability datasets (conservation state and seismic risk)</td>
<td>IT</td>
</tr>
<tr>
<td>NOAH’S ARC</td>
<td>Global climate change impact on built heritage and cultural landscapes</td>
<td>Research project funded by the European Commission, FP6 (2006-2009)</td>
<td>Climate maps, heritage climate maps, damage maps, risk maps, thematic pages</td>
<td>Leader: IT</td>
</tr>
<tr>
<td>COST ACTION C26</td>
<td>Urban Habitat Constructions under Catastrophic Events</td>
<td>Research project funded by the European Commission, FP6 (2006-2009)</td>
<td>Risk assessment methodology</td>
<td>Leader: IT</td>
</tr>
<tr>
<td>SMooSH</td>
<td>Smart Monitoring of Historic Surfaces</td>
<td>Research project funded by the European Commission, FP7 (2008-2011)</td>
<td>Development of small modular wireless sensor networks and autonomous wireless sensors that are needed to better understand deterioration processes and to help optimize the preservation of cultural heritage</td>
<td>Leader: DE</td>
</tr>
<tr>
<td>FIRESENSE</td>
<td>Fire Detection and Management through a Multi-Sensor Network for the Protection of Cultural Heritage Areas from the Risk of Fire and Extreme Weather Conditions</td>
<td>Research project funded by the European Commission, FP7 (2009-2012)</td>
<td>Aims to develop an automatic early warning system to remotely monitor areas of archaeological and cultural interest from the risk of fire and extreme weather conditions</td>
<td>Leader: GR</td>
</tr>
<tr>
<td>CLIMATE FOR CULTURE</td>
<td></td>
<td>Research project funded by the European Commission, FP7 (2009-2014)</td>
<td>More effective and efficient sustainable adaptation and mitigation strategies in order to preserve these invaluable cultural assets for the long-term future</td>
<td>Leader: DE</td>
</tr>
<tr>
<td>PERPETUATE</td>
<td>Performance based approach to earthquake protection of cultural heritage in European and Mediterranean countries</td>
<td>Research project funded by the European Commission, FP7 (2010-2013)</td>
<td>European Guidelines for the evaluation and mitigation of seismic risk to cultural heritage assets, with innovative techniques for the seismic strengthening of historical buildings and the preservation of movable artworks</td>
<td>Leader: IT</td>
</tr>
<tr>
<td>3ENCULT</td>
<td>Efficient Energy for EU Cultural Heritage</td>
<td>Research project funded by the European Commission, FP7 (2010-2014)</td>
<td>Improving energy saving, CO₂ emission, living condition and quality management in historical buildings</td>
<td>Leader: IT</td>
</tr>
</tbody>
</table>
INNOVATIVE STRATEGIES FOR THE PLANNED CONSERVATION OF ARCHITECTURAL HERITAGE

Rita Fabbri¹, Manlio Montuori², Luca Rocchi³, Marco Zuppiroli⁴

KEYWORDS: Historical building heritage, GIS.

THEME 1.3

1 GIS APPLICATION IN ARCHITECTURAL FIELD

The paper will focus on planned conservation issues with regards to strategies that technological innovation, such as the use of GIS applications in the architectural field, provides to the conservation process. Drafting a conservation plan requires the management of several multi-disciplinary data (i.e. thematic database) that, only if properly integrated, will allow to state a correct assessments; while a non-efficient management of data complexity may produce an inappropriate plan rather than discard it. The availability of computer tools able to collect and systematise large amounts of information undoubtedly facilitates the management of the procedures provided for the plan. Consequently, in this scenario, it is crucial to use GIS technology, which combines the databases management and geometrical and spatial referencing. The Geographical Information System, initially developed in a geographic research field, finds effective application even in a strictly architectural scope, not only on plans, but also on the management, up to the detail scale, of architectural elevations. The system enables the management of a geo-relational model in which there is a direct topological relationship between the stored data and the base design: the entities of graphical model (points, lines and polygons) are associated to data structures with the definition of topological relations (adjacent, closeness, overlap, inclusion, etc.).

2 GEOMETRIC DATABASES FOR ARCHITECTURAL HERITAGE

The skill to correlate the geometric databases, in an extremely versatile and potentially expandable way, with very heterogeneous data (metric, numeric, graphic, photographic, textual, etc.) makes it a flexible tool, adaptable to the complexity that characterizes the architectural heritage and the restoration site too. Moreover, the aptitude to handle, on a common geometric base, all the information relating to weathering, alteration, machining and operations, may allow a direct computation of conservation cost, although not always complete for the inability of the system to manage three-dimensional data. Finally it's possible to integrate chronological information as the “fourth dimension” in the geometric databases to monitor the decay evolution after the restoration action.

3 NEW POSSIBILITIES AVAILABLE WITH WEB-BASED GIS

Recently, web-based GIS and GIS portals offer a novel way to organize, share, and communicate geometric databases from remote operators. In this way, separate archives can be related, creating dynamic network connections, allowing interconnection of researchers, operators, and users, in a direct and inexpensive way, through the use of open source software too. The web space is able not only to provide a communication way, but also an organization technology allowing remote team working. Databases required to develop preventive conservation, monitoring and maintenance guidelines for European architectural heritage can be easily disseminated and made available through web-based GIS to specialist technicians all over the world in order to

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obtain more detailed information. Therefore internet-based systems are valuable for their supporting the real-time gathering, analysis and redistribution of data, thus connecting direction offices, scientific laboratories, and restoration sites. In this way the mapping and georeferencing of restoration data provide a spatial framework for any restoration procedure, supporting the mutual interaction of the involved working teams, information sharing, and chrono-spatial integration among database and process.

4 CONCLUSIONS

Thus, the paper will consist of three paragraphs in which will be treated, particularly in the first, the problems related to the planned conservation strategies, according to a critically informed approach applied to historical buildings, and new computer technologies. In the second, on the other hand, will be contextualized the strategic objectives conjugated according to brick architecture issues; and finally, the third section will show a case study as an example of good practice. The main objective is to separate the discussion from a mere succession of conservative actions, by carrying out the argument on a much properly theoretical subject with special emphasis on the architectural approach to the conservation issues based, in the first place, on the knowledge of used materials, on the supply tracks and, finally, on the common placing methods. The knowledge of these aspects is not secondary, because it properly involves those distinctive aspects of a technical culture that has been able to give different forms to the same material at different times; and not only that, in fact, depending on how, for example, a wall is laid changes its behaviour to deterioration issues and, as a result, the actions to be taken, under equal conditions, may be different. The challenge, of course, is to ensure the conservation of architectural heritage through preventive and planned actions, by postponing isolated intervention to exceptional events supported by a meticulous maintenance and monitoring activity.

REFERENCES

ABSTRACT: Presented in the paper shall be the systematic approach and methodology for repair and strengthening of historic monuments damaged due to man-made and natural disasters. Particular attention shall be paid to measures for taking actions in the three key phases: emergency measures, planning and measures after disaster and long term protection of historic monuments, defined on the basis of long years of activities of IZIIS and its experience in the field of protection of historic monuments in seismically active regions in the world. Emphasis shall be put on damage classification and identification within the frames of the first phase. The technical aspects, particularly the aspect of structural repair and strengthening shall be presented within the maxim of “minimal intervention - maximum protection” along with characteristic examples of seismic upgrading of historic monuments.

KEYWORDS: repair, strengthening, man-made disaster, natural disaster, earthquake protection

THEME 1.3

1 INTRODUCTION

Disasters are untimely events which cause damage, often widespread. They can be divided into two categories: natural ones, which cannot be prevented but can be anticipated and man-made disasters, which are preventable, but with unpredictable extent of damage that they might cause should they occur.

The territory of the Balkan Peninsula and hence the territory of Republic of Macedonia has unfortunately been characterized by high level of technological and natural hazards in the past and at present. It is a fact that long world wars have often been waged and started in this area. Also, all the Balkan countries are situated in one of the seismically most active regions in Europe characterized by occurrence of strong devastating earthquakes.

On the other hand, this has been an area of development, existence and perishing of many different civilizations, peoples and cultures starting from the prehistoric times until now. Material evidence, first of all in the form of architectonic structures of a sacral nature, exist today in traces and archaeological localities from the classical period, but also in fragments or entire buildings and complexes dating back to the time of the Byzantine culture and the Medieval times. Being located in a region of high natural and technological hazard, these monuments have often been exposed to climatic and human devastating factors including the effect of the earthquakes.

2 WHEN DISASTER STRIKES

The integrated systematic approach and methodology for repair and strengthening of historic monuments damaged due to man-made and natural disasters has been defined. Accordingly, in the case of damage to the structures of the cultural historic heritage due to natural or technological catastrophes, it is necessary to divide the measures to be taken for reduction of the consequences into three phases:

(i) emergency measures and action during the disaster
(ii) planning and measures after disaster
(iii) long term protection of historic monuments.

The three main activities within the first phase are:
- Quick inspection of damage,
- Temporary actions for protection of as much cultural property as possible and
- Disaster damage in depth assessment.

The main activities within the second phase are:
- Data collection on the damage and damage assessment for each damaged monument,
- Preparing of the survey documentation for each damaged monument,
• Establishment of priorities and decision making for the program of restoration, repair and strengthening,
• Setting up of multidisciplinary teams to propose projects for repair, reconstruction and strengthening of damaged monuments.

The activities within the third phase are:
• Execution of already made decisions for repair, strengthening or reconstruction of the damaged monuments in the previous phase,
• Documentation of the performed repair, strengthening or reconstruction of certain monument,
• Taking all the necessary measures for disaster preparedness, (documentation, recording, knowing the risk, town planning, disaster planning, emergency preparation, maintenance, inspections, public education, professional training e.t.c.)
• To keep pace with the development of new materials and technologies and their application.

3 IMPLEMENTATION OF DEVELOPED METHODOLOGY

Within the frames of the IZIIS' research activities, in addition to seismic design and protection of modern structures, particularly noteworthy is also the experience gathered in the field of protection of structures pertaining to the cultural historic heritage. During a period of more than 40 years of action in this sphere, the Institute has realized important scientific research projects involving experimental and analytical research, field surveys of historic structures and application of knowledge related to earthquake protection of important cultural historic structures and monuments.

Extensive research activities have been performed by IZIIS for the purpose of evaluation of a procedure for repair and strengthening of valuable historic monuments, including unique shaking table testing of models of representative monuments in its original and strengthened state. Such a procedure is based on conventional understanding of retrofitting, although, in our concepts, there are also techniques, which are based on the idea of structural control. As a result of many decades of gathering experience, it can be said that the Institute, which encompasses the following, has adopted an integral approach to seismic protection of extraordinarily important cultural historic structures:
• Definition of expected seismic hazard;
• Definition of soil conditions and dynamic behaviour of soil media;
• Determination of structural characteristics along with the bearing and deformability capacity of existing structures (on the basis of investigation of built-in materials, structural elements and structural systems);
• Definition of criteria and development of a concept for repair and/or strengthening;
• Design of structural methods, selected techniques, materials and types of excitation;
• Determination of the response of repaired and/or strengthened structures and verification of their seismic stability;
• Definition of field works, execution and inspection.

The permanent collaboration between IZIIS and Republic Institute for Protection of Cultural Historic Monuments in Macedonia enabled direct application of the knowledge gained in actual conditions and for specific historic monuments. Presented further will be several characteristic examples of application of the scientifically developed strengthening methodology in real historic monuments.

3.1 RECONSTRUCTION OF ST. ATHANASIUS CHURCH DAMAGED BY EXPLOSION

On August 21, 2001, during the armed conflict in R. Macedonia, the monastic church of St. Athanasius in Leshok experienced strong detonation, which resulted in its almost complete demolition. From structural aspects, there have been two approaches taken in the attempt to renovate and reconstruct the structure. Based on the performed detailed analysis of the structure, (i) solution for repair and strengthening of the existing damaged part of the monastic church and (ii) solution for seismic strengthening of the ruined part of the church to be reconstructed were made. Reconstruction was realized in 2004-2005.

3.2 RECONSTRUCTION OF ST. PANTELYMON CHURCH IN OHRID

In the process of conservation and rebuilding of the St. Panteleymon church, Ohrid, having in mind the importance and specific nature of the structure representing a historic monument classified in the first category and a structure of a particular national interest, it was necessary to design a building structure that will satisfy the stability conditions in the process of application of the conservation principles regarding shape, system and identification of materials. Seismic strengthening was provided in accordance with the previously developed and verified methodology, while it was realized in the course of 2001-2002.

3.3 RECONSTRUCTION OF THE BLOWN UP CATHEDRAL CHURCH OF THE HOLY TRINITY IN MOSTAR

The cathedral church of the Holy Trinity in Mostar was constructed in the period 1863 to 1873. It was exposed to shelling on 7th June 1992, while, on 15th June, its belfry was demolished and the church was put on fire and finally blown up. The remains of the church were cleared out in 2005. Later, a decision was made to renovate the church by attempting full reconstruction and maximum possible use of the existing preserved material. The selected technical solution of strengthening of the bearing structural system and the structure as a whole enables increase of its strength, stiffness and deformability capacity as well as ability for dissipation of seismic energy leading to improvement of the integrity and stability of the structure under seismic effects that are expected on the considered location. The
3.4 SEISMIC UPGRADING OF MUSTAFA PASHA MOSQUE IN SKOPJE

Respecting the modern requirements in the field of protection of historical monuments, as is the application of new technologies and materials, reversibility and invisibility of the applied technique, concept of repair and strengthening involving the use of composite materials was used for seismic upgrading of Mustafa Pasha Mosque in Skopje. In realization of this project, the established integrated approach has thoroughly been respected. The concept of structural strengthening and repair aimed at reaching the designed level of earthquake protection has been selected based on: (i) investigations of the characteristics of the built-in materials, (ii) investigation of the main dynamic characteristics, (iii) shaking table testing of the mosque model; (iv) investigations of the soil conditions; (v) detailed geophysical surveys for definition of geotechnical and geodynamic models of the site. It was realized in the course of 2007-2010.

4 CONCLUSIONS

As professionals working in the field of protection of cultural heritage, we mustn't allow that either the globalization process or any other social, political, economic or technological process take place in the world, ignoring the genesis of development of the human environment and the achievements of the human civilization in its course. The goal should then be to strengthen these structures in a manner that requires the least intervention and the greatest care to preserve authenticity.

The experimental evidence is very helpful in proving the suitability of the design choices and the effectiveness of the applied consolidation system. The developed and experimentally verified methodologies were successfully implemented in the structures of the real historic monuments.

ACKNOWLEDGEMENT

The authors wish to express their gratitude to the Council of IZIIS and to all the collaborators for their assistance in the realization of the projects.

REFERENCES


ABSTRACT: The basic idea behind the elaboration of the European Cultural Heritage Card (EU-CHIC) project was initiated during COST Action C5: Urban Heritage – Building Maintenance. The detailed EU-CHIC concept was developed through the preparation of the Description of Work (DoW) of the Coordinated Action EU-CHIC[2], and work started on 1st September 2009. Throughout the progress of the Coordinated Action all partners, and members of the Advisory Committee, have contributed to the final structure and content of the EU-CHIC. The principal stages of that process, and the outcomes of this joint collaborative effort, are described in this paper.

KEYWORDS: heritage, identity, basic data, profound data, EU-CHIC iceberg model,

THEME 1.4

1 INTRODUCTION

The idea of the European Cultural Heritage Identity Card evolved from the outline idea of creating a Building Identity Card (BICA) that was proposed by the first author of this paper at the end of COST Action C5: Urban Heritage – Building Maintenance, in the year 2000 [1]. That proposal was applied to the development of the Cultural Heritage Identity Card initiative. Being successful in gaining project support under the FP 7 call in 2008, thirteen partners from ten European countries and Israel joined their efforts in the development of the Card. Participating partners were supported by members of an Advisory Committee from four European countries and Egypt.

2 STEPS OF EU-CHIC DEVELOPMENT

2.1 THE BASIC IDEA

The main intention of the project was to facilitate the increase of knowledge on the heritage building stock across Europe to support the development of sustainable maintenance, preservation, and the revitalization of historic sites and monuments. This intention was to be achieved through the development of guidelines on the assessment and use of efficient and user-friendly systems for the identification of parameters to characterise heritage buildings and their possible alterations during their entire lifetime, using an Identity Card process. The Identity Card concept is directly oriented towards heritage buildings and assets. It should not be considered as a single document. Rather, it should be realised as a set of documented activities and resulting documents, applicable for use on assets in the EU and neighbouring countries, including those bordering the Mediterranean. Information will be collected by addressing, establishing and harmonizing criteria and indicators for tracking environmental changes to the immovable cultural heritage assets, buildings and monuments, whilst also taking into account the view that the “natural” deterioration processes, and human interventions, are an essential part of the problem.

Figure 1: The simplified scheme of EU-CHIC

The simplified EU-CHIC scheme (Figure 1) explains the process behind the decision-making procedures through using integrated documentation protocols as a tool. Decisions are based on a case-by-case analysis and the
identification of needs for carrying out activities such as inspections, diagnosis, and interventions.

### 2.2 THE FIRST STAGE OF EU-CHIC DEVELOPMENT

To establish a universal system for collecting and processing data related to cultural heritage buildings and assets, the main groups of documents that will create the integrated Identity Card, were proposed in the DoW [2], and are represented in Figure 2. Because of the complexity of the problem, an effective organization of this data was required. Therefore, the challenge of prioritizing data, and the development of an easy-to-use tool for the creation of the Identity Card, was the major task for the project partners.

**Figure 2:** The first outline of EU-CHIC content, 2009 [1]

Project cooperation amongst partners led to a proposed preliminary pyramidal scheme of data organisation and prioritization (Figure 3). This 3-level pyramid structure was originally devised where, basically, the original data groups (Figure 2) were sub-divided across the levels according to perceived degrees of need by users.

**Figure 3:** The pyramid structure of organizing EU-CHIC data, as agreed during the meeting in Ravenna, 2010

The pyramidal representation evolved through discussion amongst the project partners. The general opinion was that the pyramid format was the correct basis for further development. In turn, this led to the concept of the ‘CHIC Iceberg’ being developed during the Athens meeting in February 2012 – the ‘chic iceberg’

### 2.3 THE SECOND STAGE OF EU-CHIC DEVELOPMENT

As published in the EU-CHIC Conference Proceedings [3], a number of existing European data collection systems were presented during the May 2010 EU-CHIC Vienna workshop. These, together with well-established standards for the collection of basic data on the architectural and archaeological heritage [4], were incorporated in the developed CHIC Iceberg model. Whilst more refined in approach, the ‘chic iceberg’ pedigree emerged from combining the pyramidal model (Figure 3) and the initial outline for the EU-CHIC content (Figure 2).

**Figure 4:** The logo of the CHIC Iceberg model

The concept behind the CHIC Iceberg was to continue to divide data on heritage assets into three levels. The first is represented by the upper, visible, part of an iceberg. This offers basic data on heritage assets, and is available for a wide range of public uses, without restriction. By adopting the Core Data Index for architectural heritage, and the Core Data Standard for archaeological heritage, the structure of this data follows the Council of Europe 2009 Guidance on inventory and documentation of the cultural heritage [4]. However, the public part of EU-CHIC will propose some additional elements. Although the amount of readily accessible data will be limited to that which describes the asset, this will not give access to the details of that collected for the two sub-levels of the Identity Card.

**Figure 5:** The CHIC Iceberg scheme, as agreed during the Athens meeting in 2012

Dealing with knowledge and decision-making, the second and the third levels of data are represented by the invisible part of the iceberg (Figure 5). These data fields will remain under control of the heritage owner or site manager. They can only be published or made publicly available with permission of their owner. In some cases
the nature of the data may be security sensitive, and be totally restricted.

Knowledge about the heritage asset has a substantial economic value as it allows the owner to have more informed options to manage the building or asset. The degree of compiled knowledge can encompass detailed data on the history, previous interventions, current conditions, risks, material and structural properties and relevant survey techniques that are applicable for the asset under consideration.

Knowledge about that heritage is also necessary for its management, for related activities to economic exploitation, and for regular and extraordinary maintenance activities. The associated needs that are covered by the third level are those behind the ideas of significance, importance and added value.

This integrated knowledge and decision-making process can be structured in accordance with the checklist represented in Figure 6.

3 CONCLUSIONS

This presented outline of the content and philosophy behind the European Cultural Heritage Identity Card gives some information on the proposed methodology for the collection, presentation and application of data required for the informed understanding of particular heritage buildings or assets. Combined, on the one hand the EU-CHIC structure may be used as a powerful mechanism for generating relevant data as a processing tool for the permanent maintenance and economical exploitation of heritage, and of its retention, protection and preservation on the other.

ACKNOWLEDGEMENT

The presented paper is a compilation of the efforts of all the EU-CHIC project partners, and Advisory Committee members. Their contribution is gratefully acknowledged.

REFERENCES


DECISION MAKING ON CULTURAL HERITAGE CONSOLIDATION MATERIALS USING COMPUTATIONAL INTELLIGENCE TOOLS

Anastasia Kioussi1, Maria Karoglou2, Anastasios Doulamis3, Klio Lakiotaki4, Nikolaos Matsatsinis5 and Antonia Moropoulou6

ABSTRACT: At present there is no established methodology, based on monument documentation that could be used as a background for decision making. In this paper a decision support scenario is surveyed using computational intelligence tools and a methodology is developed for the scientific support in decision making concerning the selection of an appropriate conservation material. Firstly various consolidation materials are selected and classified based on expert and bibliographical knowledge. Then a two (2) phase intelligent process is adopted to automatically characterize the data. The first stage is implemented using a fuzzy c-means approach, resulting in the selection of the most representative data per cluster under the proposed unsupervised phase so as to be used in training a supervised classifier. A non-linear classification model is employed through the use of a neural network scheme. A constructional training approach is selected to estimate the weights (parameters) of the network. To test the efficiency of the proposed scheme, different structures of neural network models are formed. Twenty five (25) out of thirty three (33) samples are selected to be included in the training set while the remaining eight (8) sample to the test set. All the quality values of the criterion are quantified to be compatible with the neural network structure. Different scenarios were examined based on the application substrate. As a result a combined fuzzy C-means and neural network approach is proposed for recommending the most suitable consolidation materials for cultural heritage preservation.

KEYWORDS: Consolidation materials, decision making, artificial intelligence

THEME 1.4

1 INTRODUCTION

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International bibliography presents several decision making and / or support systems regarding buildings and monuments preservation and maintenance, such as: Investimmo, Prodomea Project, Masonry Damage Diagnostic System (MDDS), Monuments Integrated Management System (MIMS), e.t.c. Each one of these decision-making systems aims to provide solutions to problems related to the subject area concerned. Despite the level of performance of each of the systems mentioned, a basic weakness is detected. None of these covers the integrated protection, assessing and combining the different types of parameters involved in conservation decision making.

At present there are neither existing common procedures, nor an established methodology for collecting, organizing and presenting data that could be used as a background for decision making in the selection of refurbishment strategies because of problems in methodology, incompatible interventions, problems in
regulations and problems in the national codes and Euro
codes.
All conservation interventions require the adoption of an
integrated scientific methodology that can ensure high
and stable quality and performativity, necessary aspects
for all cultural heritage conservation works. At the heart
of this system lies the monument documentation that
registers various types of data relating to the above three
levels of cultural heritage preservation activities be used
as a background for decision making support: a) Monitoring
and inspection, b) Diagnosis and c) Interventions.

2 DECISION MAKING SERVING CULTURAL HERITAGE
PROTECTION

2.1 CONSOLIDATION TREATMENT

In this paper a support scenario is surveyed using
computational intelligence tools and based on the criteria
provided by the Conservation Intervention
documentation protocol. These tools were used for
decision support in consolidation intervention. This
approach enables decision-makers to understand the
complex relationships of the relevant attributes in
conservation problems, which may subsequently
improve the acceptability of the decision.
Consolidation is an active intervention technique. Main
aim of consolidation is the restoration of strength of a
decayed stone. Consolidation treatments are the most
risky conservation actions due to their irreversibility and
the tendency to cause undesired side-effects at stone
after their application. Thus consolidation of stone was
always considered as a complicated problem.
The overall performance of a conservation treatment
depends not only on the product but also on the stone
characteristics and the way they are applied. The
assessment of consolidation effectiveness is not
straightforward, particularly because there is
interdependence between the stone and the applied
treatment. Besides the type of product used the
performance is strongly related with the treatment
methodology, which to a large extent can be described
using parameters such as product concentration, solvent
type, application process and contact time.

2.2 DECISION MAKING SCENARIO ON CULTURAL HERITAGE CONSOLIDATION
MATERIALS

From all above it is obvious that it is really hard to select
the appropriate consolidation material. For this reason a
methodology is developed for the scientific support in
decision making concerning the selection of an
appropriate product before application.

First stage was the integrated survey on technical sheets
of consolidation materials widely used for consolidation
interventions. The most difficult part was to select and
describe criteria for all products, comprising: availability
in Greece, irreversibility, durability at environmental
loads, standards, creation of film, penetration depth,
color change, capillary absorption of water, change of
hardness. All kind of consolidants were selected
covering the whole range of consolidants types from
inorganic materials to nanolime, synthetic resins,
alkoxysilane, etc. The ranking for each criterion was
based for the most on data provided by the official
technical sheets of products, as well as at bibliographical
data concerning the application of some products, giving
both qualitative and quantitative data.
Different scenarios were examined based on the
application substrate. More specifically two different
substrates of application were selected: 1st scenario: the
application substrate to be a limestone, 2nd scenario: the
application substrate to be sandstone.
After this stage it was necessary to rank the products
from the best to the worse as the expert considered
following one scenario. The ranking values varied from
1-10 (1 for the best for the best and 10 for the worse).

3 INTELLIGENT COMPUTATIONAL
TOOLS

A two (2) phase intelligent process is adopted in this
paper to automatically characterize the data. The first
phase “selects” the most suitable dataset among the
available ones, without using any external knowledge on
the desired output for these data. In other words, under a
fully unsupervised way, in the first stage we “sort out”
the most reliable data than the most un-trusted ones.
Reliability, in this paper is described in terms of
confidence or representativity of these data as far as their
expected performance is concerned.
We implement the first stage of our architecture using a
fuzzy c-means approach. Fuzzy c-means (FCM) is a
method of clustering which allows one piece of data to
belong to two or more clusters. Clustering of data is a
method by which large sets of data are grouped into
clusters of smaller sets of similar data. Thus, we see
clustering means grouping of data or dividing a large
data set into smaller data sets of some similarity. In
particular, fuzzy membership functions are formed and
one multi-dimensional element of the large dataset is not
assigned only to one group cluster, as in conventional
C-means algorithms but to multiple clusters (according to
the shape and form of the membership function
adopted), within a degree of membership (fuzzy grade).
In this paper, triangular fuzzy membership functions
have been selected.
The output of the first stage is to select the most representative data per cluster under the proposed unsupervised phase so as to use them to train a supervised classifier. A non-linear classification model is adopted in this paper through the use of a neural network scheme. Neural networks are highly non-linear classifiers that maps multi-dimensional feature vectors to a set of available classes, in our case the performance of the consolidated materials. A constructional training approach is selected to estimate the weights (parameters) of the network. The selected approach optimally chooses the smallest possible neural network structure among all alternatives. This way, we select not only the optimal network parameters but also the most suitable number of hidden neurons and layers.

4 EXPERIMENTS

To test the efficiency of the proposed scheme, we initially form different structures of neural network models, i.e., we vary the number of hidden neurons. In all cases, a single hidden layer model is adopted for simplicity purposes since it can be proven that a single hidden layer neural network is still sufficient to model any non-linear function (with some simple restrictions regarding its continuity). Twenty five (25) out of thirty three (33) samples are selected to be included in the training set while the remaining eight (8) sample to the test set. Such a division is chosen since the number of samples within the training set should be sufficiently large so that the network can learn the complex non-linear and multi-dimensional relationships of the input data.

Initially, randomly division is selected for the samples. That is, we randomly characterize the samples of training or testing data. We also quantify all the quality values of the criterion to be compatible with the neural network structure.

Table I shows the performance of the proposed two (2) stage artificial intelligent system both on training and on testing samples. As testing samples we consider the ones that they are outside the training set, i.e., the neural network structure has not been trained on them. We observe a very efficient performance. We should mentioned that we have repeated the experiments more than 50 times and the values presented in Table I are average of the 10 worst experiments, verifying the fact that our approach is even more better on average.

<table>
<thead>
<tr>
<th>Training Error</th>
<th>Testing Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4%</td>
<td>5.7%</td>
</tr>
</tbody>
</table>

5 CONCLUSIONS

In this paper, we propose a combined fuzzy C-means and neural network approach for selecting the most suitable consolidation materials for cultural heritage preservation.
PROMISES AND DIFFICULTIES OF AN INTERNATIONAL DATA EXCHANGE IN EUROPEAN SCALE

Jiří Bláha, Irena Blažková, Pavol Ižvolt, Jan Válek

ABSTRACT: The role of inventories in the management of the cultural heritage has been repeatedly emphasized in all important international Charts and Agreements. Varieties of information systems on cultural heritage exist on national level. Nowadays the possibilities of digital data processing are advanced enough to allow integration of various national inventories into a unified system.

KEYWORDS: cultural heritage, documentation

THEME 1.4

1 INTRODUCTION

The idea of the integration of descriptive and evaluative data from national registries of historic monuments to an internationally shared information system(s) and their accessing is fairly actual in Europe. The role of inventories in the management of the cultural heritage has been repeatedly emphasized in all important international Charts and Agreements. For example the 1972 UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage included the provision that a World Heritage Committee was established, to which each party state would submit an inventory of its national heritage. Article 2 of the Council of Europe’s Convention for the Protection of the Architectural Heritage of Europe (Granada, 1985) states that ‘For the purpose of precise identification of the monuments, groups of buildings and sites to be protected, each party undertakes to maintain inventories and in the event of threats to the properties concerned, to prepare appropriate documentation at the earliest opportunity.’ Nowadays the possibilities of digital data processing are advanced enough to complete the integration of such inventories into a unified system. A large number of projects, networks and international activities have appeared in Europe during the last decades. They were initiated mostly by European Commission, Council of Europe, ICOMOS but also by various commercial and non-commercial subjects. The paper is bringing concise information about the most important ones, and especially those in where the Czech and Slovak Republics were involved.

2 EXISTING ACTIVITIES

Data about cultural heritage is being collected, managed and presented by many different bodies with varying purpose, range of coverage and level of details. The transnational view, and the approach of UNESCO to safeguard WHS’s, is interesting in comparison with the current administrative approach adopted by the national information systems and databases. Set out below are some of the well-recognised approaches.

2.1 CORE DATA INDEX

The Core Data Index [1] is a result of work carried out in early 1990’s and was approved by the Committee of Ministers of the Council of Europe in 1995. It represents a first step in defining technical standards for data exchange. The minimum data elements (core data), which should be known/recorded about a historic building, are described in a publication by Thorns and Bold [2].

2.2 UNESCO’S WORLD HERITAGE LIST

Based on the World Heritage Convention (1972) the World Heritage Committee considers natural or cultural sites for inscription on the World Heritage List (http://whc.unesco.org/en/list). The convention sets out the duties of state parties for protection of the listed sites. The List is accessible via the UNESCO website and, apart from the description, maps, photos, and videos,
there are also accessible inscription documents, periodic reports, decisions, funding assistance and frequency of reporting (indicator). The periodic reports deals with protection; management; management plans; financial resources; staffing levels; expertise and training; visitor management; scientific studies; education, information and awareness building; factors affecting the property; monitoring. On the website, there are links to local authorities and tourism centres, and amongst the options there is also a link to the TripAdvisor internet guide to enable and record feedback on issues related to the site from those who have visited.

2.3 EUROPEAN HERITAGE NETWORK AND COUNCIL OF EUROPE

The European-Heritage Network (http://european-heritage.coe.int) was set up through the HERIN projects. It offers an information system on the governmental services in charge of heritage protection within the Council of Europe membership. The information system offers data (supplied by the individual States) on the following topics: Changing perspectives on Heritage Strategies; Organisation and People; Financial Policy; Knowledge and Protection; Conservation and Management; Access and Interpretation; Digitalisation; Statistical Data; and World Heritage. A key tool of the EHN is the integration of data on national information systems by responding to common templates. The integration of data allows the effective monitoring of cultural heritage, developments regarding its protection, coordination of policies and trends in Europe.

2.4 EUROPEAN PROJECTS AND PLATFORMS

The quantity of digital content available through the European Digital Library (Europeana) from the present four key domains (libraries, museums, archives and audiovisual archives) is gaining through the activities of projects already funded through Community programmes. There is a pressing need to continue this development by involving new content providers and increasing the quantity and quality of content that is available to Europeana and its users. There is a rich variety of digital content about Heritage sites, in all media formats including images, texts, multimedia resources and virtual reality models, available from Europe’s network of heritage agencies, the sites themselves, archaeological museums and digital archives. The process of involving this network extends the institutional base of Europeana’s content providers and brings together and links up heterogeneously sourced content about individual Heritage sites, making it possible to establish integrated services with greater richness and complexity. The metadata bound with the content of Europeana are displayed mostly in national languages. EU CHIC project is aiming to develop a strategy and select most efficient methods and tools for harmonization of criteria and indicators to be addressed for tracking environmental changes of tangible cultural heritage assets, buildings and monuments, including “natural” deterioration processes and human interventions. Final achievement of the EU CHIC project will provide new procedures for cultural heritage conservation and harmonization of criteria for future adaptation of heritage to new requirements. This important issue, involving common policies, should be faced at European level.

2.5 ATTITUDES OF GOVERNMENTAL AND LOCAL AUTHORITIES

There are many reasons to seek a unified format of international cultural heritage data. Usually it is the promotion of significant tourist destinations, space for international scientific and research collaboration but also cooperation in risk management, mitigation of natural disasters like floods, earthquakes, etc. or protection against the cross border market with stolen artefacts. Of course there are not only benefits. Institutions are usually afraid of financial and time-consuming needs related to transforming and supplementing existing data, even if it is just basic information about the form and current state of monuments. The attitudes of governmental and local authorities are often ambivalent. This does also because some projects run in parallel, not know about each other.

3 COMMUNICATION AND LANGUAGE ASPECTS

The question is whether or not all information should be transformed into a common language environment – most probably to English. Data sharing at the international level has a number of lexical, respectively semantic problems associated with precise translating. In the history of culture, we know many of just locally used terms within European regions, which could be difficult to convert to a common language platform.

4 CONCLUSIONS

The paper demonstrates that a certain process of data and information systems integration is already taking place in Europe. The transnational perspective is important in research and development, coordination of activities and standardisation.

ACKNOWLEDGEMENT

The authors would like to thank to the EU CHIC project for the support.

REFERENCES


DECISION MAKING SYSTEM ON THE ASSESSMENT OF CLEANING INTERVENTIONS USING COMBINED FUZZY C-MEANS AND NEURAL NETWORKS

Ekaterini T. Delegou,1 Anastasios Doulamis2, Antonia Moropoulou3

ABSTRACT: In this work, a decision making system based on combined fuzzy c-means and neural networks is presented for the assessment of cleaning interventions on marble architectural surfaces. Results of Scanning Electron Microscopy with energy dispersion by X-ray analysis (SEM-EDS), Digital Processing of SEM Images, Laser Profilometry (LP) and Colorimetry, comprise the critical parameters of a range of set cleaning assessment criteria. These data, under the process of the developed semi-supervised learning strategy, which includes fuzzy C-means algorithms, are fed as inputs to non-linear classifiers to improve their performance for decision making on cleaning. The designed system is successfully demonstrated in practice.

KEYWORDS: decision making, cleaning, cultural heritage, monuments, conservation, neural networks, fuzzy c-means

THEME 1.4

1 INTRODUCTION

The assessment of cleaning interventions is fundamental during pilot cleaning applications or final cleaning treatment works, for the determination of the cleaning efficacy of each applied method (for particular material and particular decay pattern). Cleaning is the par excellence non-reversible conservation intervention, and therefore the compatibility concept that should governs it, relies on the setting of a range of assessment criteria along with the determination of their acceptance threshold levels.

Several previous publishing demonstrated that the following cleaning assessment criteria could be adopted:


2: Surface Microstructure; Critical Parameters: Roughness, Ratio of actual to projected surface area, Fracture Density.

3: Color; Critical Parameter: Total Color Difference.

4: Durability; Critical Parameters (clear indications): Roughness, Ratio of actual to projected surface area, Fracture Density; Critical Parameter feasible measurable in time: Total Color Difference.

However, threshold values of the aforementioned critical parameters have not been established yet and therefore their combinations for decision making on the assessment of a cleaning method is a complex procedure. Thus, the need of using a decision support mechanism that can resemble the way experts make decisions based on their knowledge and experience is great.

In this work, a knowledge-based expert system that can assess cleaning interventions, applied on marble surfaces is developed.

The proposed system uses a semi-supervised learning strategy to perform the cleaning assessment. Semi-supervised learning is a special form of classification. Traditional classifiers use only labeled data (feature / label pairs) to train. Due to the nature of our application labeled data is difficult and time consuming to obtain. This is due to the fact that it requires a specialist to label the data, which is not practically feasible. However, unlabeled data is abundant and can be easily collected. Semi-supervised learning solves these problems by combining the labeled and unlabeled data to build better
classifiers. This approach will mean that the system will require less human effort to train and modify.

2 METHODS

2.1 EXPERIMENTAL PROCEDURES & TECHNIQUES USED FOR CLEANING ASSESSMENT

In this work the following experimental techniques were used for the determination of the critical parameters of the cleaning assessment criteria:

**SEM-EDS** is applied on collected monument samples, before and after cleaning, using JEOL JSM-5600, OXFORD LINKTM ISISTM 300 with Energy Dispersive X-ray Microanalysis system, Accelerating Voltage 20 KV, Beam current: 0.5nA, Lifetime: 50 sec, Beam diameter <2µm.

**DIP of SEM images** using the EDGE program which was developed by the US Geological Survey. EDGE program was developed for the analysis of back-scattered electron-micrograph images consisting of 512 rows with 512 pixels per row, where each pixel is encoded with 8 bits on a 256-shade gray-scale palette. The fractal dimension of the exposed surfaces of stone specimens cut in cross-section is measured.

**Colorimetry** The Dr Lange color-pen LMG159/160 colorimeter, was applied in situ on the investigated marble surfaces, for measuring the L*, a*, b*, according to CIELab Uniform Color Space. Total color difference \( \Delta E \) was estimated according the ASTM D2244-93, by the following formula:

\[
\Delta E = \sqrt{\Delta L^2 + \Delta a^2 + \Delta b^2}
\]

whereas, the ratio of actual to projected surface area was measured at each micro-topography.

**3.1 DEVELOPMENT OF DATA SETS**

Decay diagnosis results indicated the presence of three characteristic decay patterns at the four investigated architectural marble surfaces: black crusts, and inter-granular fissuring. The pilot conservation interventions that were applied consisted of different cleaning methods like: AB57 poultice, poultice of sepiolite with deionized water, poultice of ion exchange resin with deionized water, poultice of ion exchange resin with 10% w/v \((\text{NH}_4\text{)}_2\text{CO}_3\) solution, atomized water, and a wet micro-blasting method of spherical calcium carbonate particles with diameter less than 80µm. The critical parameters of the set cleaning assessment criteria were classified to the following datasets depending on the decay pattern:

*Patina preservation index (PPI) (SEM-EDS results):* Two sets were defined, on the input space, named as “Low patina preservation index” and “High patina preservation index”. Values belonging to the “High patina preservation index” are the accepted ones, as cleaning methods which, cause patina removal are totally unacceptable even by Venice Charter since 1964. Therefore, the patina preservation is a prerequisite for an effective and successful cleaning intervention. These datasets classification is valid for both decay patterns.

*For the decay of black crust, the critical parameter of authentic material preservation is defined as:*

*Preservation index of gypsum layer (PIGy) (SEM-EDS results):* Three sets were defined, namely “Low”, “Medium” and “High” were proposed. “High Index” values are the acceptable ones, since in this case the resulting surface holds the microcrystalline gypsum layer, which is acceptable and desirable. Microcrystalline gypsum is the first and compact part of marble sulphation process, and the desirable remaining part of the black-grey crust during cleaning, since it preserves the details of carved and plane surfaces. “Low index” & “Medium Index” values show that cleaning intervention probably has caused loss of authentic material (that is calcite and/or microcrystalline gypsum), in high or medium rate respectively.

In the case of inter-granular fissuring decay the critical parameter of authentic material preservation is defined as: *Preservation index of gypsum in-between inter-granular fissures (PIGyF) (SEM-EDS results):* Three
sets, namely “Low”, “Medium” and “High” were proposed. “High Index” values are the acceptable ones, since in this case the remaining micro- and cryptocrystalline gypsum in the inter-granular fissures it binds together the upper part of the marble surface preserving its cohesion, and preventing the detachment of calcite grains and loss of authentic material. “Low index” & “Medium Index” values show that cleaning intervention probably has caused loss of authentic material (that is calcite and/or cryptocrystalline gypsum), in high or medium rate respectively.

Fracture Density (FD) (DIP of SEM images results): Four sets were defined: “Low”, “Medium”, “High” and “Extra High”. “Medium” set values are the acceptable ones. Values belonging to the “High” and “Extra High” sets show that cleaning intervention has caused micro-cracking and fracturing on the marble surface, due to superficial material loss, resulting to a surface which will display higher susceptibility to further decay. Values belonging to the “Low” set show that even though cleaning resulted in a marble surface of low amount of micro-cracking and fracturing (that is a surface with low susceptibility to further decay), possible unaccepted superficial material loss has taken place. These datasets classification is valid for both decay patterns of black crust and inter-granular fissuring.

Ratio of Actual to Projected Area (r) (LP results): Three sets were defined namely “Low”, “Medium” and “High”. Accepted values are considered those of the “Medium” set, since it satisfies the condition of accepted superficial material loss in relation with medium reactivation of sulphation process and medium adsorption of black particles. Higher values are unaccepted, because higher ratio values indicate higher susceptibility to further decay, along with unaccepted material loss of the cleaned surface. Lower values are unaccepted as well, because even though indicate low susceptibility to further decay, possible unaccepted superficial material loss has taken place. These datasets classification is valid for both decay patterns.

Roughness (Rq) (LP results): three sets were defined, “Low”, “Medium” and “High”. Accepted values are those belonging to the “Medium” set, since it satisfies the condition of accepted superficial material loss in relation with medium reactivation of sulphation process and medium adsorption of black particles. Higher values are unaccepted, because higher ratio values indicate higher susceptibility to further decay, along with unaccepted material loss of the cleaned surface. Lower values are unaccepted as well, because even though indicate low susceptibility to further decay, possible unaccepted superficial material loss has taken place. These datasets classification is valid for both decay patterns.

Total color difference (ΔE) (Colorimetry result): Three sets were defined, as “Low”, “Medium” and “High”. Accepted values are those belonging to the “Medium” fuzzy set. Values belonging to the “High” set show that cleaning intervention caused high difference in the aesthetics of the surface after cleaning, whereas values of the “Low” set show that cleaning intervention was ineffective, that is remaining of black depositions. These datasets classification is valid for both decay patterns.

3.2 RESULTS OF THE PROPOSED SEMI-SUPERVISED SCHEME

Figure 2 shows two examples of the proposed semi-supervised learning approaches on seven (7) and three (3) cleaning samples, which are out of the training set, used to estimate the parameters of the non-linear neural classifier. As is observed, very good performance is obtained. Similarly Table 1 shows the average performance over all cleaning test samples after conducting the experiments 100 times. The results have been classified for three different cleaning cases, on the typical decay patterns of black crust, inter-granular fissures, and washed out surfaces. We observe a good performance for all three cases, even when testing samples outside the training dataset are exploited.

Figure 2: Examples of the proposed semi-supervised learning approaches on seven (7) (left) and three (3) (right) cleaning samples

Table 1: Average Error over 100 randomly partitioned datasets when 20 hidden neurons are selected

<table>
<thead>
<tr>
<th>Decay Patterns</th>
<th>Training error (%)</th>
<th>Testing Error (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black crust</td>
<td>4.3</td>
<td>14.5</td>
</tr>
<tr>
<td>Inter-granular Fissures</td>
<td>2.4</td>
<td>8.4</td>
</tr>
</tbody>
</table>
4 CONCLUSIONS

The developed semi-supervised learning strategy which exploits fuzzy C-means and neural networks, is a powerful decision making tool, as far as it concerns the assessment of cleaning interventions applied on marble architectural surfaces. The system is able to extract from data inherent, hidden properties used and automatic suggests solutions useful for cultural heritage engineers.
MULTICRITERIAL VALORIZATION OF A MONUMENT BASED ON NATIONAL REGISTRY DATA

Marek Skłodowski,1 Miroslaw Dytczak2, Iwona Szmelter3

ABSTRACT: Value analysis in cultural heritage has already a long tradition based on a classic work of A. Riegel [1]. Since that time the awareness of its importance and usefulness constitutes an element of past decades education, practise and legal framework of cultural heritage conservation. Theoretical analysis and attempts of its practical application have brought about the need for re-orientation and changes in theory of the 20th and 21st centuries [2]. Since the beginning of the 21st century numerous compilations of various works have been published. They put forward an interpretation of “sustainable conservation” and introduce the role of various stakeholders in valorisation procedure. Contemporary assessment of values takes into account that some of the values from one point of view can be drawbacks from the other perspective. Discussions of value judgements in relation to cultural heritage and authenticity in the context of cultural differences have included some new issues including intangible heritage, technological heritage, nature heritage, spatial planning, globalization, cultural tourism etc. [3].

KEYWORDS: multiple criteria decision making, valorisation, monument, monument’s register, MCDA

THEME 1.4

1 INTRODUCTION

The concept of ‘values’ is a living idea. Value has the relative status of a thing and the message of artwork, or the esteem in which it is held, according to its real or supposed worth, significance or function [2]. Such an understanding clearly shows that there is a great need for development and use of the valorisation tools, which are not susceptible, or at least less susceptible to subjectivity of personal judgements. One should try to replace existing valorisation schemes by more objective multi-criteria analysis of values keeping in sight their mutual interactions. An adequate tool for this purpose is Multiple Criteria Decision Analysis (MCDA).

2 MULTIPLE CRITERIA DECISION ANALYSIS (MCDA)

The concept of ‘values’ is a living idea. Value has the relative status of a thing and the message of artwork, or the esteem in which it is held, according to its real or supposed worth, significance or function [2]. Such an understanding clearly shows that there is a great need for development and use of the valorisation tools, which are not susceptible, or at least less susceptible to subjectivity of personal judgements. One should try to replace existing valorisation schemes by more objective multi-criteria analysis of values keeping in sight their mutual interactions. An adequate tool for this purpose is Multiple Criteria Decision Analysis (MCDA).

The main idea is to present how MCDA can be used at operational level in valorisation processes to support conservator administrative decision of the extend of legal protection based on adopted value criteria. Hence, we do not discuss the possible sets of monuments value attributes. Such a discussion is still vivid in conservation society and sets of value criteria are redeveloped and redefined in numerous publications. In Poland itself at least six various sets of values have been suggested. Analysis of valorisation criteria pros and cons shall not be considered here as MCDA methods can be universally used with any preferred or legally defined set of attributes. For the demonstration purpose we adopt the following structure of monuments values, which is based

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A. Intrinsic
A.1. authenticity
   A.1.a. material
   A.1.b. ancienntness
B. Extrinsic Values
B.1. Sociocultural Values
   B.1.a. historical
   B.1.b. cultural/symbolic
   B.1.c. social
   B.1.d. spiritual/religious
   B.1.e. aesthetic
B.2. Economic Values
   B.2.a. use (market) value
   B.2.b. non-use (non-market) value
   B.2.c. existence
   B.2.d. option
   B.2.e. bequest
C. Externally generated
C.1. economic externalities
C.2. social externalities

Nowadays value structures include also parameters describing risk management and structural and material assessment aspects.

Another formal element of our MCDA example is a monument's documentation stored in official archives of National Heritage Board of Poland. This documentation is also commonly known as the "White Card". It contains 27 fields including diverse information. The card is a legal document [4] therefore it is assumed as a primary information source about a monument. In this way we assume that every expert has the same information, collected and organized according to the legally defined rules identical for every monument. The card comprises indispensable data source for evaluation of monuments. The white card of Visitations Church located in Warsaw is a well known example for the EU-CHIC project participants and is used as the data source in our work.

Diversity of monument features results in a need for application of special approaches for reliable monument evaluation. Application of adequate evaluation measures is also needed for a successful expression of diversified monument features. There are several multi-criteria decision analysis approaches available which include such measures. They are capable of including both tangible and intangible attributes.

Specific approach should be selected taking also into account its suitability. Although existing mathematical methods belong to different classes of tools they seem to be capable of delivering similar results adequate to analysed problems [5]. Utility criteria e.g. familiarity to a user and simplicity of use play therefore important role during approach selection process.

3 CONCLUSIONS

Availability of numerous MCDA approaches is advantageous and should encourage future research on MCDA application for evaluation of monuments. Research results confirm that appropriate combination of methods makes reliable evaluation of complex objects and phenomena possible and more reliable [6]. Considerable number of the results of monuments valorisation is a need for justification of decision tools, which are suitable for evaluation of numerous heritage objects. Such tools are already available and widely used to solve multi-criteria decision problems in other fields [7]. Sample MCDA evaluations of historical monuments will be presented in the paper to illustrate theoretical considerations.

ACKNOWLEDGEMENT

Presented work was partially supported by EU-CHIC Project under Grant Agreement No 226995 (FP7-ENV-2008-1)

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ABSTRACT: People used to believe (and many still do) that digital formats were the ultimate formats for storing information indefinitely. The idea that texts, images and more in general data can be perpetuated by converting them into digital form is popular and widely supported. As a result, a significant amount of our documents and data relies on digital technology. But is digital technology really suitable for long-term preservation? And are electronic devices, which are required in order to access information stored in digital formats, durable enough to guarantee future access to this information? If not, what can we do to overcome this problem? Of course, we cannot preserve everything; there are products and content that will not necessarily reach future generations. Perhaps we should devote some time to choosing what should be destroyed/recycled. This challenge involves many different aspects: technological, organisational, legal, economic and more. At the same time we cannot forget some more specific aspects such as the requested period of archival time and the typology of digital objects and the accuracy we want to preserve. The present contribution will adequately take into account these aspects and draw some guidelines in order to help facing this problem.

KEYWORDS: Digital preservation, digital fragility, cloud computing, EU-CHIC

THEME 1.4

1 INTRODUCTION
In the last decades we faced two related processes, the increasing role of electronic devices in our everyday life and the “rush to digital formats”. Institutions, organisations and private companies launched a midterm programme converting their own archives in digital format. Even people at home started a “personal data” conversion toward digital format: documents, music, movies, drawings and photos left their original format and medium reshaped in “bit streams” on digital media. The idea that texts, images and more in general data can be perpetuated by converting them into digital form is popular and widely supported.

2 THE RATIONALE BEHIND DIGITAL PRESERVATION
The idea that once you have managed to convert your original into a digital format the hard work is over does not reflect reality; once the digital data have been obtained, it is necessary to consider a different conservation strategy. One of the first things to consider is that content has its own life cycle. Of course, we cannot preserve everything; there are products and content that will not necessarily reach future generations. Perhaps we should devote some time to choosing what should be destroyed/recycled. Even though the “paperless” office uses more paper than ever before, and low-cost storage technology has created terabytes of ”digital garbage”, we must take into account what is relevant and what it is not; not only because preservation will cost some resources but also because irrelevant data will simply increase the “entropy”. “Appraisal” is one of the key points in approaching digital preservation, we must choose what is relevant and must be preserved and what it is not relevant and may or must be recycled. Another relevant aspect of preservation is related to the data refresh/update rate to understand fixed information and dynamic information. The life cycle of the data will influence its own creation and will generate an accounting record for the resources to be preserved. Since prevention is better than cure, if we define preservation strategies we are halfway to the solution.
3 IT IS NOT ONLY A MATTER OF TECHNOLOGY

The management of the whole problem involves several different aspects in addition to bare technological ones, there are administrative, procedural, organisational, legal, IPR and policy issues surrounding long term preservation of digital content. This increased complexity is even due to the different nature of digital versus physical traditional documents.

At least one aspect should be investigated before settling on a particular preservation approach: the overall cost of preservation. This involves considering the best way to ensure future access to information during the design phase of the long-term data set. This approach may involve some feedbacks on the way to choose technology and standards and even the way to shape data sets. Once the data set is created, in addition to infrastructure costs, running costs may include: additional room on storage devices to archive copies and/or documentation and metadata, software applications that manage data refreshing, and costs related to porting or emulation. Of course the massive use of the Internet, its technology, standards, multiple instances of the same content and different “time machines” in some way helped very much the solve the problem.

4 CLOSING REMARKS

The long-term preservation of digital content is one of the big challenges of the digital age; important digital information is in danger of being lost forever. The technologies required by particular types of digital content become obsolete; application versions and files formats frequently change, making data in Accessible. Even when content is coded in the simplest format, such as ASCII code, the degradation and obsolescence of storage media can result in its disappearance. Online information sources such as web pages and databases become more difficult to find as the web(s) in which they are located become more complex and diverse (due to an increasing number of hyperlinks, cross-references as well as types of web application and even webs themselves).

A systematic approach to this relevant topic has to be adopted. First of all we must consider the economic approach in a broad sense; some resources, this means some more archiving space, some additional care and work. In addition a background analysis of our documents, a tight classification accordingly with basic archival principles and specific archival tagging is required. The expectation is that such basic tagging and the enrolment in the ad hoc preservation “pipeline” will be included within the operating system services. This will significantly help the end user inserting a temporary annotation text file in a different preservation pipeline compared with a contract or a mission critical database. Starting from this point many different solutions may be applied: stand-alone preservation architecture, corporate architecture and service centre architecture.

Recently many IT Centres or Server Farms and “Clouds” started to offer a long term preservation service. Customers store their data on those systems and the host takes the charge to ensure long term access to such data. The increasing use of clouds as storage solution, mainly due to the opportunity to access from any device, anywhere and anytime your information, may support the implementation of this additional feature. Finally, it is very important that strong interdisciplinary groups carry out research into digital preservation, since this should guarantee that an effective approach to a problem that concerns the foundations of the digital era is defined. On October 2011 as a follow up of the UNESCO Conference on Digital Preservation held in Moscow a declaration has been issued. This declaration has been endorsed care of the UNESCO general assembly held in Paris on November 2011.

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VALORIZATION OF CULTURAL HERITAGE: THE ROLE OF THE UNIVERSITY

Matteo Gambaro, Andrea Tartaglia, Silvia Gugu

ABSTRACT: A vision that integrates cultural heritage valorization in a cohesive manner to local development policy and processes is increasingly encouraged at all decision-making levels. Universities can play a potent role in this visioning process as well as in its implementation phases by capitalizing on the production and dissemination of knowledge and long-term goals, as well as on the ability to activate collaborative networks connecting research units, private stakeholders and public administration. The article shows how, over the span of a decade, the dedicated curriculum and vast array of projects of the Technology and Environmental Management Lab (TEMA) in Mantua, Lombardy, have played a marked role in changing the relational system that governs the local cultural heritage resources and in redefining heritage valorisation as catalyst of local development.

KEYWORDS: cultural heritage valorisation, knowledge transfer, collaboration networks, local development

THEME 1.4

1 INTRODUCTION

Over the span of a decade, the dedicated curriculum and vast array of research projects of the Technology and Environmental Management Lab (TEMA) in Mantua, Lombardy, have played a marked role in changing the relational system that governs the local cultural heritage. TEMA’s efforts have helped secure significant funding for the application of comprehensive, knowledge-based, integrated models for the protection and valorisation of cultural heritage, have stimulated new economic perspectives and built a high level of awareness and specialized knowledge of the role of cultural heritage in local development.

A vision that integrates cultural resources – and cultural heritage in particular – in a cohesive manner to local development policy and processes is increasingly called for at various decision-making levels, starting from supra-national policy and incentives and trickling down to national and regional initiatives. It has long been highlighted that cultural policy, as one of the main components of endogenous and sustainable development policy, should be implemented in coordination with policy in other social and economic areas on the basis of an integrated approach [1].

The EU cultural agenda has been gradually aligning to this principle. While in the guidelines for the programming period 2000-2006 at a European level, the importance of culture in attracting tourism was still the predominant way of thinking about its potential contribution to development, lately a broader conception of the role of culture has emerged. This is especially visible in the references that recognize its importance in promoting the attractiveness of places and encouraging inward investment, as well as to the stimulation it provides for the development of information technology.

For the 2007-2013 programming period, changes were introduced, making the integrated guidelines for growth and jobs in the renewed Lisbon agenda the central point of focus [2]. Moreover, the "Common Strategic Framework" (CSF) for 2014-2020 presented on March 14th, 2012, mentions that “Cohesion policy resources can be used to maximise the contribution of culture as a tool for local and regional development, urban regeneration, rural development and employability. Examples of potential investments in culture could include investments in research, innovation, SME competitiveness and entrepreneurship in cultural and creative industries under the corresponding thematic objectives” [3], highlighting

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once again the role of culture and cultural heritage as a tool with a variety of ends. The growing emphasis on the necessity of concerted efforts towards developmental goals and integrated cross-sector policies has made collaborative tools fundamental. Building relations and trust, a common pool of knowledge and stimulating a collective learning process between the actors in the cultural heritage sector and related economic sectors emerge as compelling necessities for a collaborative milieu. The new organizational forms, configured as networks (cultural districts, creative clusters, tourist systems) are based on cooperative processes between actors, primarily institutional ones, but also private stakeholders and local communities, which favor the consistency and convergence of decisional processes, joint investments through the sharing of human capital and other resources, administrative coherence, constant monitoring and adjustment [4]. In this perspective, the opportunities offered by universities through the production and dissemination of knowledge and scientific research are an enticing departing point, revealing great potential for the active participation of universities in the economic process and social development of local systems. Responding to this logic, in Italy the role of the university has expanded in recent years, adding the so-called "third mission" to the traditional combination of teaching and research, which concerns the awareness transfer and integration between scientific research, production and public administration. This established a virtuous cycle which, by facilitating the transfer of research outcomes, yields direct effects on the local development and consequently allows the university to fund and implement their own activities independently (with funding derived primarily from the Regions and local authorities, and partly from smaller businesses and private producers). This process results in a relational system that encourages dialogue and active collaboration between the university and institutional stakeholders (Regions, Provinces, Municipalities), trade associations, the chambers of commerce and private enterprises. The case of the TEMA Lab in Mantua - Technology and Environmental Management (a research branch of the BEST Department in Milan Polytechnic, Mantua Campus) represents a compelling example of the vast role the academic institutions can play in building local relational systems and diffuse knowledge, with particular relevance to innovative approaches for the fruition of cultural heritage. Based on original documents, literature review and firsthand experience, this article explores an array of projects that allowed the TEMA Lab to expand its local role and make a sound socio-economic impact by experimenting with the implementation of action-oriented network systems and a new procedural, programmatic and management models (such as planning instruments, negotiated agreement programs, integrated interventions, joint ventures, partnerships, urban transformations, project financing). The TEMA Lab projects have developed around four themes, highlighting their interdependencies: innovation and technology transfer; valorization of cultural heritage; environmental design; and human capital and training. This article focuses on the TEMA projects, actions and training programs directed at heritage conservation and valorization, which illustrate the culture of renewal in managerial and methodological approaches: seeking social and economic sustainability for protection and conservation, and developing forms of active safeguarding based on the physical, cultural, individual and collective reuse and repossessing of heritage assets, as reflected in strategic plans, marketing plans, territorial, regional and European development programs, cultural districts, eco-museum systems and research approaches. Cultural heritage [5] is particularly relevant to the city of Mantua and to the Province, as well as to the whole Italian territory. In the Italian context, it has been long recognized as an important driving force for the economic growth and social development of the territory, opening new perspectives for experimental and applied research. The Mantua area is endowed with an exquisite patrimony of tangible and intangible heritage, including the UNESCO site of Mantua and Sabbioneta [6]. The initiatives developed by the TEMA Lab aim to promote Mantua as a "centre of excellence" for cultural heritage valorization on a regional scale, pursuing multiple territorial benefits: the consolidation of a territorial partnership as key element in a broad-scale, multi-year intervention; its extension to institutional and business partners operating in the field of cultural heritage; the activation of innovative forms of entrepreneurship in the field of culture; knowledge and awareness transfers; the enhancement of skills and qualifications of cultural industry employees; the integration of local planning and actions. The article describes the research and consulting undertaken by TEMA Lab, highlighting the efforts for knowledge transfer and the collaboration mechanisms that enabled the projects as well as the eventual implementation. Among the projects presented are two territorial marketing plans, one for Alto Mantovano, the northern area of the Province ("The Territorial Marketing Plan of Mantua Morenica"), and one for the area to the south of the River Po ("The Mantua Oltrepò Strategic Territorial Marketing Plan"), as well as two Cultural District projects ("The Gonzaga Palaces" and "Mantua Oltrepò for Innovation, Unity and Development - DOMINUS"). In addition, the Department BEST at Politecnico di Milano established several graduate programs targeted at the valorization of cultural heritage in the Mantua area: a PhD in "Design and technologies for the valorization of cultural heritage", launched in 2005; the Master programs in "Management of cultural, environmental and scenic resources " [7], funded under the European Social Fund (ESF Objective 3, C3 measure "courses and university masters levels I and II"), and research co-funded by Ministry of Education, Universities and Research (MIUR) in 2004, entitled "Technologies for the valorization of Cultural Heritage" [8]. Also at the graduate level, two Master's degrees have been introduced; a Master’s in "Project Design for Planned Conservation", funded by the planned
conservation centre of the “Gonzaga Palaces” Cultural District” and the Master’s in “Management of Cultural and Touristic Hospitality” [9], funded as part of the project “Excellent Lombardy”, which aims to promote the excellence of human capital. Finally, the article anticipates the future prospects for TEMA Lab, shaped under the auspices of several programs currently under development in collaboration with the UNESCO office in Mantua and Sabbioneta. The future initiatives are aimed at disseminating the activities provided by the Management Plan of the UNESCO Site of Mantova and Sabbioneta, "designed to combine the demands of preservation and conservation with integrated development across the territory". Conclusions are drawn regarding the role of the university as key actor in territorial partnerships and collaborations, particularly with regards to the broad capacity for knowledge transfer and dissemination and to the ability to identify adequate partners, funding sources and strategies that activate the potential of cultural heritage conservation and fruition as catalyst for local development.

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[5] Italy is in first place with 47 of the 936 UNESCO World Heritage sites in 153 countries; 1,966 towns/cities have one or more protected areas (source: Ministry of Environment, EUAP Official List of National Protected Areas), of which 1,150 have more than 10% of the protected areas and nearly 300 more than 48% (Raffaello Cervigni, Oriana Cuccu, Simona De Luca and Benedetta Stratta - Public Investment Evaluation Unit, Department of Politicians for Development in the Ministry of Economy and Finance, at the “Forum of Public Administration” held May 13, 2005).

[6] The inclusion of the site “Mantua and Sabbioneta” on UNESCO’s World Heritage List was approved during the thirty-second session of the World Heritage Committee (Quebec City, 2008). “Mantua and Sabbioneta” is the fortieth Italian site to be recognized by UNESCO.

[7] The administration of the scientific and didactic elements of the Masters was carried out by Fabrizio Schiaffonati and Elena Mussinelli, with coordination from Roberto Bolicci and Andrea Poltronieri. The experience of the first year of the Masters is documented in, Elena Mussinelli (ed.), Management of cultural, environmental and landscape assets. Arachne publisher. Rome, Italy, 2005.

[8] The research, at the local office level, was overseen by Daniel Fanzini, under the supervision of Fabrizio Schiaffonati and Elena Mussinelli, and with the support of a working group made up of Giorgio Casoni, Anna Cavalleri, Stefania Terenzoni and Raffaella Riva. The works carried out form part of the research program co-funded by MIUR in 2004 "The design for the enhancement of cultural assets. Strategies, tools and project methods", coordinated on a national level by Maria Benedetta Spadolini (2004-2007).

[9] The project was promoted by the Forma Company and the province of Mantua, with the operational involvement of the Chamber of Commerce of Mantua and its Promoinpresa Company, the towns of Mantua, Castiglione delle Stiviere, Sabbioneta and San Benedetto Po, Confesercenti of Mantua, the Trade, Tourism and Services Union of the Province of Mantua, the University Foundation of Mantua, the Polytechnic of Milan and CGIL, CISL and UIL Trade Unions.
RIGHT IN THE SERVICE OF THE PRESERVATION OF NATIONAL TREASURE

Majda Rubić¹

ABSTRACT: The purpose of this study is to present the importance of establishing a register of cultural property in which cultural goods are classified status of national treasures, pointing to the significant exception of the free traffic of goods, which regulates the binding provisions of national legislation in line with EU laws, and considering the problems of protection and return of cultural objects of art, historical and archaeological value of the common market finds that the establishment of the said resolution of the conflict of interest register for a free single market for all goods with the interest of protecting national treasures by the possibility of prohibiting use of the EU Member States.

KEYWORDS: protection, national treasures, common EU market and Law, national legislation, bans trade of goods.

THEME 1.4

1 INTRODUCTION

Because of the depth and global change and establishing a modern framework for the Union's regional policy which takes into account the particularities of national traditional cultural heritage and its products are the safest to protect against damage and loss application for entry registration body. A key element of the cultural identity of European nations and regions are non-commercial values of objects of archaeological, artistic, historical and scientific data. Therefore, a national cultural treasures removed from the regime of free circulation of goods, and each EU Member State regulates the legal protection of their cultural heritage is a leading principle of the extensive application of the restrictions.

2 PROTECTION OF CULTURAL PROPERTY IN THE PROCEDURES FOR THEIR REGISTRATION

Provisions of Art 36th TFEU/L regulates the exceptions for cases where the prohibition of export, import or transit permitted, along with other cases they are justified by reasons of protection of national treasures possessing artistic, historic and archaeological value. Binding EU laws regulating the protection of cultural heritage are the Regulation on the export of cultural property no. 3911/1992 and Directive on the return of unlawfully removed cultural goods from the territory of EU Member States, no. 93/7 in 1993. The protection of cultural property remains within national jurisdictions, and in Croatia the status of objects of cultural significance and have a good national treasure that should be dealt article 36.UFEU / L and art. 42nd SAA, although the Law on the Protection and Preservation of Cultural Heritage in 2003 compliance with these European laws.

3 CONCLUSION

Today is an important issue to protect national cultural goods in a large EU common market that is saturated with commercial goods. Among Member States there are no more internal borders and customs control of goods and which included cultural material and immaterial goods, performed without restrictions. By accessing the Croatian EU-27 more will be risking the loss of cultural heritage if the membership of the Union in accordance with existing legislation does not register the heritage of national significance and if it does not list the individual as it is now
generally begun to implement. The previous requirement was the categorizing of all cultural goods and a list of moving objects that are considered national treasures that can be determined by groups of rules.

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THE CULTURAL HERITAGE IDENTITY CARD AS A BASIC TOOL FOR A “EUROPEAN BENCHMARKING CODE IN ARCHITECTURAL AND URBAN CONSERVATION”

André De Naeyer

ABSTRACT: Some conservation or restoration projects of cultural heritage buildings and historic city centres are raising pertinent questions about the orthodoxy of the intervention. The imperative needs for modern comfort and safety and the urge for modern design from certain architects often transform the authentic object to a mix of old and new in which the cultural heritage value or the identity of the object has largely disappeared. The international regulations or recommendations from ICOMOS and other are little precise and decision makers do not show always the correct sensitivity to prevent deplorable deformations. There is a need for a appropriate EUROCODE, benchmarking the ‘acceptable levels of transformation or intervention for each specific built heritage object, and this depending on the existing physical state of that object and the local or general cultural need and value (tangible and intangible). Such Eurocode should guide professionals and decision makers to guarantee an optimal conservation on the long term for each individual built heritage object. The EU-CHIC containing all relevant data on the existing fabric can also indicate the level, type and scale of any future intervention and (new) function(s) and some hierarchy on what has to be preserved at all costs and what is less important. This way, it can be an excellent tool in the decision process on what can be done and what not. For that reason, as all conservation action is by definition a multi- and interdisciplinary intervention, the EU-CHIC should involve objective and measurable benchmarking criteria for any future preservation and use of the built heritage object.

KEYWORDS: conservation, transformation, benchmarking, monument, cultural value, Eurocode

THEME

1 INTRODUCTION

The permanent cultural and physical extension of the 'monument'-concept and the integration of the non-tangible dimension within heritage concern during the last twenty years have created in some places very contested restoration or transformation projects of important historic buildings. Although many theoretical documents or guidelines on the orthodoxy of interventions are available since the mother of all modern charters (i.e. the Venice Charter of 1964), a lot of interpretation is left open, and sometimes excessively used by too self-confident ‘architects-artists’. Interpretation is inevitable as neither architecture nor conservation is an absolute objective mathematical discipline, but last years, also the ‘architectural correctness’ became a quite difficult matter. Some recent restorations projects look as a new curious building connecting some old and new, and are often the most fundamental destruction of the authentic heritage object (1).

2 NEED FOR MEASURABLE INDICATORS

Enter To prevents aberrant projects or misunderstandings due to different cultures or traditions; a EU Benchmarking Code in this field could certainly help the professionals as well as the mostly non-specialised (e.g. political) decisions makers. A Benchmarking Code should give transparent and objective quantifiable indicators to those who don’t have the full scientific preparation or the appropriate architectural or cultural feeling. A EU Benchmarking Code should give objective measurable indicators (e.g. quantities, volumes, surfaces, materials performances, functional relations, economic or financial criteria, aesthetic qualifications) on what level of intervention is possible or acceptable (e.g. maximum percentage of

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material substitution, maximum number of volume change or additions of new construction, minimal conservation level). Some hierarchy in type or value of heritage can also be taken in account (e.g. world heritage versus national or local monuments, tangible versus intangible). The start for terminological standardization has already been given through appropriate CEN Technical Committees (2), but the translation into practical applications still needs a lot of work.

For that reason, the EU-CHIC should contain as much relevant information as possible (3). This information concerns all historic and archaeological findings, materials and structural data; a full measured drawing (if possible including the output of monitoring of deformation or degradation processes), iconographic and photographic documentation, objective and independent assessment of values, risks and possible procedures. All conservation action today has imperatively to be preceded by a thorough ‘Pre-conservation analysis and evaluation’ process; this is a detailed study with detection and diagnosis of all visible and invisible physical and structural characteristics of the built fabric or settlement with or without sophisticated instruments. These techniques have intensively been developed recent years and can give most useful data (4).

Other less tangible data such as historic, cultural, aesthetic, social, functional, economic or financial data are the result of full architectural and urban survey of the heritage as a single object as well as a part of a larger context (5). An updated SWOT analysis is mostly an important element in such survey. The EU-CHIC should involve as much information of this kind as possible.

4 EXTENSION OF EXISTING INVENTORIES

Most countries already dispose of some small or large inventory of heritage buildings and/or objects (e.g. for Belgium the historic buildings inventory is a series of about 120 book volumes, describing more than 250,000 ‘established immovable heritage’ buildings and sites). These inventories mostly contain a small description and/or identification based on their archaeological and/or historical character, and (correctly) don’t involve any hierarchical evaluation. One could think about going one step further for some selected buildings and extend those descriptions, mainly limited to what can be seen from the outside of the building, towards a more consistent tool such as a full ‘Identity Card’, as described before.

3 EU-CHIC AS APPROPRIATE ADMINISTRATIVE OPERATIONAL TOOL

The Cultural Heritage Identity Card can become an excellent instrument to establish a first application tool for specific intervention levels (maintenance, preservation, stabilization, conservation, reconversion, renovation, restoration, reconstruction, anastylosis). It is obvious that the definition of each of those intervention levels must be agreed and precisely described. The CHIC has to be the basis for all decisions and should contain all relevant indicators, which help or put the limits to the architect or the user in what is acceptable or not within a specific context.

Figure 1: Ghent: renaissance guild house of bricklayers - eccentric and our of proportion extension behind traditionally restored front façade.

Figure 2: Antwerp ‘Reconversion’ of the 19th cent. St. Felix Depot into city archives – Full conservation of structures with indication of floors (red colour) with possible introduction of fire-safe ‘container’-space for the archives.

Figure 3: Antwerp – Project for disproportional extension of historic building (neo-renaissance administrative building).
It also could include the benchmarking indicators for one or more alternatives about the type of architectural intervention that could be accepted (e.g. full conservation, indicated measurable transformation, maximum number of users, proportion between old and new fabric) and even the technical standards for possible or desirable intervention within given time period (6).

5 CONCLUSION

Within the many on-going or finished EU research projects, the EU-CHIC, completed with all data mentioned before, together with a appropriate Benchmarking Code for decision making about type and level of possible intervention will be an excellent output and help for all professionals in the field (i.e. owners, financing bodies, architects, planners, engineers, contractors and maintenance managers).

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[5] More evaluation methodologies are available e.g. ‘Monument Coefficient’(Netherlands), ‘Valuation of the historic environment’ (English Heritage), ‘Assessing values of cultural heritage’ (Getty Cons.Inst., L.A.)
ABSTRACT: Belgium has a rich variety in natural stones applied in historical buildings. In the oldest buildings these are typical local stones. Since the 19th century, large amounts of natural stones have been imported from abroad (especially France). The large diversity in properties, the rather wet and cold climate of Belgium, and the fact that many stones are not available anymore, are at the base of the general problems connected with the restoration of these materials, both on the technological as on the deontological level. Below we describe some important evolutions in the field of natural stone restoration and preservation.

KEYWORDS: Natural stone, quality control, standardisation, restoration mortars, artificial stone.

1 INTRODUCTION
Belgium has a rich diversity of natural stones, that have been employed for ages in historic buildings. Some stones are found in vast quarries, where the layers have heights of several meters, and where large blocks of stone (typically lime stones) can be found. But in a large part of the country, the stones are found in the shape of isolated ‘lumps’, instead of continuous ‘banks’. The difficulties of exploiting such quarries, the heterogeneity of the stone (causing large amounts of non useable stone, resulting in a relatively small amount of useable stone, compared to the amount of work that has been investigated to quarry the stone) has caused, mainly since the 19th century, that restorations have been carried out with more easily available stones from abroad (usually from France). This is still happening nowadays, even though stone from throughout Europe is employed. This causes, evidently, problems on the issue of authenticity, even though stone replacement has become ‘a tradition’ (even though of lesser importance nowadays, because of the shift from ‘restoration’ towards ‘conservation’).

During the studies that the BBRI undertakes for restoration purposes (often in collaboration with the Royal Institute for the Cultural Heritage), we see two important developments on the restoration of natural stone: the importance of European normalisation, and the employment of artificial stones (simili-stones).

2 QUALITY OF REPLACEMENT STONE
The main qualities of replacement stone should be frost resistance, resistance against acid rain (nowadays luckily less important), and compatibility with the existing masonry (even though this requirement cannot easily be quantified, and is somewhat vague).

Frost tests have been executed for a long time, and nowadays European normalisation, particularly through the standard EN 12371, allows to control the stone quality far more easily. A test report for a stone from a country abroad can now easily be interpreted. A stone has to be tested once, for application throughout Europe, thus facilitating easily an evaluation of stone for particular applications. However, some important points of attention, from our practice:

- ‘the existence of a test report for a stone’ is not the same as ‘this stone has good qualities’.
- The interpretation of the report is not always very clear. We see sometimes that a report without explanation is mis-interpreted by architects or building contractors who are not familiar with the methodology and interpretation rules of these standards. Causing application of ill-suited stones for restoration purposes.
- Simplification of stone-properties and names of stones. Properties of one (well-documented!) stone-

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variation are extrapolated to all stones with the same name. For instance, we see the wide application of the Massangis roche claire (with poor frost-qualities, at least in the Belgian climate) instead of the very resistant Massangis roche jaune. The same goes, for instance, with the Anstrude stone (again the good yellow variety opposed to the poor white variety). Many other examples can be mentioned.

- We also sometimes notice that a quarry sells stone which is not at all found in that quarry. The commercialised stone is merely a commercial product, imported from somewhere else, but sold under the quarry’s name. Especially when this other stone is difficult to distinguish from the ‘real’ stone with that name, this could give rise to serious problems.

Because of the last two issues, identification tests are winning importance. An identification test in itself is not a quality check. It is a ‘fast’ test, that enables us to see if a certain stone will behave the same as a stone that once has been tested for its resistance (against frost, for instance). Typical identification tests are: resistance against compression, ultrasound velocity, porosity, density (preferably more than one identification test is carried out, because they remain indirect quality controls). It avoids the necessity of doing frost tests, which is usually expensive and time-consuming.

- Thus one is able to check if the stone at a construction site is the same as the stone that has been tested in the past, and suitable for the restoration purpose.

- Another application of these identification tests could be to simply avoid extra tests. Imagine a building where there is not frost damage whatsoever to the stone. But some stones need to be replaced (because, for instance, mechanical damage has occurred). By an identification test, one can easily check if new stone from the original quarry has the same properties as the stone that is already present in the building (and has already proven to have sufficient qualities). We do realize that this does not rule out all uncertainties regarding the qualities of the new stone, but at least it is a much better control, compared to just using a stone from the same quarry.

3 NEW APPROACH: ARTIFICIAL STONE

The application of artificial stone, or ‘simili’-stone is definitely not new. Already at the end of the 19th century, and definitely beginning of the 20th century, we see a wide-spread application of such artificial stone. Now however, is the application of this in restoration of important buildings, especially to replace natural stone elements. This is done, for instance, for reconstruction works, when the original stone is not available, or has poor performance. An example is the reconstruction of all the turrets and domes in concrete (initially constructed in the limestone of Vinalmont), on the Central Station in Antwerp (decorations that removed, some decades ago), for which the BBRI has performed preliminary studies (regarding durability) in the past. Innovative 3D-printing techniques have been used to form the moulds in which the concrete was cast. Another example is the restoration of the neo-gothic, early 20th century, balustrades on the choir of the Antwerp cathedral (Figure 1). The recent, ‘less authentic’ balustrades were in a very poor condition (limestone of Euville, of poor quality, was used). In spite of their importance as part of the historic layering of the building, it was chosen to replace them using artificial stone. In both these examples a cement-based replacement material has been employed, even though other production mechanisms (imitating the natural formation of the stone) are at this very moment under investigation at the BBRI.

Figure 1: Systematic replacement of neo-gothic ornaments with identical elements in artificial stone.

CONCLUSIONS

The protection and maintenance of historic buildings should be guaranteed by an continuous quality control, both while designing restoration projects, but also during execution. Standardisation (now on European Level) is a great aid to this purpose. Nevertheless, financial and deontological issues cause to develop new approaches towards well established restoration principles. The rise of techniques, where artificial stones are produced, to replace natural stone, is an example of this, and it is gaining interest in Belgium. It is an important opportunity to perform more durable restorations, keeping in mind that it could cause problems on the level of authenticity of buildings.
CULTURAL HERITAGE AND SUSTAINABLE DEVELOPMENT: TOWARDS CONCEPTUAL CONVERGENCE

Vesselin Loulanski

ABSTRACT: Cultural heritage is an evolving social concept, charged with dynamism, complexity and multiplicity as primary intrinsic features. Sustainable development is the dominant development paradigm of our time. How do these concepts relate to each other? How can they be drawn together in a common theoretical framework and further in practice? To answer the lack of comprehensive and systematic interdisciplinary knowledge linking the two so far independent notions, this paper provides the theoretic rationale for upgrading and integrating their conceptual base by means of an interpretive synthesis. The latter builds upon identified common principles and goals and new perspectives from relevant interdisciplinary fields. The paper argues that disciplinary interaction and interdisciplinary approaches are the key for building the necessary discipline-transcending terminologies, and shared methodological grounds for the elaboration of a common framework for analysis. The article provides rationale for the conceptual integration of cultural heritage and sustainable development, presumed valuable for the further exploitation of the framework of heritage preservation policy and practice. Such analysis is further deemed critical for the informed policy-making and undisrupted knowledge transfer.

KEYWORDS: Cultural heritage, Sustainable development, Conceptual convergence, Meta-synthesis

THEME 1.4

1 INTRODUCTION

The article brings together the academic accounts of cultural heritage and sustainable development and re-focus the discussion on the identification of interdisciplinary common ground between them. The theoretical rationale for their conceptual integration is presented by means of a cross-disciplinary interpretive synthesis, based on the acknowledgement that the subject of the cultural heritage and sustainable development integration is elaborately constructed from social, cultural, environmental, economic and physical viewpoints. To address the problem of persistent specialized and codified disciplinary vocabularies, languages and perceptions that seriously obstruct the adequate treatment of the complex interrelation between cultural heritage and sustainable development, the article suggests the employment of the meta-ethnographic approach, that is currently gaining recognition in terms of enhancing the analytic capacity and generalizability of multiple studies in different fields. The approach is considered essential for building the needed comprehensive and systematic knowledge base and common framework for the study of cultural heritage and sustainable development, informing equally theory and practice.

2 CULTURAL HERITAGE AND SUSTAINABLE DEVELOPMENT

Enter In order to do so, the paper feature an interpretive synthesis table that is an extensive attempt to bring together and cluster the interdisciplinary fields that are studying the relationship between cultural heritage and sustainable development, consecutively delineated by: scope and focus, relevance to the conceptual integration of cultural heritage and sustainable development, and list of key contributors to the respective disciplines. Further analysis claims that despite the expected interconnectedness in regard to the scope and focus of study among the above interdisciplinary fields, none of them is in a position to claim a singular role in its capacity to address such a complex issue as the conceptual integration between cultural heritage and sustainable development. And quite understandably so, as the subject of that integration, is elaborately constructed from social, cultural, environmental, economic and physical viewpoints. What is also found beyond doubt is that each field’s contribution to the theme can significantly add to the pool of elements necessary to build the common theoretical framework
for cultural heritage and sustainable development. In the same time though, consistent interdisciplinary efforts aimed at advancing the mechanics of such integration are still missing. Even though a number of integrative theories have recently spawned from the listed fields, the achieved results remain rather distant and too specific, resembling the pieces of a puzzle, but failing to pull together the bigger picture of cultural heritage within sustainable development. Efforts to resolve that complex issue are considered focal for the adequate understanding of the relationship, and for the effective and informed policy and practice endeavors in the heritage field.

The synthesis table and following analysis prompt an outline of some important cross-points and principles between the concepts that illustrate not only of the two’s natural embedment, but also promise to guide the process of “gluing” their many different components into the construction of a valid integrative conceptual base. The conceptual frame consists of the following nests: interdisciplinary approaches, recognition of holism and interdependence, management of multiplicity and dissonance, management of change, anthropocentric approach, inter and intra-generational equity, long-term approach and preservation of systems integrity, resource efficiency and conservation, respect of diversity and community-centeredness, cross-sectional cooperation. A concise summary for each nest is provided, laying the ground for the following methodology argument.

The advancement of the still novel method of meta-synthesis follows the interpretive synthesis table analysis. The method is cross-disciplinarily consilient and insightful for theoreticians and practitioners alike, and is considered appropriate to support integrated knowledge building, thus able to enhance the practical value of the overtly dispersed and fragmented research in both fields. The successful synthesis must be audience-appropriate, that is enabling different audiences from different fields to compare their perspectives with those revealed in the studies and in the synthesis. The method is originally designed to facilitate the dialogue between perspectives and “not to achieve closure, but to enable disclosure” (Noblit and Hare, 1988: 77). This philosophy can be considered particularly meaningful in terms of advancing the “science of sustainability” in both heritage and development terms, by conveying the notion of multiple sciences addressing a common theme, with a problem-driven research agenda, seeking to create and apply knowledge to support decision-making for sustainable development (Clark and Dickson, 2003). In an example of the multiplying efforts in this direction, Munasinghe (2002) has developed the innovative comprehensive and eclectic sustanomics approach, described as a trans-disciplinary, integrative, balanced, heuristic and practical meta-framework to define, analyze and implement sustainable development. As to cultural heritage, the new approach is expected to contribute to theory-building in the Heritage studies field, supporting the current efforts to develop greater cohesion and connectedness by providing the missing conceptual or theoretical means for modeling or mapping the interplay of economic, cultural, political, and other social contexts in which it is situated.

The paper illustrates the proposed methodology by providing an example on meta-ethnographic approach, based on a 2011 original study that provides theoretical framework on the sustainable integration of cultural heritage and tourism. The example briefly delineates the procedures and findings of the study, and explains the factors that have been found responsible to the sustainable integration of heritage and tourism.

3 CONCLUSIONS

The paper advocates the inauguration of novel methodology that is to lead to conceptual convergence in the fields of heritage and sustainability, further enhancing the research and realization of more informed, complete and effective heritage preservation policy and development.
SMART MONITORING OF HISTORIC STRUCTURES
(FP7 SMooHS Project)

Vlatka Rajčić¹, Giovanni Pascale², Stefan Simon³, Markus Krüger⁴, Alexandra Troi⁵, Camilla Colla⁶, Michal Lukomski⁷

ABSTRACT: The paper describes a project aiming at delivering novel structural health monitoring (SHM) systems capable of taking advantage of the reduction of wiring costs typical of wireless sensor networks and at the same time achieving a further cost reduction by e.g. not relying on a centralized communication gateway architecture. Such novel approaches would deliver a “place-and-forget” SHM solution that would be affordable even for historical structures that are considered of lower importance due to their smaller dimension, lower fame or reduced preservation budget.

In order to provide the practitioners in the field of cultural heritage with a tool which goes beyond the mere accumulation of data, but instead provides help in the sense of warnings (e.g. if damaging factors increase) and recommendations for action (e.g. window opening/closing, ventilation on/off, heating on/off, etc.) data fusion and interpretation is implemented within the monitoring system.

Three main case studies (located in Berlin - Germany, Schwäbisch Gmünd - Germany, and Bologna - Italy) are used to demonstrate and to validate the work that is done in the core work packages. Three test sites (located in Hebron - West-Bank, Palestine, and Vienna – Austria) served for method and system enhancement.

KEYWORDS: SHM system, wireless sensors networks, case study

THEME 2

1 TYPE OF TECHNOLOGY/ METHODOLOGY

Developments in the proposed project are designed as smart monitoring techniques that employ permanently installed technologies addressing mainly the following aspects:

- Competitiveness
  - Simple application (installation, data interpretation, calibration capability)
  - Stable long term behaviour
  - Minimally invasive mounting and installation (interchangeability, miniaturization, aesthetically appealing)
  - Open for different sensor technologies (multi sensor platform)
  - Integrated data analysis and interpretation methodologies (automatized procedures)

Taking these aspects into consideration, the focus of the monitoring system development will be on small wireless sensor networks and autonomous wireless sensors based on platforms that (i) could be used in combination with any kind of low power sensors (Fig.1), (ii) provide self organizing and reorganizing network functionality, (iii) have very low power consumption with optimized soft- and hardware functionality and (iv) achieve sufficient methodologies for data analysis, data fusion and data reduction. Additionally, competitive sensors and sensor technologies (e.g. MEMS – Micro Electro Mechanical Systems) will be developed or used, if they are already available on the market.

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However, continuous monitoring of structures is not useful if just a large amount of data is recorded and stored without further adequate analysis. This is why often continuous monitoring is unappreciated. There is a lack of sufficient models for material and structural deterioration that take into account the data from continuous monitoring.

In order to provide the practitioner in the field of cultural heritage with a tool which goes beyond the mere accumulation of data, but instead provides help in the sense of warnings (e.g. if damaging factor values increase) and recommendations for action (e.g. window opening/closing, ventilation on/off, heating on/off, etc.) data fusion and interpretation is implemented within the monitoring system. To this aim software will be developed which is:

- user friendly, to be used by practitioners in the field,
- modular (modules for specific questions arising at the object to be monitored and sensor combinations),
- open source, for maximum transparency,
- open for extensions and new modules, also from other research groups.

The modularity and open source concepts are most important for providing a dynamic tool, which can and will be updated and broadened continuously with new research results, both from partners within this project team and from other research groups with their special expertise.

2 TYPE OF PREFERENTLY MEASURED PARAMETERS AND OF MONITORED MATERIAL

A number of building materials (wood, brick and stone masonry, mortars, plasters, terracotta, pigment layers, etc.) and material assemblies typical for historic structures will be monitored for better investigation of structural damage and environmental pollution effects. With respect to the aspects of smart monitoring techniques defined above, for some applications there are presently no sufficient sensor technologies available. This is especially true for chemical attack due to gases or salts, for the measurement of moisture content inside a material and for the measurement of airflow at low speed inside buildings. For this reason new sensor technologies will be investigated and tested with these purposes (especially air flow sensors for low air speed, humidity and temperature sensors as well as acoustic emission sensors will be developed). In particular the following parameters will be measured/monitored:

- temperature & humidity (in environment and materials using resistive sensors air humidity sensors and miniaturized MEMS)
- air velocity (especially for low air speed measurement inside buildings)
- strain and crack opening (strain gauges etc.)
- acoustic emissions
- vibration, inclination (MEMS)
- ambient light, UV light, (with regard to paintings and pigments)
- chemical attack due to gases (e.g. HCl, O3, SO2, NH3 NOx, etc.) or salts (chlorides, sulphates etc.)

3 IN SITU APPLICATION

There are three climatic zones (Central European, Northern and Southern Mediterranean) represented in three main and three additional case studies during the project. Those sites offer the possibility of indoor and outdoor testing. Three main case studies are used to test and to demonstrate several different methodologies simultaneously and are also used for the modelling:

1. Museum Island, Berlin, Germany. World Cultural Heritage since 1999
2. Polychrome Portals of the Holy Cross Minster Schwäbisch Gmünd, Germany
3. Main office of the Province of Bologna, Italy

The additional case studies (freely selectable by each partner) are located in Palestinian-administered area, Jordan and Austria where specific partners are responsible.
4. Old town of Hebron in the Palestinian administered areas (West Bank)
5. Schönbrunn Palace, Vienna, Austria. World Cultural Heritage since 1996.

Figure 3: Three additional case studies

Monitoring demands would be the determination of temperature and moisture profiles within the wall thickness (at different heights), of wall surface temperature (at different heights) and the measurement of air temperature near the wall (at different heights). It would have to be checked if the water content is in liquid or gaseous form and how large is the humidity exchange at wall-air interface. Therefore, another important aspect is the air velocity at the wall surface, which directly drives desorption and absorption of water. With regard to diffusion processes, the determination of salt concentration within walls becomes one of the most important aspects of monitoring, because salt crystallization/hydration cycles within the wall could lead to internal stress and as a consequence to micro-cracking and loss of strength.

Figure 4: Interconnection between measurements, simulation and data evaluation

4 EVALUATION OF USE OF THE METHODOLOGY / TECHNOLOGY

Measures of physical, chemical and mechanical material and environmental parameters during repeated monitoring on samples and specimens in varying environmental conditions are aimed to simulate and better understand structural and material deterioration processes due to environment (Fig. 4). Based on previous experiences of authors, physical models built in the lab will simulate the form of structural elements made of brick and stone masonry, with addition of plaster layers; component materials and masonry layout will be chosen in view to reproduce complex elements typical for historical structures. Specimens will be of two types: the first type is aimed at evaluating the effectiveness of different NDT methods to quantitatively detect defects and inhomogeneity. Therefore these physical models will contain simulated defects such as voids, irregular mortar joints, inclusions, etc. The second type of specimens will be used to evaluate the capacity of the NDT methods to detect the beginning of material and structural damage and its evolution over longer periods, by measuring mechanical and physical properties. Therefore in their as-built condition, these specimens will not contain simulated defects and after a first measurement campaign, their physical parameters – i.e. moisture and salt content, such as from capillary rise in the masonry - will be progressively varied and tested repeatedly. Reliability and applicability of employed techniques to the specific cases of complex historic structures has been studied.

5 CONCLUSIONS

The use of wireless monitoring systems often are supposed to have several advantages compared to wired monitoring systems, that is for example easy installation, cost-effectiveness and autonomous operation over longer periods providing remote control and analysis features. Therefore, a lot of research and development activities are ongoing with regard to wireless monitoring systems to be applied on civil engineering structures. At first glance, continuous monitoring with wireless sensors seems to be a perfect solution to get more detailed information about structures than from visual inspection only. However, wireless monitoring is often not that simple if the monitoring task is more complex than simply acquiring and transferring relatively basic data like temperature or humidity every hour. For such simple tasks, many competitive solutions with adequate reliability in the form of data loggers, partly also equipped with wireless communication, are nowadays commercially available.

The situation becomes challenging if the desired monitoring is focused on acquiring and analysing data like stress, strain, inclination, salt and moisture content inside materials that require reliable sensor technologies and adequate signal conditioning or even vibration or acoustic emissions caused by fracture processes that require higher sampling rates. The main challenges in this context is the power supply (primary batteries are most common) and the reliability over longer monitoring periods. To remain cost-effective and practicable, a balance between the monitoring task respective to the expected result from the monitoring and the time and effort to perform the continuous monitoring must be found. This is why wireless monitoring systems frequently have to be customized for the desired monitoring objective. Although various low-cost monitoring systems and systems are commercially available, the user shall take reasonable care to choose technologies he can rely on.

ACKNOWLEDGEMENT

Work has been designed, developed and financed inside the EU FP7 project SMooHS (Smart Monitoring of
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ENERGY EFFICIENCY IN CULTURAL HERITAGE BUILDINGS AND EARLY WARNING SYSTEM FOR MICRO CLIMATE MEASURING („Climate for Culture“ and „SMooHS“)

Jochen Kaferhaus

ABSTRACT: In order to preserve our cultural heritage for a longer future we have to minimize energy cost to be able to afford these monuments in future. The past has shown that complex technical installations in historic buildings are no longer a guarantee of better micro climate. On the contrary famous examples as Stift Klosterneuburg, (A), and Skokloster Castle, (S), are showing that cultural heritage has better chance of surviving without complex housing services.

KEYWORDS: Energy saving, sustainability, housing services, comfort, damage prevention, preventive conservation

THEME 2

1 INTRODUCTION

Main principles of stable indoor climate with energy saving and sustainability in historic buildings are:

- Use of the thermal masses of the building
- Improve thermal quality (i.e. roof insulation, windows, etc.)
- Air tighten the hull and create good buffer rooms
- Choose best possible shading and glass quality to minimize external loads
- Minimize internal load (i.e. light)
- Minimal air change rate, controlled by air quality sensor and absolute humidity indoors and outdoors
- Chose simple controlling systems
- Last not least and most important: pure radiation heat – never use convective heat through ventilation because of negative drying effect of rel. humidity and dust transportation

2 ENERGY EFFICIENCY IN HERITAGE BUILDINGS

What are the main topics to reach climate stability, energy saving and sustainability in historic buildings? In the EU project „Climate for Culture“ is shown in the project „Art Gallery“ in the „Academy of Fine Arts“, Vienna, a museums planning „state of the art“, energy saving and mold protection in the famous Viennese „Museum of Fine Arts“ (KHM) and the intelligent planning of a underground book depot in monastery of Einsiedeln, which needs no cooling and is heated only by waste heat of computers.

Since microclimate measuring are always „ex post“ data, it would be very helpful to have a warning system, which gives an alert before something happens due to bad microclimate in an object.

The author of this paper has developed an early warning system in the course of „SMooHS“ project.

2.1 CLIMATE FOR CULTURE

In the course of the EU project “Climate for Culture” of the 7th Framework influence of climate changes to our cultural heritage is researched by a large group of scientists. In several case studies new and simple control strategies were demonstrated well as energy saving in historic objects and sustainability were researched.

The typical case is a case of the monastery of Einsiedeln where the protection of numerous and precious books is needed. The underground depot (500m²) is build and the existing historic building will be transformed into library.

Various dynamic simulations have proved that cooling of such an underground depot with continuous temperature of the earth about 10-13°C is not necessary. Different insulation keeps the balance of heat losses and gains in the depot and tempering in the walls, which got a clay plaster for humidity exchange, avoid mold and keep a minimal temperature between 18 and 22°C.

Ventilation of 0,5 to 2 air exchange rate is planned. For heating the depot waste heat from the IT trough a heat pump is used.

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2.2 SMOOHS (SMART MONITORING OF HISTORIC STRUCTURES)

Besides finding best possible new measuring devices ("smart-mote") one part of EU project “SMooHS” of the 7th framework was to show on site in different case studies the application of new measuring devices and energy saving examples. In Schönbrunn Castle in Schönbrunn Chapel destroying rising humidity was measured and healed with a very cost effective provisory wall heating. The initial idea of creating an early warning system for climate measuring systems was the idea that all electronically stored data in a museum never do indicate a wrong development of micro climate in a museum before this happens because all climate data in principle are ex post data which always come afterwards when critical situations had happened and would have destroyed artifacts.

It would be of mayor interest to know critical situations in microclimate in museum before they happen and before they harm artifacts. To reach the ambitious goal of early warning system a data base of room measurements of the object to measure of about 2 to 3 years is necessary because the climate alarm needs former data to analysis congruity with the present climate data.

The following graph shows a situation in collection of ancient music instruments (SAM), Kunsthistorisches Museum, Vienna, room 14, on 9. March 2010 with checking hours in the past of 72 and prognosis hours of 6 hours with the result that on top left of the chart temperature keeps in defined limits as well as relative humidity in the chart seen on top right.

CONCLUSIONS

Sustainability, energy saving and stability of climate is not a question of machinery or building services. It is the result of integrated, intelligent planning including using the masses of the building. Best shading, air tightness, buffer rooms, minimal internal and external loads, small ventilation, radiation heat, decentralized humidification are the colons on which sustainable planning is based on.

REFERENCES

PORTABLE 3D OPTICAL MICROSCOPE AS A TOOL FOR IDENTIFICATION OF CLIMA CHANGE INFLUENCE ON HERITAGE ASSETS

Petra Štukovnik¹, Roko Žarnić², Violeta Bokan Bosiljkov³

ABSTRACT: In the paper properties of portable 3D Digital Video Microscope System HIROX will be presented first, followed by the reference analyses of results of on-site tests carried out on Byzantine church Agios Petros Domikanon in Heraklion on island Crete, on surfaces painted with frescos in Brežice Castle, Slovenia, and on renders of church of Holy Three Kings which stands on an altitude of 1188 m of Slovenian Pohorje Mountains. The analyses were carried out in framework of EU FP7 project Climate for Culture and will be presented in detail in the full paper

KEYWORDS: 3D microscopy, in-situ tests, heritage assets, cracks, salt weathering, biodegradation

THEME 2

1 INTRODUCTION

Heritage assets that embrace also historical buildings and their collections present national and cultural identity of a nation. Historical buildings are often in bad shape, due to decay of materials and damaged structural and non-structural elements. Causes of damages are in many cases due to changes of climatic influences of indoor and outdoor environment. On the porous mineral surfaces, such as renders, plasters, frescoes, masonry walls etc., they are evident in form of salt crystallisation (efflorescence and sub-efflorescence) and consecutive alveolisation, bulging, scaling, spalling and/or cracking. Another evidence of mineral surfaces decay is colonisation by living organisms, often designate as biodegradation.

When historical assets are renovated and/or restored, approach based on accurate diagnosis of the asset and its surrounding is seldom applied. This is especially true for historical buildings. Therefore we are often confronted with renewed and faster decay of the buildings after intervention. Accurate diagnosis of the historical building condition before planning of intervention actions is thus of prime importance, using predominantly adequate non-destructive techniques (NDT). Among NDT techniques in-situ application of portable 3D optical microscope system seems to be a powerful tool to gain important information about damaged heritage assets. The same equipment can also be used after the application of minor destructive tests, such as pull-off test, coring and surface and in-depth probing. On the other hand, specimens taken from building can be analysed with the equipment in laboratory. In the paper properties of 3D Digital Video Microscope System HIROX (3D microscope) will be presented first, followed by the analyses of results of on-site tests carried out on Byzantine church Agios Petros Domikanon in Heraklion on island Crete, on surfaces painted with frescos in Brežice Castle, Slovenia, and on renders of church of Holy Three Kings which stands on an altitude of 1188 m of Slovenian Pohorje Mountains. The analyses were carried out in framework of EU FP7 project Climate for Culture.

2 3D MICROSCOPE

3D microscope system available at the University of Ljubljana, Faculty of Civil & Geodetic Engineering, consists of HIROX KH-3000-LCD main control portable unit, portable 0-50x macro lens with depth of field equal to ∞ - 3 mm, portable 50x-400x zoom lens with depth of field equal to 13-0.2 mm and non-portable co-axial zoom lens 350x-7000x with depth of field equal to 40-0.8 µm. With the 50x - 400x zoom lens several available adapters

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can be used. One of them is dynamic rotary head with changing angle (25°-55°) of observation (Figure 1). The rotary head allows observations of the conditions of the sides of the object. In case of pores or cracks we can observe inside of the pore walls or have a look behind the crack without rotating the lens or the object. Therefore, in case of on-site tests, we can observe space behind the detached plaster, for example, if detachment is accompanied with cracks. On the other hand, we can observe inside of cracks and thus determine, if the crack is only surface crack or if it progresses deeper in the base material. Image or movie of observations can be captured as well.

Figure 1: Dynamic rotary head (HIROX presentation CD, 2004).

Motorized stage with the motor controller and minimum single step of 0.05 µm enable taking of images from different focal planes and digitally merge them into single image with extended depth of focus (multi-focus image) (Figure 2). Thus 2D and 3D image of observed non-flat sample can be obtained. In addition, surface texture of the multi-focus (3D) image can be obtained and presented, including its roughness/waviness distribution in selected sections.

Figure 2: Multi-focus image
Images of coin from 10 different focal planes merged into single image with extended depth of focus – multi-focus image of the coin (HIROX Presentation CD, 2004).

Additionally, various measurements are integrated in the 3D microscope system, which allow us to measure different lengths, shapes, angles and areas, as well as to count, without touching the surface of test samples. Results of these measurements can be used as input for adequate stereological expressions in order to estimate properties of three-dimensional material, such as volume fraction of aggregate in mortar, characteristics of void system in mortar or masonry units, etc.

For on-site measurements with 3D microscope special supporting system was constructed in order to enable the application of the 50x-400x zoom lens and available adapters for microscopic observations, measurements and taking of images or movies also on-site, predominantly on vertical walls and horizontal ceilings. Figure 3 shows arrangement of 3D microscope system for the on-site testing, in front of plaster with colonisation of organisms, and Figure 4 shows the 50x-400x zoom lens used for observation and measurements of cracks in the fresco.

Figure 3:Arrangement of 3D microscope system on site.

Figure 4:Position of 50x - 400x zoom lens for crack observation and measurements.

3 MEASUREMENTS OF CRACKS IN BREŽICE CASTLE

In the paper measurements of cracks carried out in the Castle chapel are presented. The chapel is a small room (7, 5m long and 5m wide) in a second floor of the Brežice castle. It stays in the west part of the castle. All walls and ceiling were painted with baroque frescoes in 1720. It has been restored fifty years ago. Today it has different damages like cracks, damage on colour layer, holes…(Figure 4).

The width of cracks was measured with 3D microscope at the 50X magnification at four different positions in the
The indoor temperature was 10.5°C and RH was 54%. Results of measurements are given in Table 1. In Figure 5 the image of the 1st and 2nd measurement points at the position 2 is presented.

**Table 1: Widths of cracks at different positions**

<table>
<thead>
<tr>
<th>Position</th>
<th>1st measurement point</th>
<th>2nd measurement point</th>
<th>3rd measurement point</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>385 µm</td>
<td>351 µm</td>
<td>-</td>
</tr>
<tr>
<td>P2</td>
<td>372 µm</td>
<td>182 µm</td>
<td>-</td>
</tr>
<tr>
<td>P3-1</td>
<td>306 µm</td>
<td>358 µm</td>
<td>-</td>
</tr>
<tr>
<td>P3-2</td>
<td>707 µm</td>
<td>923 µm</td>
<td>232 µm</td>
</tr>
<tr>
<td>P4</td>
<td>24 µm</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Figure 5: Measurements taken at position 2.**

Figure 6 presents 3D image of the crack at position 2, profile graph along the line that covers the measurement line L1 and topographic image of the surface with crack at position 2. From the profile graph we can conclude that maximum width of crack at the measurement point 1 (L1) is at the surface and is gradually narrowing through the plaster towards the base wall. The same is actually true for the whole crack segment presented by the 3D image. The topography of the crack segment clearly shows only two points in light blue colour, which belong to the deepest part of the crack segment, with height of about 2 mm. Other parts of the crack segment are in green and yellow a colour, which means that these parts are shallower. This indicates that the crack is most probably surface crack in coloured layer and plaster and does not propagate in the structural wall.

We can also see that the width L1 of the crack measured on-site (372 µm, Table 1) is equal to the same width obtained by positioning lines A and B of the profile graph on the left and right edge of the crack (371.787 µm, Figure 6). It means that by selecting grid with distance between measuring points in the grid joints of about 5 mm at 50X magnification, we can actually measure width of particular crack at arbitrary points by selecting profile graph at these points.

**Figure 6: 3D image of the crack at position 2, along with profile graph and topographic image**

**4 BIODEGRADATION IN CHURCH OF HOLY THREE KINGS**

Presented measurement location is location with extent biodegradation. Visually detected biodegradation in form of green areas covers about 7 m² of the location surface (Figure 3). The microscopic observation on the position 2 revealed that biodegradation is in progress and has influence on the outer layer of the plaster. On the multi-focus image (Figure 7) we can see that green surface (extent biodegradation) is closer to the microscope lens as surface that should be without biodegradation (based on visual observation). Difference is about 500 µm. This can be due to thickness of the biological growth or influence of root system of the growth that is lifting up the outer layer of the plaster. From the image we can also see that the root system is progressing towards “non-damaged” part of the plaster. The used magnification was 100 x.
5 SALT WEATHERING OF AGIOS PETROS DOMIKANON

The small fresco was painted on the south wall of the church. Different types of salt on the fresco surface were detected. The picture below presents multifocus picture, 3D graph and profile graph of the fresco surface (Figure 8). Two different salts are seen very well on the multifocus picture. Dark white (beige) crystals represent the first type of salt and white salt crystals represent the second type of crystals of salt. On the right side of the multifocus picture and 3D image white salt crystals covered the dark white (beige) crystals. The magnification used was 200 x.

6 CONCLUSIONS

Short presentation of images obtained on-site by the 3D microscope and analyses of these images reveals that the equipment can provide important information about extent and type of damages on heritage assets. Various types of damages of mineral surfaces such as alveolisation, bulging, scaling, spalling and/or cracking can be identified, measured and monitoring, if needed. Beside, efflorescence can be analysed and different types and shapes of salt crystals can be identified. In case of biodegradation different biological colonisations can be distinguished and progress of the colonisation can be observed. Results of the measurements presented in the paper show that 3D microscope can be a powerful non-destructive method for the on-site research of surfaces of heritage assets.
SHAKING TABLE TESTS FOR THE SEISMIC PROTECTION OF ANCIENT MASONRY CONSTRUCTIONS

Sergio Lagomarsino¹, Chiara Calderini², Paolo Clemente³, Gerardo De Canio³, Marialuisa Mongelli³, Michela Rossi², Dario Rinaldis³

ABSTRACT: In the paper, a series of shaking table tests on historic architectural elements performed in the context of the PERPETUATE project are presented. In particular, an obelisk, an arch-pier system and a cross vault were considered. The goal of the tests was the evaluation of displacement capacity of such elements and the validation of performance-based seismic analysis procedures developed in the PERPETUATE project. To this aim, the models were subjected to Incremental Dynamic Analysis (IDA) tests. The experimental results were then compared with the theoretical results obtained through a displacement-based procedure of analysis developed by the authors for masonry structures subjected to rigid blocks collapse mechanisms in the framework of capacity spectrum method.

KEYWORDS: Shaking table tests, Masonry, Displacement-based design

THEME 2

1 GENERAL OVERVIEW

The paper presents a series of shaking table tests on historic architectural elements planned and performed in the context of the PERPETUATE project [1]. In particular, three architectural elements were considered: an obelisk, an arch-pier system and a cross vault. At the time, the tests were carried out on the obelisk and on the arc systems only, while the cross vault model is under construction (the tests will be carried out in July 2012). The goal of the tests was the evaluation of displacement capacity of such elements and the validation of performance-based seismic analysis procedures developed in the project. To this aim, given a time-history, the models were subjected to increasing value of PGA up to collapse, thus performing an experimental Incremental Dynamic Analysis (IDA). The experimental results were then compared with the theoretical results obtained through a displacement-based procedure of analysis developed by the authors for masonry structures subjected to rigid blocks collapse mechanisms in the framework of capacity spectrum method [2]. All the tests were at ENEA UTTMAT-QUAL laboratory in Casaccia (Rome). The displacement data have been recorded by means of a new, innovative, high resolution 3-D optical movement detection and analysis tool named “3DVision”, tracking the dynamic displacement of special markers positioned at selected points of the structures during the shaking table tests [3].

2 TESTS ON A THREE-BLOCKS OBELISK

The study of the Egyptian Obelisk located in piazza S. Giovanni in Laterano, Roma (Italy) were performed in order to analyse the seismic behaviour of simple multi-blocks structures.

2.1 THE LATERENASE OBELISK IN ROME

The “Obelisco Lateranense” is the tallest and most damaged Egyptian obelisk in Rome (Italy). It was positioned at the current location of Piazza San Giovanni in Laterano in the 16th century by the architect Domenico Fontana: he made the connection of the three large fragments in which the obelisk was broken due to the crash occurred at its previous location at the Circo Maximo and the rupture in three blocks. The Obelisk is 32 m tall and is composed by three blocks of granite connected each other and at the base by three crux metallic joints. The obelisk stands on a 10 m tall basement and, considering also the crux on the top, the total height of the monument is 45 m [4].
2.2 SHAKING TABLE AND PULL RELEASE TESTS

A 1:6 reduced scale mock-up of the obelisk, with the same hinge connections between the blocks designed by Domenico Fontana has been realized. As the original obelisk, the mock-up is not base symmetric and the geometry of the hinges does not allow sliding, therefore combined multi directional rocking is present for this structure. The obelisk mock-up has been subjected to the following series of shaking table tests: pull release (to characterize the rocking dynamics), one directional and three directional earthquakes, one directional and three directional pulse. The tests have been performed on the single block, double blocks and three blocks configuration. Figure 1 shows obelisk mock-up on the shaking table, the light spots at the corners of each block are the retro reflecting markers for 3DVision-DDA.

![Figure 1: the obelisk on the shaking table for the seismic tests](image)

Figure 1: the obelisk on the shaking table for the seismic tests

Figure 2 shows the results of experimental Incremental Dynamic Analysis (in red) together with the theoretical results obtained through PERPETUATE methodology on the three-blocks obelisk.

![Figure 2: IDA of the obelisk – experimental (in red) vs. theoretical (in black) results.](image)

Figure 2: IDA of the obelisk – experimental (in red) vs. theoretical (in black) results.

3 TESTS ON AN ARCH MODEL

The behaviour of arch-piers systems reinforced with different types of tie-rods was analysed. Besides the general aims discussed in §1, in this case, the analysis of the influence of the stiffness of tie-rods on arch-piers systems was also considered.

3.1 THE ARCH MODEL

The model is composed by discrete blocks made of plastic material (Figure 3). The plastic material adopted is a polymer named Polyamide 6 cast. Thin membranes of Polyvinyl Alcohol foam were introduced between blocks. Two different tie-rods were considered in the arch-piers system (in steel and in nylon). Both tie-rods were subjected to an axial force of 10 N.

![Figure 3: the arch model adopted for the seismic tests](image)

Figure 3: the arch model adopted for the seismic tests

3.2 SHAKING TABLE TESTS

Two different accelerograms (characterized by comparable PGAs and different displacement demands) were applied to each configuration. They were obtained by scaling two accelerograms recorded in L’Aquila 2009 earthquake. Both freestanding and reinforced arches were considered. The tests showed that reinforced arches collapse with PGA up to 6 times greater than freestanding ones. More flexible tie-rods increase the displacement capacity of the structure and thus the collapse multiplier. Figure 4 shows the results of freestanding arch, with one of the time-histories considered.

![Figure 4: IDA of the freestanding arch – experimental (in red) vs. theoretical (in black) results tests](image)

Figure 4: IDA of the freestanding arch – experimental (in red) vs. theoretical (in black) results tests
TESTS ON A MASONRY CROSS VAULT

A full-scale cross masonry vaults will be tested on the shaking table in July 2012. The model is actually under construction. The aim is to analyse the seismic behaviour of vaults by assessing their damage modes and by experimentally evaluating their shear drift.

4.1 THE VAULT MODEL

In general, the model reproduces a cross vault with asymmetric boundary conditions, representing vaults typically lying on one side of churches and mosques or in cloisters and arcades. More in detail, the idea is to reproduce the geometry of a real cross vault of the Mosque of Dey in Algiers (Figure 5, left). The Mosque is constituted by a central dome surrounded by a series of cross vaults resting on marble columns. Such vaults are made by the intersection of two about semi-circular barrel brick vaults thickened by an ogival arch along the longitudinal direction and reinforced by a couple of wooden ties. Rounded wooden logs lie at the base of arches (Figure 5, right); such logs are supposed to be earthquake-resistant traditional components.

The model under construction (Figure 6) reproduces in size, geometrical shape and constructive details one of these vaults. However, in order to simulate the boundary conditions of the real vault, which is not an isolated structure but is included in a greater one, some technical details were introduced. Moreover, further simplifications were introduced due to technical problems related to the shaking table. In particular, marble columns were removed in order to lower the centre of mass of the structure (thus limiting the flexural moment on the table) and a portion of the masonry external wall was cut off in order to better balance and arrange the mass distribution.

4.2 PLANNED TESTS

The objective of the test is to simulate a specific damage condition, that is the drift of vault in its horizontal plane. Experimental Incremental Dynamic Analysis tests will be performed.

5 CONCLUSIONS

The tests provided much information on the damage and seismic behaviour of the architectural elements considered. Moreover, the comparison between the experimental and theoretical results showed the reliability of PERPETUATE methodology to assess their seismic vulnerability.

ACKNOWLEDGEMENT

The results were achieved through the project PERPETUATE (www.perpetuate.eu), funded by the European Commission in the 7th Framework Programme (FP7/2007-2013), under grant agreement n° 244229.

REFERENCES

MODELLING CLIMATE CHANGE IMPACT ON CULTURAL HERITAGE – THE EUROPEAN PROJECT CLIMATE FOR CULTURE

Johanna Leissner¹, Ralf Kilian², Florian Antretter³

ABSTRACT: Climate Change is one of the most critical global challenges of our time. For many decades a huge number of scientists from all over the world have been researching this topic and are developing complex climate models, which will be suitable to make future climate projections. However, less certain information is available on how the changing climate affects mankind and its environment. Although many studies have been conducted to explore the impact of climate change on e.g. biodiversity and agriculture or on fresh water availability, only little is known on whether and how climate change influences our cultural heritage. Within the integrated European funded project ‘Climate for Culture’ (2009 - 2014), a multidisciplinary research team consisting of 27 partners from the EU, Croatia and Egypt is performing research to estimate the impacts of climate change on the indoor environments in historic buildings and their vast collections in Europe and the Mediterranean. In order to identify the most substantial risks, the project has taken the innovative approach of correlating high resolution climate change scenarios with building simulation models. This document provides an overview of this aspect as one of the key elements of the project.

KEYWORDS: Climate Change, Climate for Culture, climate scenarios, climate simulation, building simulation, climate indices, tools, cultural heritage

THEME 2:

1 INTRODUCTION

Climate Change is one of the most critical global challenges of our time. For many decades a huge number of scientists from all over the world have been researching this topic and are developing complex climate models, which will be suitable to make future climate projections. Climate change is not the main concern; more important is its impact on the planet. But less certain information is available on how the changing climate affects mankind and its environment. Although many studies have been conducted to explore the impact of climate change on e.g. biodiversity and agriculture or on fresh water availability, only little is known whether and how climate change influences our cultural heritage. Within the integrated European funded project ‘Climate for Culture’ (2009 - 2014) a multidisciplinary research team consisting of 27 partners from the EU, Croatia and Egypt is performing research to estimate the impacts of climate change on the indoor environments in historic buildings and their vast collections in Europe and the Mediterranean.

2 PROJECT APPROACH

To assess future projections of outdoor climate changes on the indoor environments in historic buildings and its impacts on cultural heritage items, the ‘Climate for Culture’ project has started for the first time ever to connect completely new high resolution climate change evolution scenarios with whole building simulation models. Against this background, the main scientific innovation of the project consists of:

• The development of a regional climate model over entire Europe including Upper Egypt with a resolution of 10x10 km.
• The development of a whole building simulation tool adapted to historic buildings.
• The coupling of climate simulation with building simulation, which has never been performed before.

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2.1 CLIMATE SIMULATIONS

According to the World Meteorological Organisation the term climate can be defined as ‘the statistical description in terms of the mean and variability of relevant weather quantities over a period of time’. These elements determine the state and dynamics of the Earth’s climate. Climate covers different weather elements like temperature, air humidity, wind, clouding, precipitation, sunshine duration, air pressure, snow fall, radiation and evaporation. All these parameters including their interactions with the atmosphere, the hydrosphere, the cryosphere, the surface lithosphere, the biosphere, and the resulting carbon cycles are integrated into so called general circulation models, nowadays called global climate models (GCM). They are the most complex computer models existing up to now. Furthermore, global climate models also must take into account parameters which cannot be calculated and for which we do not have any values from the past. For example we must do assessments on the future population growth or on which technologies will be applied to curb CO2 emissions. These descriptions are called scenarios for which the climate models calculate climate projections. Within the ‘Climate for Culture’ project two scenarios are investigated for the high resolution climate simulations, the A1B scenario and the very recent RCP4.5 scenario for the next IPCC assessment report 5 (AR5) due in 2014.

<table>
<thead>
<tr>
<th>Value</th>
<th>Unit</th>
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<tr>
<td>Temperature</td>
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<td>Relative Humidity</td>
<td>HREL%</td>
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<tr>
<td>Normal Rain</td>
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<td>Wind Speed</td>
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<td>Wind Direction</td>
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<tr>
<td>Global Radiation</td>
<td>ISGH W/m2</td>
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<td>Diffuse Radiation</td>
<td>ISD W/m2</td>
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<td>Global Counterradiation</td>
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<td>Cloud Coverage</td>
<td>CI %</td>
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<td>Ground temperature</td>
<td>°C</td>
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<tr>
<td>Ground reflectance</td>
<td>-</td>
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<td>Air Pressure</td>
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Figure 1: Defined sets of climate indices

Within the first period of the project (30 months), we have been concentrating on the mid-line A1B scenario. Here a greater CO2 emission increase is assumed until 2050 and a decrease afterwards. Originally B1 was planned as the second scenario to drive the simulations of near- and far future climate. However, in the recent past the global circulation model community launched the climate runs driven by the new AR5 IPCC emission scenarios. Therefore, it was decided to take the finer tuned RCP4.5 as the second scenario for the ‘Climate for Culture’ project. RCP 4.5 stands for Representative Concentration Pathway (RCP) 4.5 and is a scenario of long-term, global emissions of greenhouse gases, short-lived species, and land-use-land-cover which stabilizes radiative forcing at 4.5 Watts per meter squared (W m-2, approximately 650 ppm CO2 equivalent) in the year 2100 without ever exceeding that value. For the development of the whole building simulation tools, sets of climate indices were defined (see Figure 1 below). The test datasets were prepared for the period of 1950 to 2100. The calculations made for the period of 2001 to 2010 are based on the A1B IPCC scenario. A main objective for the first period until project mid-term is the assessment of available and applicable tools to convert modelled exterior climate data into interior climate conditions to assess the climate change impact.

2.2 BUILDING SIMULATIONS

Modeled climate data needs to be verified and processed to be suitable for building simulation as well as new methods and modules for the simulation tools to be developed, implemented and tested. A successful application of suitable simulation tools allows computational testing of active and passive adaptation and preservation strategies.

Figure 2: Location sites for which climate indices are provided

The tools Hambase, IDA, EnergyPlus, ESP-r, WUFIPlus, TRNSYS were tested. The results revealed that Hambase, WUFIplus and possibly IDA-ICE are suitable for modelling the change in relative humidity fluctuations due to moisture buffering. For some buildings already software models for case study buildings exist, such as for Linderhof castle, Kings House on the Schachen, the church of Roggersdorf or Amerongen Castle. Those case study building models allowed to produce first results, derive suggestions for
software development and improvement and to apply different active and passive measures in the model. The development of the building simulation tool is also based on real data from historic buildings collected as case studies. For this purpose a survey with a specially designed, virtual usable questionnaire was performed to set up a range of case studies from all over Europe and Egypt. The questionnaire covers up to now over 106 case studies in eleven countries (see Figure 2, red square). Parameters like type of building, specific site-related factors, available indoor and outdoor climate data, observed damages and suitability for other work packages are reviewed and are transferred into a database with its several layers of information (see Figure 3). The list of case study buildings is continuously updated and further extended.

Based on the climate data received from work package 1, the project partner Doerner (DIBS) developed a climate classification map over entire Europe and Northern Africa. The climate map is derived from an overlay of temperature and humidity for the baseline climate 1960-1990 since temperature and humidity changes have a great influence on most degradation processes of materials. Applying this procedure we gained four climate zones shown in Figure 4. These were established to organize the collection of crucial data from various historic buildings. For each climate zone, a zone leader is responsible for a harmonized data collection.

According to the description of work: “In the cultural heritage sector the traditional use of thermo-hygrographs continues, which can be observed in almost any museum. The data charts are valuable for instant inspection of the actual temperature and relative humidity, but cannot be easily evaluated for logistical technologies. The in situ measurements are carried by laser speckle interferometry, which was developed in a previous EU project (Laseract) and by 3D microscopy. The two methods have been already successfully applied at the test site at Fraunhofer Institute for Buildings Physics in Holzkirchen (Germany) and at several case study sites in Croatia and Crete and show good complementarity.

To assess the corrosivity impact of indoor and outdoor conditions at cultural heritage sites throughout Europe investigations by glass sensors from the previous EC project AMECP have further been installed at case study sites in Crete, Croatia and Germany. These examinations will allow a much more precise and integrated assessment of real damage impacts of climate change on cultural heritage at regional scale. In terms of climatization of historic buildings a survey of the state of the art has been finalized and will be used to develop appropriate mitigation/adaptation strategies. This means that active and passive measures are discussed and defined resulting in the implementation of humidistat heating and equal sorption as well as in absolute humidity control algorithm in WUFI®Plus. Also different existing and new microclimate control approaches are considered in the Hambase and MATLAB/Simulink environment. All these results will be finally incorporated into the assessment of the economic costs and impacts.

2.3 SOFTWARE DEVELOPMENT FOR DIGITIZING ANALOGUE DATA CHARTS FROM THERMOHYGROGRAPHS

An important achievement is further the development of algorithm by project partner RSD Jan Radon in order to transfer thermo-hygrographs into a digital format. As another contribution to innovation in the cultural heritage sector, this will soon be available to stakeholders for testing the practicability in daily conservation work.
reasons since the conservator has to check and collect the sheets on a daily or weekly or monthly rhythm. This action requires a huge personal and time capacity, which not many Museums/cultural heritage owners can simply afford due to restricted budgets. For collections that are still dependent on the use of thermo-hygrographs, ‘Climate for Culture’ software will provide a special accessory for digitizing graphics which will help to enhance the evaluation of existing and also of historic climate data.” (see Figure 5).

The ‘Climate for Culture’ project will thus couple high resolution climate indices from two climate scenarios with a whole building simulation software developed especially for historic buildings to estimate more systematically future thermohygrometric change (see Figure 6 representing T and RH measurements for a historic building in the past) and its damage potential for the collections inside the buildings.

![Figure 6: Measured data of a historic building over a period of one year, indicating areas of high risks for sensitive materials (frost, microbiological growth and dryness) and for future modelling of a building in the year 2100 as final project result](image)

3 CONCLUSION

Results on the changing thermal environment, calculated by using building simulation software and high resolution climate modelling, allow a first assessment of the influence of climate change on historic buildings. With further use, this method will support more reliable predictions on temperature and humidity levels as well as projections of other parameters such as daily fluctuation, freeze/thaw cycles or differences between day and night.

4 REFERENCES

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DEVELOPMENT AND APPLICATION OF PERFORMANCE-BASED APPROACHES FOR THE ASSESSMENT AND SEISMIC PROTECTION OF CULTURAL HERITAGE BUILDINGS IN SLOVENIA

Meta Kržan1, Patricia Cotič2, Vlatko Bosiljkov3

ABSTRACT: Within the framework of EU research project PERPETUATE - extensive in-situ and numerical investigation of individual heritage assets and groups of buildings has been carried out in Slovenia. In order to exclude the uncertainties in respect to applied modelling strategies, construction knowledge, effectiveness of particular strengthening techniques and effect of soil-structure interaction (SSI) on the seismic capacity of cultural heritage assets, various architectural types of buildings were investigated. For the case studies in Slovenia, problematic issues such as material characteristics in case of deteriorated masonry, improvement of stone masonry by grouting with different types of grout injections, introduction of ties for prevention of local mechanisms of failure and resonance effect due to SSI were dealt with. The Macro block model method is convenient and efficient for determining the vulnerability of groups of buildings, while global response mechanism produce more realistic results in respect to single buildings assessment. Knowledge factor should be defined depending from the adopted strategy of modelling. With proper introduction of low cost strengthening techniques considerable stock of building may be preserved in the case of seismic events of lower intensity with higher probability of occurrence.

KEYWORDS: masonry, heritage buildings, seismic analysis, in-situ tests, strengthening, material characteristics,

THEME 2

1 INTRODUCTION

The seismic assessment of old masonry cultural heritage buildings is subjected to many uncertainties, as the variety of material and architectural characteristics of the buildings is enormous and buildings are set to specific geological area and urban context. Furthermore, the knowledge regarding geometrical properties of the structural system, details of construction and built in materials (material properties considered in the analysis) can extend from very limited to very good. Moreover, for the prediction of seismic capacity different strategies of modelling can be applied, of which some are more efficient for specific types of buildings and urban settings. The estimation of the seismic capacity and the effectiveness of various strengthening interventions is therefore a rather difficult task.

Within the framework of EU research project PERPETUATE (www.perpetuate.eu) the efficiency of different strategies for the assessment of old brick as well as stone masonry structures was investigated. Two individual architecturally diverse buildings in different seismic areas were thoroughly investigated with extensive in-situ investigation and numerical analysis. On one of them also the efficiency of retrofitting with different grout injections was studied. On the other hand two larger case studies analysing also the influence of urban background have been done.

In current European standards for earthquake resistant design, assessment and retrofitting of buildings EN 1998-3:2005 [1] the uncertainties that arise from limited knowledge of the building are to be considered with confidence factors, which correspond to certain knowledge levels. These knowledge levels serve also for the purpose of choosing the admissible type of analysis. One of the main objectives was to assess whether these confidence factors are satisfactory for different problematic issues in respect to specific buildings analysis.

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2 SINGLE CULTURAL HERITAGE ASSETS ASSESSMENT

Two individual buildings case studies in Slovenia have been analysed: brick masonry buildings with lime mortar (the Kolizej Palace in Ljubljana) and a stone masonry house in the N-W part of Slovenia. For both assets various investigation techniques (NDT, MDT and DT) were applied in order to achieve the full knowledge level and also different modelling approaches were used.

2.1 THE KOLIZEJ PALACE IN LJUBLJANA

Extensive experimental and numerical work was carried out on 150 yrs. old Kolizej Palace in Ljubljana (Slovenia), which has recently been demolished. This building was interesting mostly because of accelerated deterioration due to moisture in one storey, while all the other floors were in normal condition. Microtremor measurements, in-situ shear and compressive tests showed tests, moisture measurements as well as numerous laboratory tests on masonry components and assemblages revealed that moisture content and state of deterioration affected both strength and stiffness properties of built masonry.

Following the results of seismic analysis determined using structural element model (SEM) considering both storey mechanism response by SREMB software and global response mechanism calculated with 3Muri, the building would not withstand earthquake resistance demands according to current standards [2]. The influence of decay of material on the decrease of seismic capacity may be estimated between 29 and 37% for longitudinal X and transversal Y direction respectively.

![Figure 1: State of deteriorated brickwork masonry and model for SEM analysis](image)

2.2 STONE MASONRY BUILDING IN N-W PART OF SLOVENIA

The influence of different grout injections (cement and combined cement-lime) on mechanical characteristics of the stone masonry [3] and consequently on the seismic capacity was studied on a smaller multi-leaf stone masonry residential building in the Bovec region. With extensive in-situ campaign a reliable set of mechanical properties also depending from the type of grout was gained for further numerical analysis. Performance based studies were made through the comparison of crack-pattern survey from the building following '04 earthquake and the results of different SEM and MBM strategies.

![Figure 2: Cross section of investigated building with positions of in-situ tests](image)

3 GROUP OF BUILDINGS IN HISTORIC URBAN SETTINGS

Within this scope, seismic vulnerability study for group of buildings from rural and urban architecture was done. For the first a set of already damaged buildings from Bovec basin (N-W Slovenia) that has been struck by two strong earthquakes in 1998 and 2004 was investigated, while for urban architecture the historic city center of Ljubljana was analyzed. For investigation of the vulnerability of a group of buildings a different modelling strategy has been used; Macro Block Model (MBM) approach by application of FaMIVE (Failure Mechanisms Identification and Vulnerability Evaluation) developed by D’Ayala & Speranza [4].

3.1 RURAL URBAN SETTING - N-W SLOVENIA

Following the analysis of 33 in '98 (VII-VIII EMS) and in '04 earthquake (VI-VII EMS) already damaged buildings, critical failure mechanisms evaluated through FaMIVE methodology were compared with observed ones following earthquake events. For each building several possible failure mechanisms were observed on-site and the matching with FaMIVE outcome was almost 50%. In respect to the investigated stock of buildings, the out-of-plane failures with overturning were the most critical. Results of vulnerability analysis show that the major stock of buildings of one and two stories is highly vulnerable. Fragility curve reveals that 87% of buildings would be damaged if they were exposed to maximum expected PGA for 475 yrs. return period earthquake for Bovec region (0.225-0.25g for soil class A). Considering more probable seismic event with 100 yrs. period of return, 51-67% of buildings would be damaged.

3.2 URBAN ARCHITECTURE – OLD CITY CENTRE OF LJUBLJANA

In Ljubljana the historic part of the city was investigated, which may be related to the urban architecture of Ljubljana characteristic for the period between XIV and XIX century. The older buildings are rubble stone masonry, while more recently built ones brickwork masonry. Number of floors varies depending on the time of construction, so the characteristic building has between 2 and 4 floors with wooden floor structures and a few or no ties visible on the façade. Most of the
buildings are closely packed together and leaning on each other thus effective seismic assessment cannot be provided with SEM approach. Results of FaMIVE analysis of 34 buildings revealed that the critical mechanisms of failure are overturning with diagonal crack, and in-plane failure due to failure in spandrels. The predominant number of buildings would fail with in-plane shear mechanism due to presence of large openings in ground floors, numerous openings in upper floors and weak spandrels. Damage index is also very high and thus final vulnerability of the investigated stock of buildings can be classified as high or very high according to FaMIVE criteria (Figure 3).

Considering also other uncertainties such as connections between buildings, position of ties in the building and material parameters considered in the evaluation, vulnerability curves for the stock of buildings from the old city centre in Ljubljana reveal that for the 100 yrs. return period at least 80% of buildings would be damaged. None of the investigated buildings would sustain maximum expected PGA for 475 yrs. return period for Ljubljana. With proper introduction of ties considerable stock of building may be strengthened to sustain seismic event of lower intensity with higher probability of occurrence.

4 CONCLUSIONS
Following the results of these analyses it can be concluded that extensive in-situ investigation contributes to more certain results and that if not carried out, the seismic capacity is by default lower due to confidence factors prescribed in EN 1998-3. Prior application of more invasive techniques for the evaluation of mechanical properties, detail survey regarding built-in masonry constituents should be done. The results of MBM analysis on groups of buildings revealed that local mechanisms of failure may be triggered before the global response of the structure is achieved, which implies that prior effective global analysis of stone masonry structure MBM analysis should be performed and the tying of walls and improvement of walls intersection should be done according to identified most critical mechanisms. These strengthening techniques however depend from the type of cultural heritage asset. As for the different structural element model approaches, the results obtained for single heritage buildings considering global response mechanism seem to be more realistic in comparison to storey response mechanism; the results are consistent with the results of MBM analysis.

Another conclusion is that prior effective global analysis of the structure, information regarding fundamental frequencies of soil should be obtained, and otherwise some of the methods for strengthening buildings may not be effective due to possible soil-structure interaction.

ACKNOWLEDGEMENT
The results were achieved through the project PERPETUATE (www.perpetuate.eu), funded by the European Commission in the 7th Framework Programme (FP7/2007-2013), under grant agreement n° 244229 and coordinated by Sergio Lagomarsino, University of Genoa, Italy. The authors acknowledge the help of Samo Gostič and Mojmir Uranjek from GI ZRMK for their contribution during test campaigns in Slovenia as well as to prof. Dina D’Ayala and Viviana Novelli, University of Bath, UK for their help regarding application of FaMIVE methodology.

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IMPLEMENTING CULTURAL HERITAGE PRESERVATION IN SPATIAL PLANNING (POPULUS PROJECTS)

Darja Marinček Prosenc

ABSTRACT: In this paper we present a data collection method for EU CHIC. The method was developed for two projects managed by POPULUS office and focuses on attitudes towards the evaluation and preservation of particular elements within an urban planning area. The proposed process is divided in several phases, among them the most important are:
1. Forming GIS database for each spatial unit
2. Selection of indicators of identity (significance) for further evaluation
3. Implementation of workshops by including multidisciplinary experts, local experts and most importantly, residents and other stakeholders.
Evaluation is implemented in workshops using “Charette method” and results can be directly used as basis for the urban management plan.

KEYWORDS: Cultural heritage, GIS, Conservation plan, Spatial planning, Charette method, Identity evaluation

THEME 2

1 INTRODUCTION
In Slovenia spatial planning and protection of cultural landscape have legal basis in two main laws that prescribe an instrument - Management Conservation plan for developments in the area under cultural protection. As there is not enough experience in the field and the regulation is not precise regarding the form and content of that document, it was necessary to find a new scientific approach, based on International conventions and ICOMOS charters. Through long years of practice in the field of spatial and urban planning, it was clear, that systematic approach is the only possibility to achieve multidisciplinary and transparent results. Current issues faced by spatial planning, especially the effects of globalization and the simultaneously increasing awareness of the importance of protecting cultural identity by preserving cultural heritage, posed a special challenge.

2 METHOD
Three steps, which can also be used as separate procedures, are proposed for evaluating place identity:
(1) preparing data, (2) defining the indicators of place identity, and (3) carrying out evaluation workshops.
One cannot get to know and plan the areas in question without good knowledge of the individual elements that make up the whole. At the analysis stage, it unfortunately too frequently happens that, in losing the data from previous generations, one also loses both time and funds.
This is why establishing a database on current conditions with the option of updating the information represents the first stage of a methodological approach. The database includes spatial elements such as structures with the appertaining functional land (residential, business, and industrial buildings), squares, parks, streets, green areas, waterways, infrastructure areas, and other areas. In the pilot project, the index units were defined by taking into account the lot boundaries, which are mostly defined by ownership.
The second stage entails defining the areas of significance of the relevant site elements, and presenting the specific features of identity.
The goal of the second stage is primarily to determine problems in a place and use the results to define the priorities for solving them.
The third stage (i.e., the workshops) represents tools for including experts and local residents in the evaluation, with the goal of defining spatial planning methods and priorities. Separate Charette workshops are organised for
each stakeholder group using the same indicators and criteria. Understanding identity within the scope of the method presented is important because of the breadth of the goal set; to this end, the following definition was selected, which, however, refers to the attitude towards space rather than a person.²

3 PRESENTING TWO CASES CARRIED OUT IN SLOVENIA

The applied part features two cases of applying the methodology described above. The first case was carried out in a small area within the historical centre of Idrija, which is protected as cultural heritage, and the second case deals with the protected area in the historic centre of Tolmin as well as the unprotected modern centre nearby.

3.1 IDRIJA

Figure 1: The area’s division into index units of structures and open spaces

The study of the site depends on familiarity with the individual units, which is why index units were developed. The site included a small number of units, which made it possible to evaluate a larger number of significances.

Figure 3: Graph showing local residents’ evaluations of significances

In the case of Idrija, it was established that a wide range of diverse significances typical of a specific area could be covered for small areas. With larger areas this is impossible because a large area also implies a much greater burden on the part of the respondents, who lose the will to cooperate due to the amount of data and the time required. A possible solution to this problem is to form quarter units that can be identified from the comprehensive spatial analysis as units of future comprehensive renovation of the settlement.

3.2 TOLMIN

Figure 5: The boundaries of the area studied including the protected cultural heritage site

² “My identity is defined by the commitments and identifications which provide the frame or horizon within which I can try to determine from case to case what is good, or valuable, or what ought to be done, or what I endorse or oppose” (Taylor 1989, 27).
4 CONCLUSIONS

The advantages of this method lie in the multi-layered results of defining place identity. The results and the evaluations of the significances can be directly compared between the interest groups. Evaluation method is because of its simplicity useful and flexible. Further examples and researches will prove if it is applicable in other models of spatial planning, for example preservation of cultural landscape heritage. As this method is part of a long-term process there is no immediate result as usually participants expect. Implication can be seen after five years or even more. What can be notice just after workshops is a change in perception of participants on their own living or working environment. They much easily recognize quality, threats or degradation equally for buildings or open spaces, for cultural heritage of great importance or just an object of evaluation without outstanding significance, because all elements of an area are important as a part of identity. The publication of index sheets on the municipality website not only expands the knowledge of the area, but the publication of all the results also enables the widest circles of the community to follow spatial planning and the renovation project.

REFERENCES

THE ELAICH PROJECT, A CONTRIBUTION TO THE DOCUMENTATION OF CULTURAL HERITAGE

Anna Lobovikov-Katz

ABSTRACT: “ELAICH – Educational Linkage Approach In Cultural Heritage – was formulated during the European project of the same name within the framework of the Euromed Heritage 4 Programme. It was initiated by a group of experts from different fields of conservation of cultural heritage, including architecture, chemistry, and material science, combining both research and teaching in the field of conservation and preservation of cultural heritage.” [1] It aimed to “open the door” to youth “into conservation of cultural heritage - a much needed and fascinating inter-disciplinary field, combining arts, architecture, sciences, and technology” [2]. This three-year project created the ELAICH Educational Toolkit, to encourage and facilitate the involvement of the general public, especially youth, in preservation of cultural heritage, with a focus on documentation and survey.

KEYWORDS: Preservation, Documentation, Cultural heritage, ELAICH, Educational Toolkit

1 INTRODUCTION

The objective of the ELAICH project was “to increase awareness of the importance of Cultural Heritage (“CH”) and its conservation by particular target groups within the general public (“GP”), such as youth, with a focus on built heritage” [3]. The project was aimed at creating “…an educational tool with a multi-modal interface through which a group of high level conservation scientists (“CS”) with expertise in both research and education of conservation of cultural heritage from various disciplines, including architecture, will expose the GP, especially youth, to the modern principles of the preservation of CH. The CS will be assisted throughout the project by other experts as well, such as conservators. The tool will be based on a solid innovative didactic-methodological foundation through a mixture of traditional course materials, modern e-learning applications (through a subcontractor) and “intelligent” in-situ practical work. "Intelligent" in-situ practical work means that the in-situ work itself will be focused on intellectual work, such as measurements & documentation, and not focused on manual work, as is currently the practice.” [4]

The project, indeed, has developed an educational toolkit intended for educators and heritage authorities in order to enable them to introduce the values of cultural heritage and challenges of its preservation for youth. The Toolkit is accessible to the general public without registration or charge, via the eLAICH e-learning platform, which provides interactive on-line exercises, as well as teaching material and guidelines for the laboratory exercises. The material is organized in six thematic teaching units (Modules), each devoted to a specific integral part of the contemporary inter- and multi-disciplinary field of conservation (preservation) of cultural (built) heritage. The sequential study of these six Modules prepares the ELAICH students for the concluding unit of ELAICH – “Adopt a site”, which includes a set of specific guidelines for undertaking “intelligent” in-situ study and documentation of a historic site. [5]

The wide accessibility of the ELAICH Educational Toolkit by means of an e-learning platform, along with “intelligent” in-situ study” provides a specific contribution of the ELAICH Project to the documentation of cultural heritage.

2 THE ELAICH TRIAL

The ELAICH Educational Toolkit is based on the ELAICH Methodology, developed during the first phase of the project. The Methodology was applied and tested during the second phase of the project, implementation, - which comprised ELAICH courses actually taught by the ELAICH partners in Greece, Israel, Malta, Turkey, and Jordan (Figure 1).
Both Phase I and Phase II facilitated construction of the eLAICH e-learning Educational Toolkit during Phase III of the project. The eLAICH Educational Toolkit was transformed to its e-version and provided via e-learning platform, which was tested during the e-learning on-line course with a group of students with their school-teacher. The teaching material was found easily manageable by school-teachers, and the e-learning platform was characterized as enjoyable by both teachers and pupils. The mixture of on-line and on-site educational activities proved to be popular with the students.

The cooperation between a heritage authority and “virtual” eLAICH on-line students to provide the latter an access to actual study on a historic site was an important issue to test, due to its crucial importance to the implementation of “intelligent-in-situ” study, and it was tested as well [6]. The students documented selected portions of historic sites (Figure 2). The cooperation of educational and heritage authorities in the participating countries was encouraged, e.g. in Israel all key heritage authorities were involved in supporting the eLAICH educational activities on historic sites, while both local educational authorities and the Ministry of Education representatives supported the project and attended its activities.

3 ELAICH AND THE DOCUMENTATION OF CULTURAL HERITAGE

One of the main goals of the eLAICH Toolkit is to facilitate the development of the basic ability of in-field study and analysis of physical conditions of the historic buildings among the eLAICH students. At the same time, the Toolkit contributes to the development of basic understanding of cultural heritage, its values, the reasons for and the challenges and main principles of its conservation. This combined structure of eLAICH can make it useful for facilitating the documentation of cultural heritage, in several aspects.

First, the eLAICH Educational Toolkit can be used directly as intended – to educate high-school students in cultural heritage and to enable them to execute BASIC documentation and investigation of historic buildings and sites. Furthermore, the eLAICH Guidelines [7] encourage the school administration to undertake all on-site educational activities on the same historic site, in the vicinity of school, year after year. In this case, the school would actually “adopt” a historic site, and make a contribution to its monitoring through the students’ survey.

Second, the eLAICH students after the completion of the eLAICH course, including its on-site session, might assist relevant authorities in their documentation of cultural heritage, on different levels and different versions, e.g. in collecting data on historic sites, which might be later processed by experts. The eLAICH Toolkit encourages and facilitates a respectful, accurate and systematic approach to cultural heritage, which might facilitate such contributions.

And, finally, the eLAICH e-learning platform might be applicable to enriching the education of a wide range of public officials involved in heritage preservation, who are not conservation experts. It will provide them with basic knowledge of cultural heritage and the basics of its conservation. Easy access and flexibility of the eLAICH e-learning platform will encourage their learning process.

4 CONCLUSION

The eLAICH Education Toolkit can have an important and lasting influence on the preservation of built heritage, and more specifically, on its documentation, survey and monitoring, by means of its target audience – high school students, as well as through extending its application circle to other relevant end-users.
ACKNOWLEDGEMENTS

We would like to take this opportunity to thank EuroMed Heritage IV, as well as the educational and heritage authorities, and organisations which provided support to the project in participating countries and different course locations, i.e. in Israel, Greece, Belgium, Italy, Malta, Turkey and Jordan.

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PROGRAM
of
EU-CHIC Final Events:
International Conference on Cultural Heritage Preservation
EU-CHIC Steering and Advisory Committee Meeting

May 29 - June 1, 2012
Venue: Hotel Atrium, Split, Croatia

May 29, 2012

17:00 -19:00   EU-CHIC Preparatory Meeting
(Work Package Leaders and Advisory Committee Members; Chair Roko Žarnić)

20:00 -       Welcome reception at the conference venue

May 30, 2012

8:00 -9:00   Registration

9:00 -10:00  Opening of Conference (Chair: Wolfgang Kippes)

Roko Žarnić       CULTURAL HERITAGE IDENTITY CARD - EU-CHIC
Antonija Buljan    CONSERVATION-RESTORATION WORKS AT ANCIENT FLOOR
                   MOSAICS IN ROMAN BATHS, ISLAND VIS, CROATIA
Vinka Marinković  CONSERVATION-RESTORATION WORKS AT PERISTYLE,
                   DIOCLETIAN’S PALACE IN SPLIT, CROATIA
Ingval Maxwell    EU-CHIC CULTURAL HERITAGE IDENTITY CARD: ADVISORY
                   COMMITTEE SUMMARY
Vlatka Rajčić     THE INTERNATIONAL EU-CHIC CONFERENCE

THEME 1: Topics Related to EU-CHIC

10:00 -10:30  Topic 1.1: Documenting Cultural Heritage (Chair: Alfredo Ronchi)

Rand Eppich      CULTURAL HERITAGE INFORMATION SYSTEMS. RESEARCH
                   RESULTS FROM INTERVIEWS, WORKSHOPS, SURVEYS AND
                   BIBLIOGRAPHIC STUDIES
Jacques Akerboom VISUAL INSPECTION APPLIED TO CULTURAL HERITAGE
10:30 - 11:00  Coffee

11:00 - 12:00  Topic 1.2: Surveying and Monitoring Techniques and Systems  
(Chair: Johanna Leissner)

Constanze Fuhrmann  METHODS, TOOLS AND TECHNIQUES APPLICABLE TO CULTURAL HERITAGE: AN EVALUATION APPROACH

Roberto Di Giulio  EUROPEAN PROTOCOLS FOR METHODS, TOOLS AND TECHNIQUES: NEW STANDARD FOR 3D LASER SCANNER

Camilla Colla  INTEGRATION OF STRUCTURAL AND ENERGETIC NON DESTRUCTIVE DIAGNOSTICS: DYNAMICS OF AIR FLUXES BY IR THERMOGRAPHY

Ingrid Hopfner  MEASURING OF MOVEMENTS OF MEDIEVAL PANEL PAINTINGS FOR HANDLING AND TRANSPORT

12:30 - 14:30  Lunch

14:30 - 16:00  Topic 1.3: Damage Risk Assessment (Chair: Antonia Moropoulou)

Marta Quaranta  CRITERIA AND INDICATORS FOR RISK ASSESSMENT: A EUROPEAN OVERVIEW

Marco Zuppiroli  INNOVATIVE STRATEGIES FOR THE PLANNED CONSERVATION OF ARCHITECTURAL HERITAGE

Yves Vanhellemont  NATURAL STONE DEGRADATION AND REPLACEMENT IN BELGIUM. AUTHENTICITY ISSUES, THE IMPORTANCE OF EUROPEAN NORMALISATION, NEW APPROACH

Zlatan Novak  3D LASER SCANNING - BRINGING THE PIECES OF HISTORY BACK TOGETHER

16:00 - 16:30  Coffee

16:30 - 18:00  Topic 1.4: Policy Making, Legal and Economic Aspects of Cultural Heritage Preservation (1st part) (Chair: Roberto Di Giulio)

Roko Žarnić  BASICS OF CULTURAL HERITAGE IDENTITY CARD - CHIC ICEBERG

Antonia Moropoulou  DECISION MAKING ON CULTURAL HERITAGE CONSOLIDATION MATERIALS USING COMPUTATIONAL INTELLIGENCE TOOLS
Jiří Bláha  PROMISES AND DIFFICULTIES OF AN INTERNATIONAL DATA EXCHANGE IN EUROPEAN SCALE

Antonia Moropoulou  DECISION MAKING SYSTEM ON THE ASSESSMENT OF CLEANING INTERVENTIONS USING COMBINED FUZZY C-MEANS AND NEURAL NETWORKS

Marek Skłodowski  MULTICRITERIAL VALORIZATION OF A MONUMENT BASED ON NATIONAL REGISTRY DATA

Alfredo M. Ronchi  FUTURE HERITAGE, OUR LEGACY

19:30 -22:00  Dinner

May 31, 2012

9:00 - 10:30  Topic 1.4: Policy Making, Legal and Economic Aspects of Cultural Heritage Preservation (2nd part) (Chair: Jacques Akerboom)

Antonia Moropoulou  INTEGRATED DOCUMENTATION PROTOCOLS ABLE TO SUPPORT DECISION MAKING PROCESS IN CULTURAL HERITAGE PROTECTION

Silvia Gugu  VALORIZATION OF CULTURAL HERITAGE: THE ROLE OF THE UNIVERSITY

Amalija Pavlić  MODELS OF CREATING DOCUMENTATION IN FUNCTION OF THE RESTORATION OF DUBROVNIK

André De Naeyer  THE CULTURAL HERITAGE IDENTITY CARD AS A BASIC TOOL FOR A “EUROPEAN BENCHMARKING CODE IN ARCHITECTURAL AND URBAN CONSERVATION”

Vesselin Loulanski  CULTURAL HERITAGE AND SUSTAINABLE DEVELOPMENT: TOWARDS CONCEPTUAL CONVERGENCE

10:30 -11:00  Coffee

11:00 -13:00  THEME 2: Projects Related to Cultural Heritage Preservation (Chair: Ingval Maxwell)

Vlatka Rajčić  SMART MONITORING OF HISTORIC STRUCTURES - FP7 SMooHS PROJECT

Johanna Leissner  MODELLING CLIMATE CHANGE IMPACT ON CULTURAL HERITAGE - THE EUROPEAN PROJECT CLIMATE FOR CULTURE
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<td>IMPLEMENTING CULTURAL HERITAGE PRESERVATION IN SPATIAL PLANNING (POPULUS PROJECTS)</td>
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13:00 - 15:00 Lunch

15:00 - 16:30 ROUND TABLE: From Current to Future Research in Cultural Heritage (Chair: Terje Nypan)

17:00 - 19:00 EU-CHIC Steering Committee and Advisory Committee meeting (Chair: Roko Žarnić)

June 1, 2012 (Guided tour)

  8.00 - 11:00 Archaeological site of Salona
  11:00 - 12:00 Medieval fortress of Klis
  12:00 - 14:00 Lunch on Klis
  14:00 - 17:00 Medieval town of Trogir
Coordinated Action

European Cultural Heritage Identity Card

FP7-ENV-2008-1, GA 226995

Starting date: 1 September 2009
Project duration: 36 months
Coordinator: University of Ljubljana,
Responsible: Prof. Roko Žarnić, PhD

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www.art-design.si